

Toward an HSI Assessment Methodology for U.S. Coast Guard Systems

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HSI Division (CG-1B3)



"The Coast Guard relies on cutters, boats, and aircraft to operate in the maritime environment, but it is our people who deliver truly unique capabilities to the Nation."
- ADM Paul Zukunft, *Commandant's Direction* (2014)

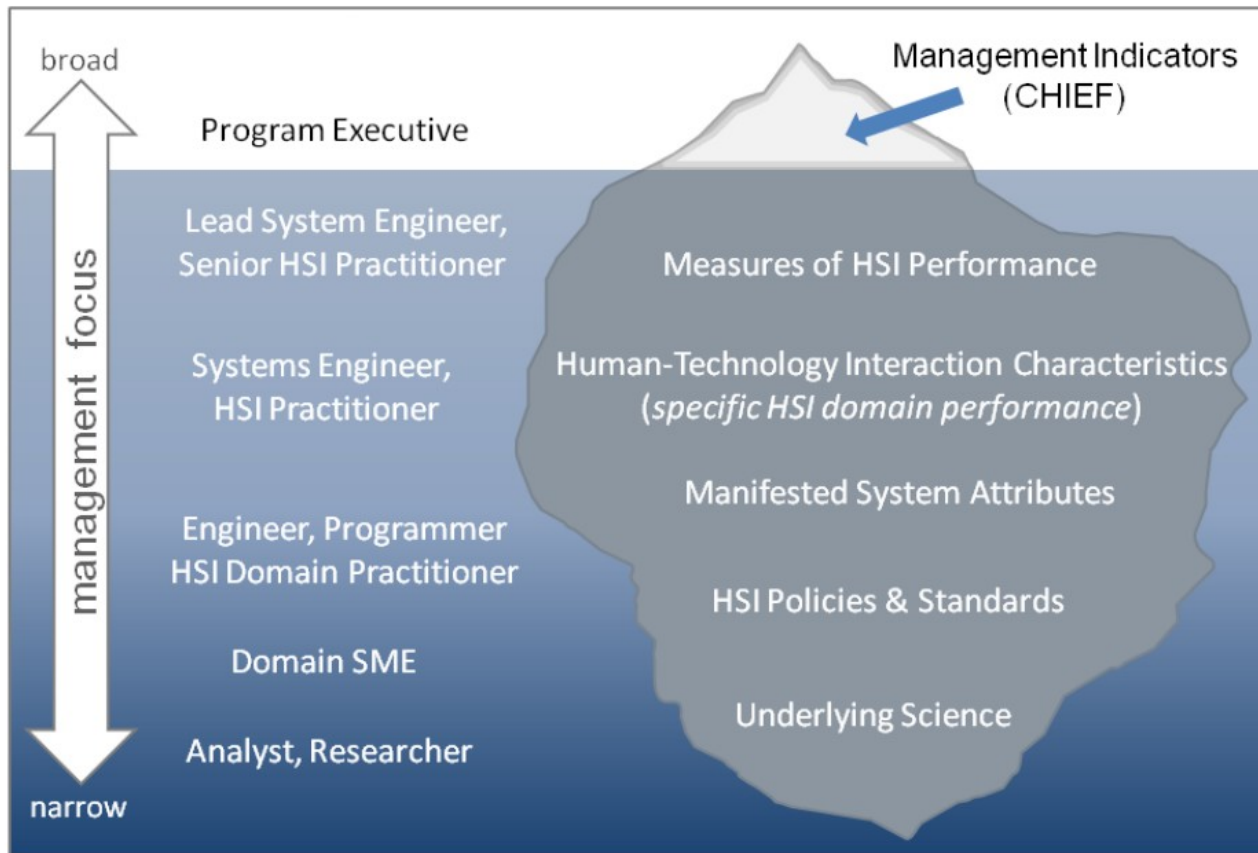


HSI balances human capabilities and limitations with the affordances and constraints presented by system technology to accomplish system goals.

(Shattuck, O'Neil & Sciarini 2014)

How do we place humans on par **tech**?



