Moving HSI T&E To The Left: Early Analysis, Modeling, and Validation of Human Systems T&E Requirements

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Early Operational/LFT&E Testing Could Have Caught This: The “ALIENS” (1986) movie, Motion Tracker System Interface

- **Aliens are attacking the Colonial Marines!**
- The handheld tracker Symbology looks cool, but shows 2D threat aspects only, while aliens are infiltrating above them (3D problem). **Fails to support tactical decision making**.
- Poor CONOPS development, poor critical task analysis.
- Should have done early user test with robust use cases.

“Ripley: That can't be; that's inside the room.

Private Hudson: It's reading right man, look!

*Corporal Hicks: Then you're not reading *it* right”.*

(… blame the user?)

Credit: 20th Century Fox (and Weyland-Yutani Corp)

WEYLAND-YUTANI CORP
BUILDING BETTER WORLDS

The Problem

The Need Exists for Human Systems Integration (HSI) Test and Evaluation (T&E) that:

- Provides better feedback to the customer, and
- Provides it earlier in the design/verification cycle in order to mitigate problems.
- An improved approach is provided for consideration.

"Examples of common problems discovered in OT&E and LFT&E include… deficient human systems integration, and insufficient training and technical manuals. DOT&E commonly makes recommendations to fix system deficiencies in these problem areas prior to fielding".

2024 DOT&E Summary Report (p. 24)

HSI Trends in DoD

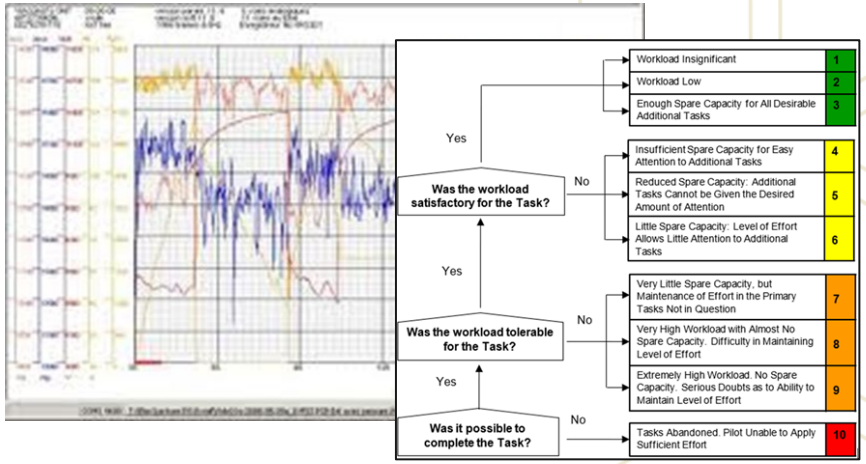
Human Systems Integration (HSI) is mandatory.

- DoDI 5000.95 (Human Systems Integration in Defense Acquisition) coupled with the FY25 NDAA mandate for the incorporation of Human Readiness Levels (so called HRLs per ANSI/HFES 400-2021) into all DoD Programs of Record are actionable guidance.
- In the coming months, DoDI 5000.95 will be enhanced to include specific guidance for program managers on how to implement HSI Plans into everything they do (this has been a long time coming).

Operational Test and Evaluation (T&E) Trends in DoD

“Shift Left”, a 2024 DOT&E Policy Update:

- Testing and evaluation activities will move closer to the start of the development process, rather than waiting until later stages.
- Earlier testing for interoperability, effectiveness (e.g. cyber hardening), and within a more mission-representative environment, is needed based on T&E lessons learned.
- Benefits: reduced costs for fixes, improved system performance, faster development cycles.