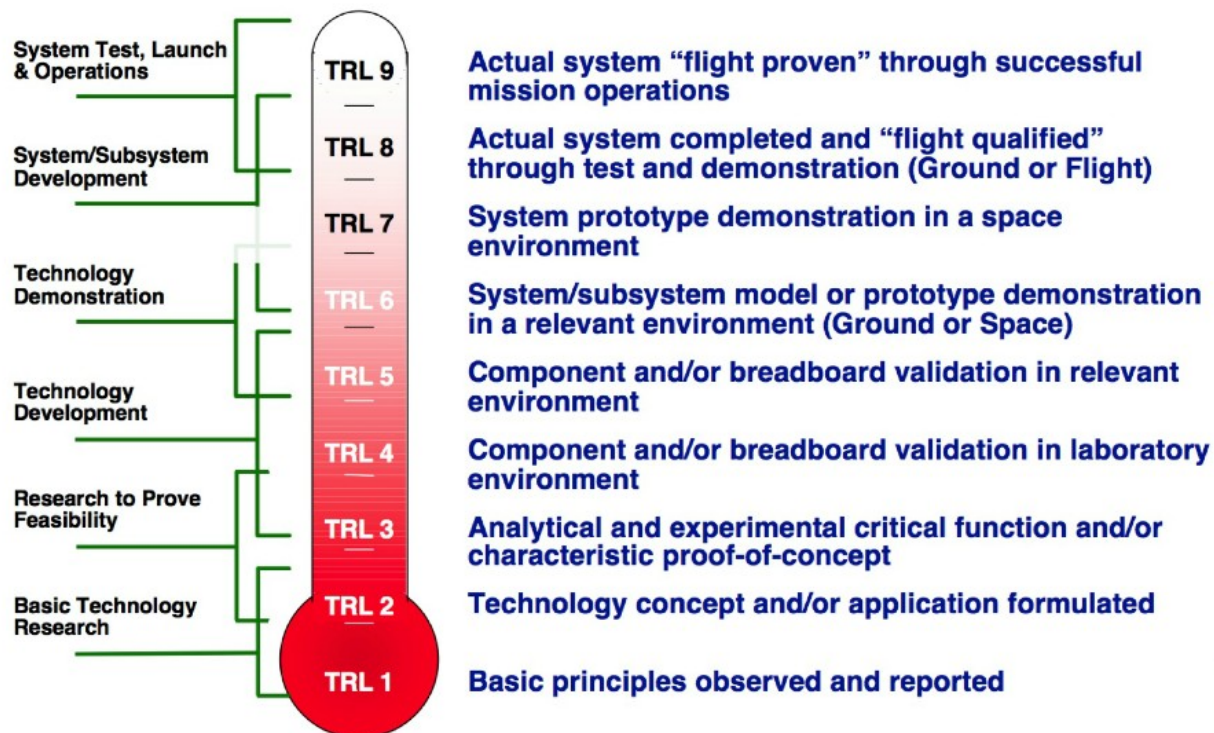


The challenge: convey a useful understanding of HSI efficacy across the acquisition life cycle

What can we learn from TRL?



NASA/DOD **Technology** Readiness Level



T.R.L.

Strengths:


- simple & elegant
- discipline-independent
- broadly applicable

Weaknesses:

- level of abstraction
- process-oriented
- integration ?



How can we apply the lessons of TRL to develop an HSI measure?

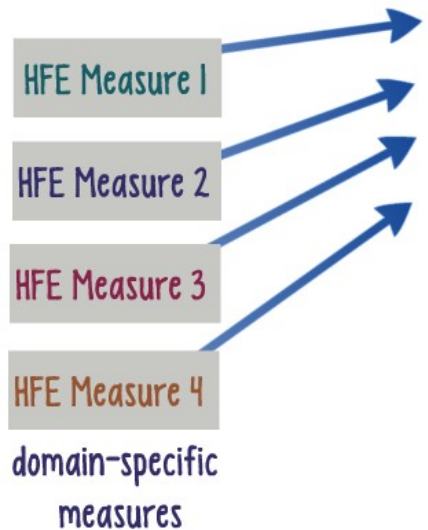
- ⊕ suitable for broad audience
 - ⊕ performance-focused
 - ⊕ evaluation beyond risk
- 

central question:



how is HSI affecting total
system performance?

CHIEF approach:



HFE Evaluation Criteria				
TSPI	Analyze/Select (Preliminary Design)	Obtain (pre CDR) (Detailed Design)	Obtain (Post CDR) (Prototype/LRIP)	
5	Optimizing			criteria 1 criteria 2 criteria 3 criteria 4
4	Enhancement			
3	Minimal Degradation			
2	Moderate Degradation			
1	Severe Degradation			

unifying scale for each HSI domain

Comprehensive Human Integration Evaluation Framework (CHIEF) DRAFT			Total System Performance Implication				
HSI Domain	HSI Glide slope	Rating	1 Severe Degradation	2 Moderate Degradation	3 Mild Degradation	4 Enhancement	5 Optimizing
Manpower	-	3					
Personnel	+	4					
Training	+	4					
Human Factors Engineering	+	4					
Systems Safety	+	2					
Survivability	+	3					
Habitability	+	4					

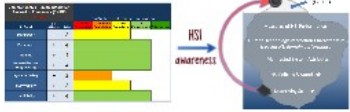
integrated HSI assessment

central question:

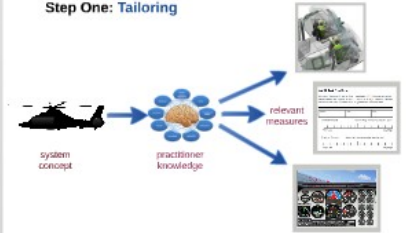


how is HSI affecting total system performance?

Step Seven: Briefing



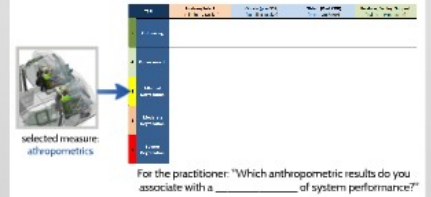
Step One: Tailoring



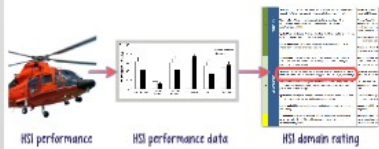
Step Six: Analysis



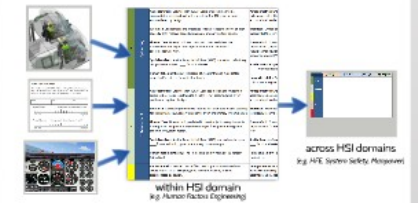
Step Two: Anchoring



Step Five: Collection and Assessment



Step Three: Calibration



Step Four: Socialization



Awareness 4 Buy-in

- ✓ Framework for assessing HSI Impact to the program
- ✓ Overview of HSI measures relevant to program
- ✓ Range of acceptable performance for given measures

Start:

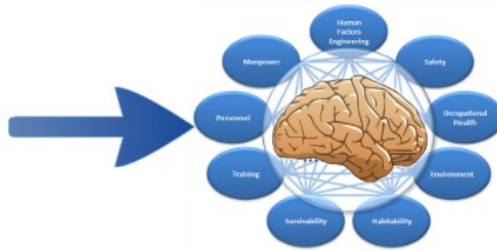


Entering Arguments: Users, Work Context, System Config

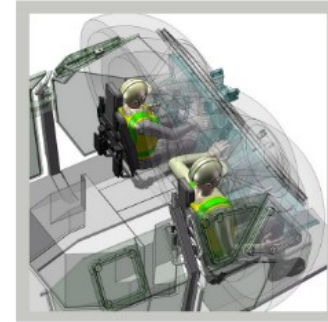
Step One: Tailoring



system
concept



practitioner
knowledge



relevant
measures

NASA Task Load Index

Hart and Staveland's NASA Task Load Index (TLX) method assesses work load on five 7 point scales. Increments of high, medium and low estimates for each point result in 21 gradations on the scales.

Name	Task	Date

Mental Demand How mentally demanding was the task?

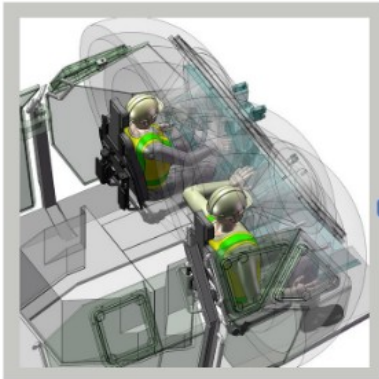
Very Low Very High

Physical Demand How physically demanding was the task?