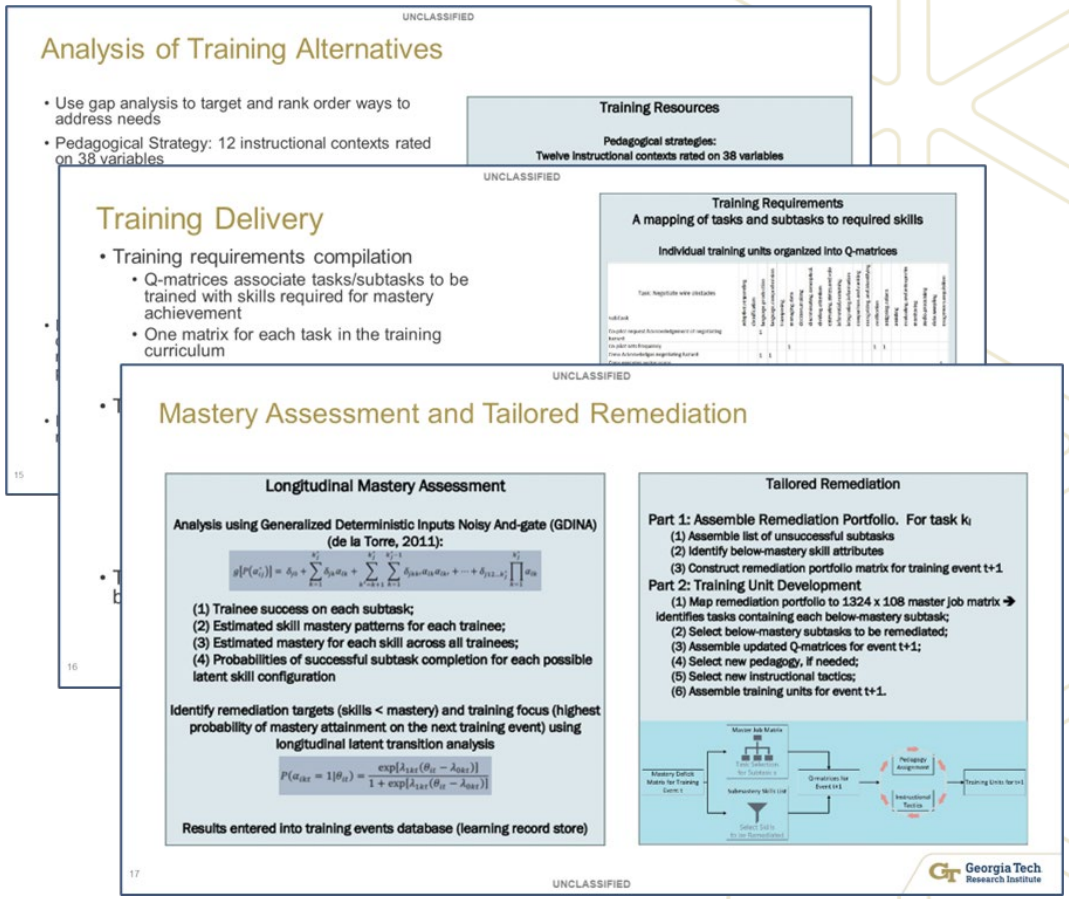
HSI T&E with the F-35 Test Team

Tasking an HSI Team Early

We cannot meet both Requirements without:

- Breaking the habit of seeing HSI as a band-aid, late-stage problem.
  - Don't wait to involve human systems people until the symbology or controls are being designed.

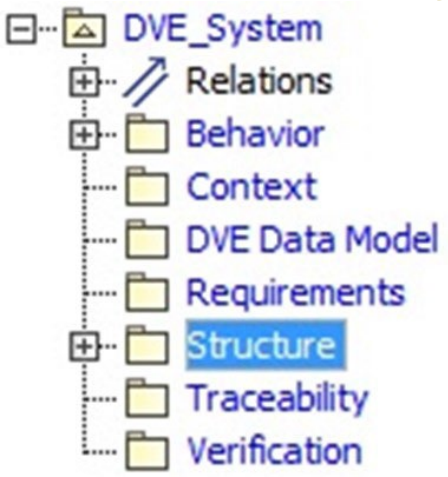
- Getting an HSI Team involved earlier to:
  - Define the "mission context" terms of how the user will interface with the system to do the mission.
  - Start with pre-Milestone A threat and trade studies
  - Characterize user impacts in Gap Analyses
  - Supply HSI factors for Analyses of Alternatives (e.g. manpower, training, logistics issues, quantification of automation benefits, if any.
  - Identify HSI aspects of KPPs, and MOPs/MOEs and venues (I/A/D/M&S/T) for early DT/OT events.

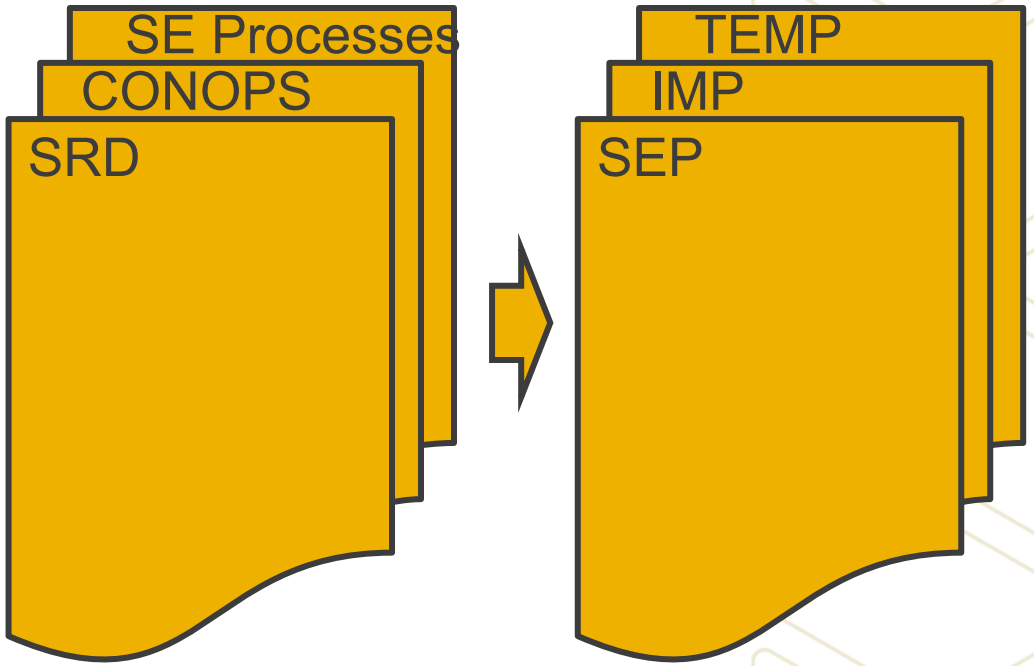


Planning **Early** for Verification of All Human Systems Interfaces

Impacts on MBSE (and MBHSE)

1. Updates CDD and OV-2, OV-6c tasks, need lines, interfaces to use/test cases.
2. CTA provides key user/system tasks, characterizes user workload.
3. Mission Task Analysis provides full mission/vignette tasks *in context*.
4. Functional Analysis and Allocation details allocation to user/operator elements.
5. Behavioral Task Analysis characterizes user/system behaviors.
6. Information Requirements analyzes data required to conduct task(s)
7. Supports a digital model for design/V&V