Very Low Very High



Step Two: Anchoring

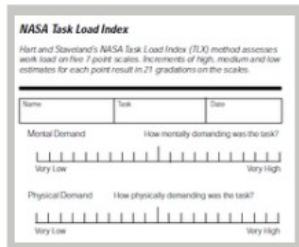
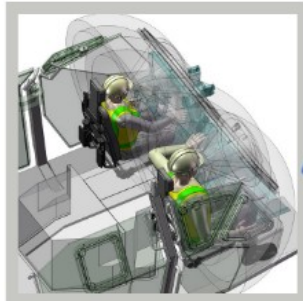


selected measure:
anthropometrics

TSPI		Analyze/Select (Preliminary Design)	Obtain (pre CDR) (Detailed Design)	Obtain (Post CDR) (Prototype/LRIP)	Produce, Deploy, Support (Full-rate Production)
5	Optimizing				
4	Enhancement				
3	Minimal Degradation				
2	Moderate Degradation				
1	Severe Degradation				

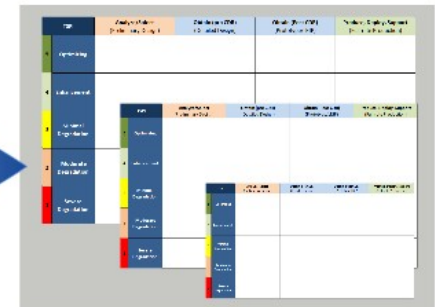
For the practitioner: "Which anthropometric results do you associate with a _____ of system performance?"

Step Three: Calibration



5	Optimizing	<p>Antropometrics: Greater than 99% of users are predicted to be accommodated across critical tasks; less than 1 in 100 users are not accommodated by design.</p> <p>Workload: Critical tasks are predicted to require less than 80% of user capacity (20% reserve capacity) given preliminary system design.</p> <p>Time on Task: Time on task are predicted to exceed objective requirement for requisite manpower limitation (reference spec/manpower KPP).</p> <p>Spatial Analysis: Spatial Analysis Link Tool (SALT) scores for preliminary design do not exceed ____ for critical tasks.</p> <p>Human Reliability Rating: HRR score of greater than 96 % or better modelled/predicted for critical systems.</p>	<p>Antropometrics: Greater than 99% of users are predicted to be accommodated across critical tasks; less than 1 in 100 users are not accommodated by design.</p> <p>Workload: Critical tasks are predicted to require less than 80% of user capacity (20% reserve capacity) given preliminary system design.</p> <p>Time on Task: Time on task are predicted to exceed objective requirement for requisite manpower limitation (reference spec/manpower KPP).</p> <p>Spatial Analysis: Spatial Analysis Link Tool (SALT) scores for preliminary design do not exceed ____ for critical tasks.</p> <p>Human Reliability Rating: HRR score of greater than 96 % or better modelled/predicted for critical systems.</p>
4	Enhancement	<p>Antropometrics: Greater than 98% of user population acomodated across critical tasks; less than 2% (1 in 50) is not acomodated given preliminary system design.</p> <p>Workload: Workload predicted to require less than 90% of user capacity for critical tasks (10% reserve capacity) given preliminary system design.</p> <p>Time on Task: Time on task predicted to meet objective requirements for requisite manpower mix (reference spec/manpower KPP) given preliminary system design.</p> <p>Spatial Analysis: Spatial Analysis Link Tool (SALT) scores do not exceed ____ for critical tasks, given preliminary system design.</p> <p>Human Reliability Rating: The Human Reliability rating of 96 percent (objective)</p>	<p>Antropometrics: Greater than 98% of user population acomodated across critical tasks; less than 2% (1 in 50) is not acomodated by design.</p> <p>Workload: Workload predicted to require less than 90% of user capacity for critical tasks (10% reserve capacity) given preliminary system design.</p> <p>Time on Task: Time on task predicted to meet objective requirements for requisite manpower mix (reference spec/manpower KPP) given preliminary system design.</p> <p>Spatial Analysis: Spatial Analysis Link Tool (SALT) scores do not exceed ____ for critical tasks.</p> <p>Human Reliability Rating: The Human Reliability rating of 96 percent (objective)</p>
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within HSI domain
(e.g. Human Factors Engineering)



across HSI domains
(e.g. HFE, System Safety, Manpower)