Navigate Earlier Human Systems T&E

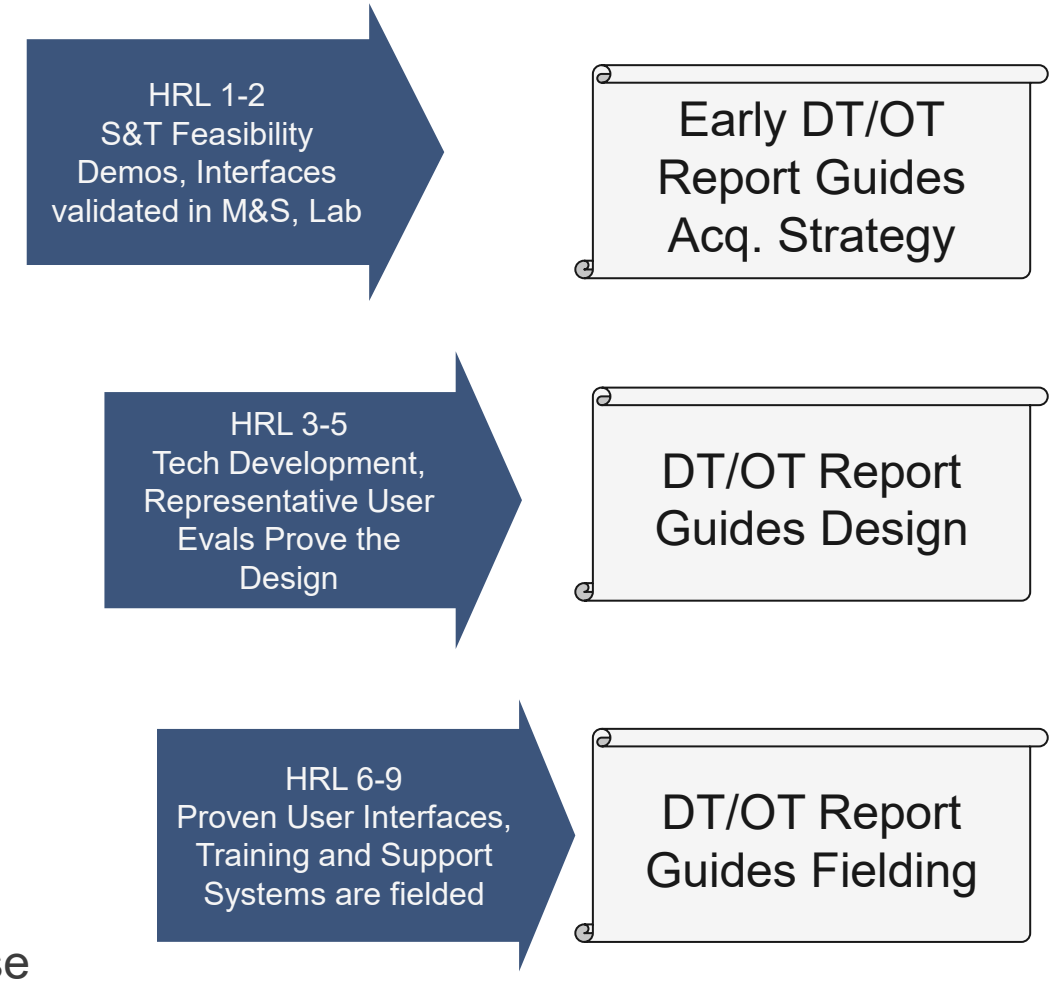
DoDI 5000.95 mandate for HSI to include documentation of Human Readiness Levels (map to DARPA TRLs).

Pre-Milestone A Testing (Map Gaps, V&V Reqmts.):

- Gap analysis: what Tasks are unmet? What best fills the gaps (Automation? Humans? At what Level?)
- Test candidates to derive AoA comparisons (MOP/MOE data)
- Develop CONOPS Vignettes, Use Cases as a basis for a CDD, an SRD, and a TEMP, to include HSI testable elements
- Develop Prototypes (design/test/down select)