Step Four: Socialization



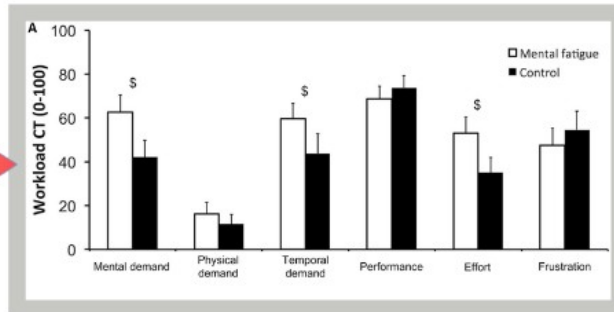
Awareness & Buy-in:

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Step Five: Collection and Assessment



HSI performance

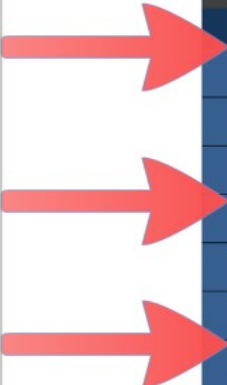
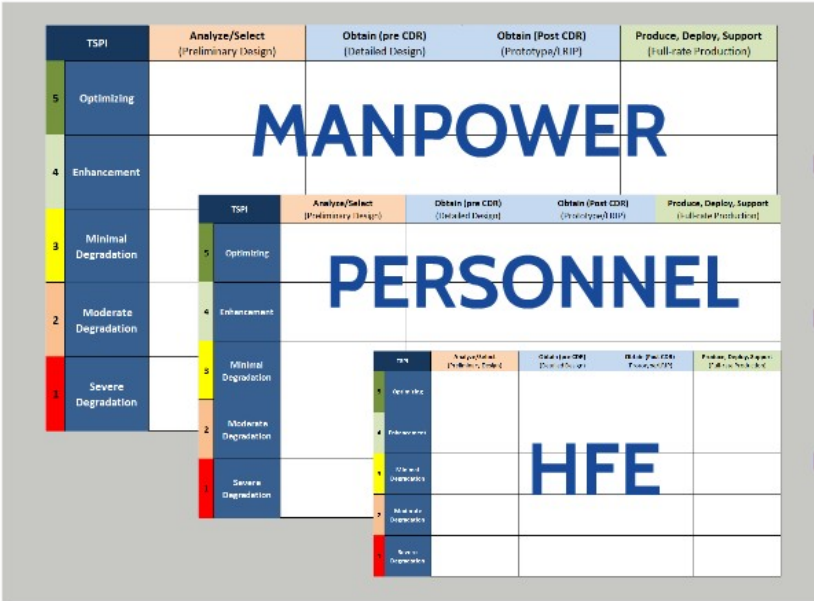