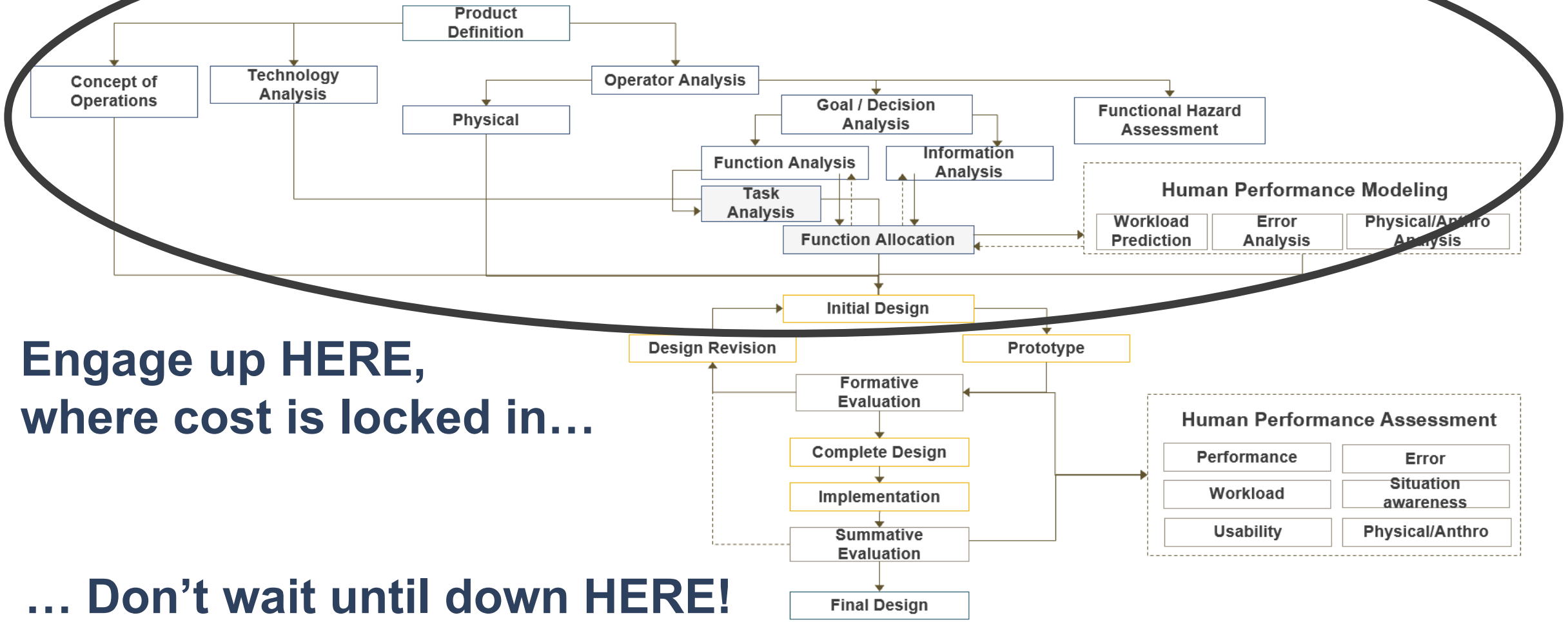
Post Milestone A Testing (Performance, Safety, Suitability):

- Perform Crew Systems engineering (with MBHSE/DE)
- Perform requirements analysis, derivation, allocation.
- Perform design work (design/test/design/freeze)
- Document results (e.g. RFI/RFP, PWS, SRD, HEPP, HESAR, HETP, HETR), source selection and TRL/HRL assessments
- Supply insight for vendors with key HSI technical expertise
- Plan, staff, execute HSI Developmental and Operational Testing



Fielded, Safe, Effective, Supportable, Trainable User Interfaces

Human Systems Engineering Process Flow (GTRI)

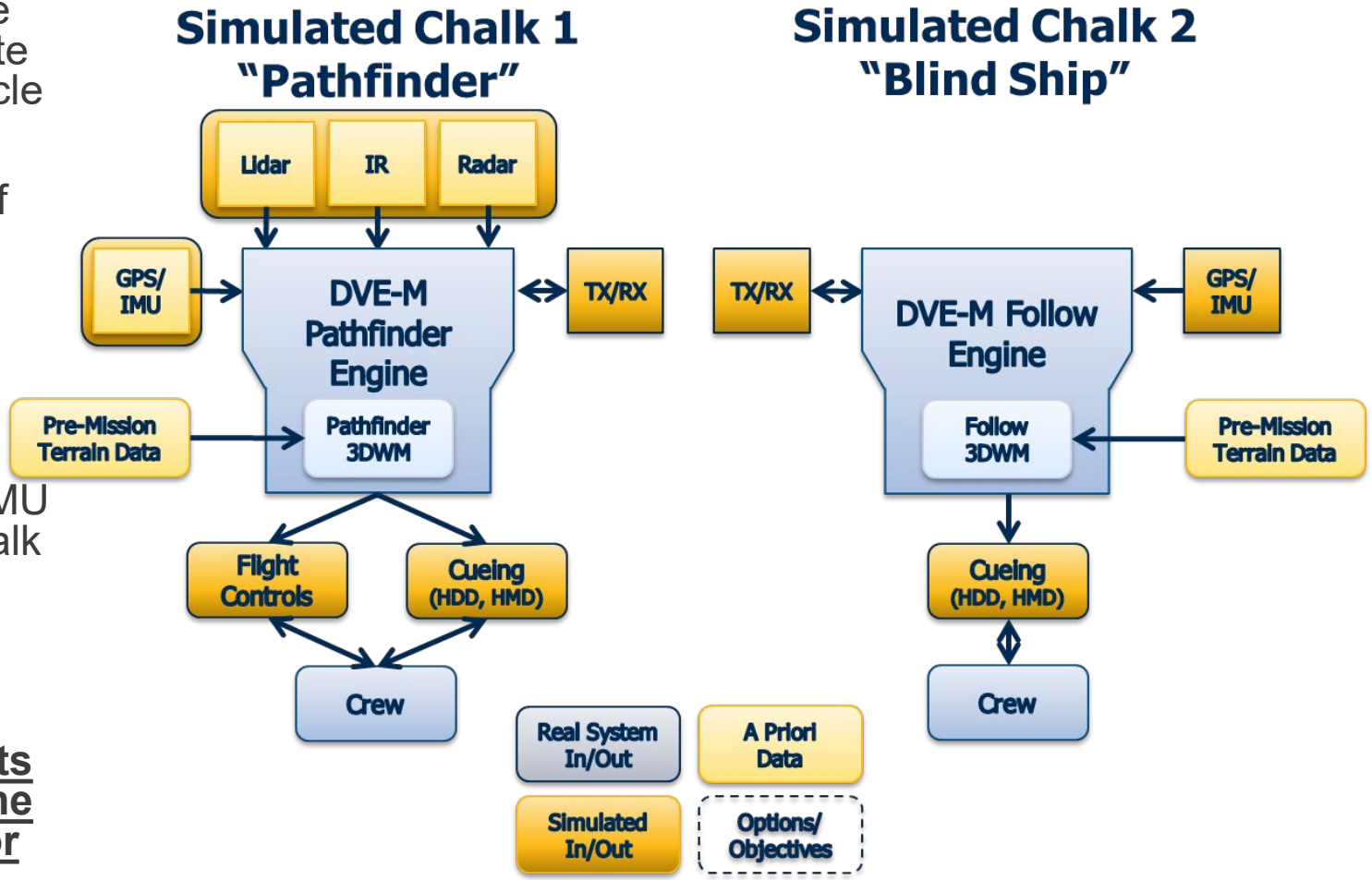


Engage up HERE, where cost is locked in…

… Don’t wait until down HERE!