HSI performance data

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HSI domain rating

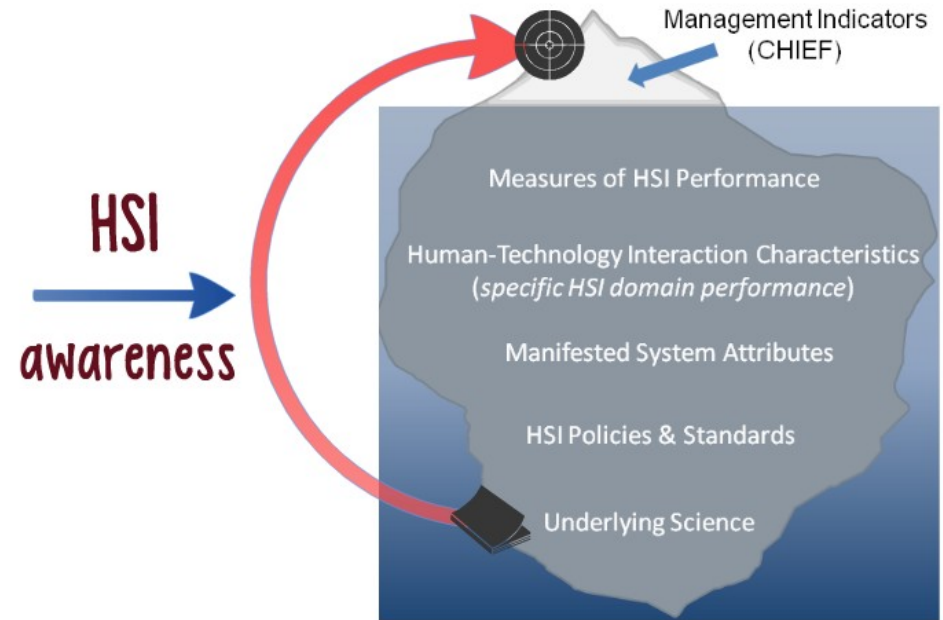
Step Six: Analysis



Comprehensive Human Integration Evaluation Framework (CHIEF) <i>DRAFT</i>			Total System Performance Implication				
HSI Domain	HSI Glideslope	Rating	1. Severe Degradation	2. Moderate Degradation	3. Mild Degradation	4. Enhancement	5. Optimizing
Manpower	-	3	[Yellow]				
Personnel	+	4	[Green]				
Training	+	4	[Green]				
Human Factors Engineering	+	4	[Green]				
Systems Safety	+	2	[Orange]				
Survivability	+	3	[Yellow]				
Habitability	+	4	[Green]				

Step Seven: Briefing

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Training	+	4	[Green bar]				
Human Factors Engineering	+	4	[Green bar]				
Systems Safety	+	2	[Orange bar]				
Survivability	+	3	[Yellow bar]				
Habitability	+	4	[Green bar]				



C.H.I.E.F. Attributes

Advantages

- Assessment of HSI available at any phase
- Tracking of domain performance across phases
- Responsive to changing program realities
- Facilitates ROI calculation

Limitations

- Dependent on experts (HSI & domain-specific)
- Limited by availability of HSI performance measures
- Yields ordinal data

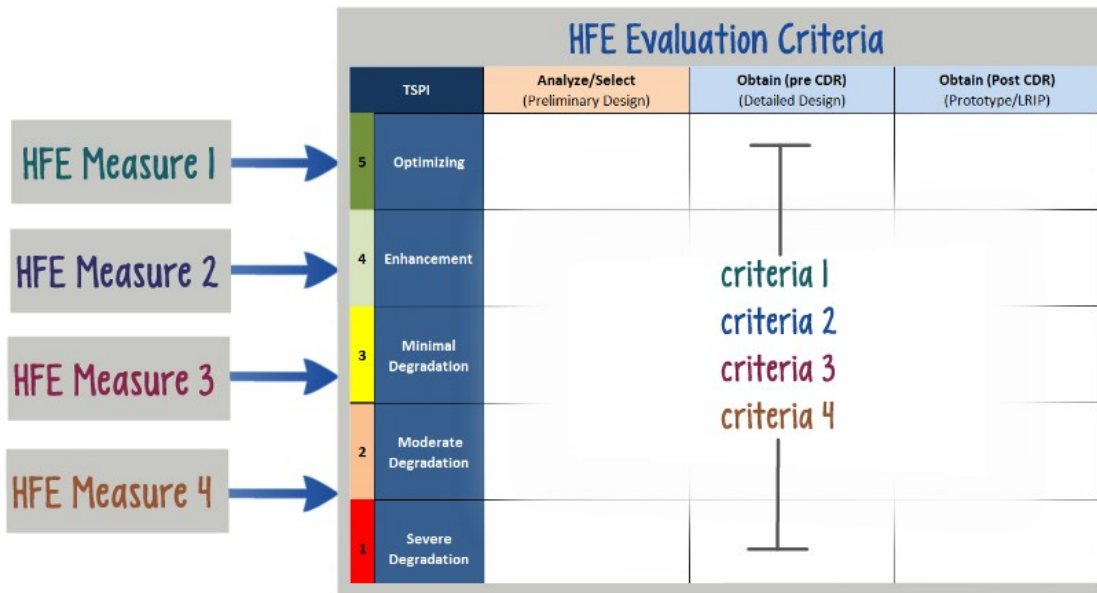


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www.uscg.mil/ff21/HSI/default.asp



Comprehensive Human Integration Evaluation Framework (CHIEF)

DRAFT

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