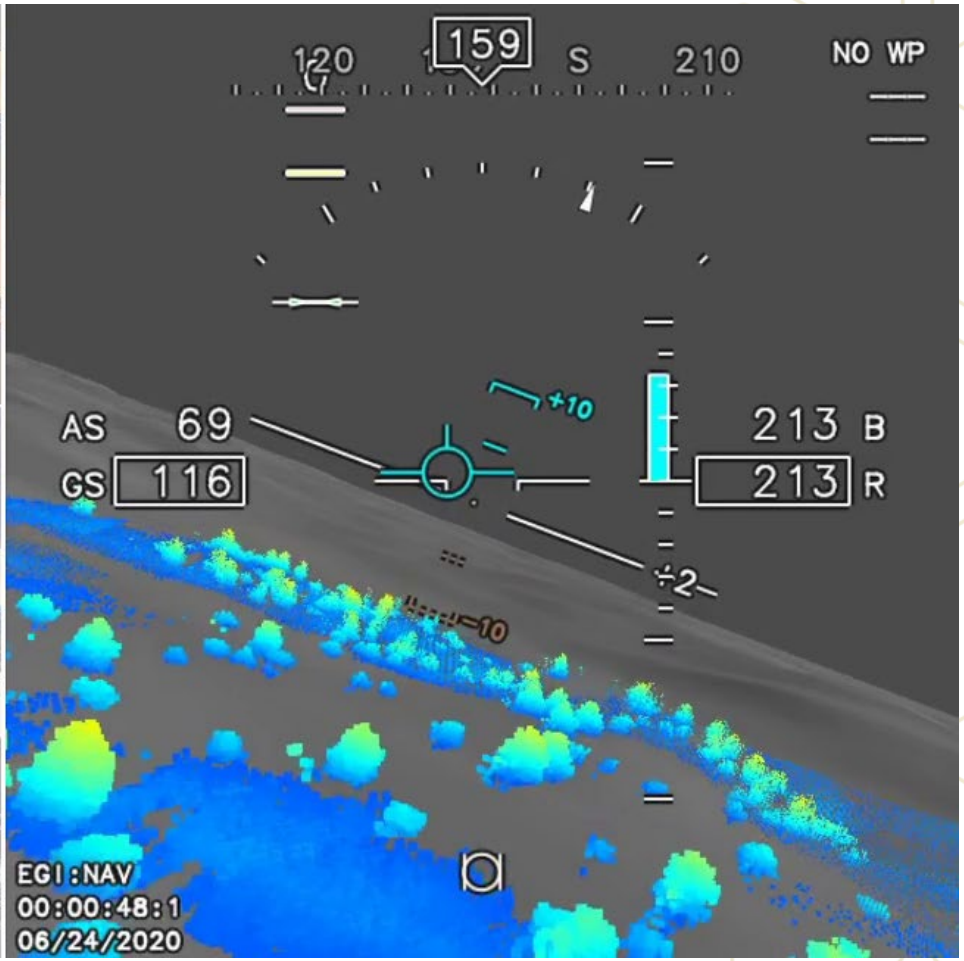
Case Study: Helicopter Multi-Ship DVE MS&A Demo (2021)

- Provided foundational MS&A data for future rotary wing acquisition programs to integrate interoperable, multi ship, data linked obstacle sensing and avoidance data.
- Flexible architecture supported a mixture of real HW and software models for HITL simulation.
- “Playback” of actual recorded DVE system and flight data from Chalk 1 to stimulate Chalk 2 simulator.
- Addition of simulators/emulators for GPS/IMU and DVE sensors provide independent Chalk 1 simulation capability.
- Test Cases looked at helicopter speed, granularity of obstacle data, etc.
- **Question: what are the user requirements for displayed obstacle data? What are the threshold and objective requirements for human tasks, vs. automated tasks?**



Case Study: Helicopter Multi-Ship DVE MS&A Demo (2021)

- Analysis results validated detailed KPP requirements for granularity (apparent object size), latency, etc.
- The early demo therefore resulted in a significant ROE in terms of design rework avoided, DRs written, etc.



What does the pilot actually need to see, and how fast?
(**Don't just look cool**; **base design decisions on Test Data**)!

Summary

- DoD must Shift Left all Human Systems design and T&E activities, digging deeper, earlier, into meta-human factors well beyond conventional practice.
- Shifting Left provides early inputs:
  - Actionable, validated, design/test/design requirements for the next phases,
  - CTA based inputs build operationally relevant scenarios and provide vital early user involvement,
  - Prevents rework/saves money and time.

Do It Right.
Do It For Hicks.

Questions Please?

Thank you for your time!

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