Headquarters U.S. Air Force

Integrity - Service - Excellence

Human Systems Integration – Ensuring the Human is Considered "Left of A"

Colonel Larry Kimm, Director
Air Force Human Systems Integration Office (AFHSIO)
NDIA Systems Engineering Conference
28 October 2009

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Overview

- Scope of HSI
- HSI: Optimizing Total System Performance
- Lessons Learned
- Inserting HSI into JCIDS “Left of A”
- Translation between JCIDS and Acquisition
- HSI Requirements Pocket Guide

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Scope of HSI

Human Systems Integration is the integration of the human into the engineering of the system

- **AFPD 63/20-1 definition of HSI:** ***The integrated, comprehensive analysis, design and assessment of requirements, concepts and resources for system Manpower, Personnel, Training, Environment, Safety, Occupational Health, Habitability, Survivability and Human Factors Engineering***
- **"We'll continue to push the UAS envelope…unmanned systems are unmanned in name only. While there may be no Airmen onboard the actual vehicle, there indeed are airmen involved in every step of the process, including the pilots who operate the vehicles' remote controls and sensors and maintenance personnel." (General Fraser, VCSAF, 23 Jul 09, Pentagon News Conference)**

Human Systems Integration: Vision and Mission

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The mission of the United States Air Force is to fly, fight and win ... in air, space and cyberspace.

Vision

Integrate Air Force people and technology for total systems performance

Mission

Ensure all AF warfighting systems are designed, built, tested, operated, and sustained in a manner that optimizes total system performance at every warfighter level

The purpose: permanent Air Force cultural & organizational change – optimize & sustain human performance at every warfighter level

Human Systems Integration "Domains"

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MANPOWER

- Wartime/Peacetime manning requirements
- Deployment considerations
- Force structure

PERSONNEL

- Selection & Classification
- Demographics
- Knowledge, Skills & Abilities

TRAINING

- Training strategy
- Training methods & development
- Simulation/Embedded/ Emulation

HUMAN FACTORS

- Human-centered design
- Human-system interface
- Design impact on skill, aptitudes, performance

HABITABILITY

- Living environment
- Support services
- Working conditions (Ergonomics, bed, toilet, bath, food, medical, lighting)

SURVIVABILITY

- Threats
- Operational arenas
- Fratricide & Identification Friend/Foe
- Force protection

ENVIRONMENT

- Hazards that affect/impact human or earth
  - Air, water, earth
  - Noise
  - Natural Resources
  - Local Communities
  - Disposal

SAFETY

- Safety of design
- Normal Ops & Emergency Procedures
- Human error prevention and recovery

OCC HEALTH

- Operational Health
  - Hazards
  - Acoustics
  - Chem - Bio
  - Radiation - Laser Protection
  - Oxygen Deficiency
  - Air Pressure
  - Temperature
  - Weather
  - Shock/ vibration

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HSI: Optimizing Total System Performance

- **"The (Air Force's) aircraft inventory dropped by 10 percent while operational costs grew by 19 percent compared to 2000.": Air Force Times 09/15/2009**
- **HSI reduces long term costs:**
  - **A small investment up front to consider the human can result in substantial future O&S savings**
  - **Prevents costly re-designs**

AF HSI: Role and Cost in the Procurement Process

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NEED OR OPPORTUNITY

Requirements Generation

- HSI role: Review, Consult, Refine, Plan
- HSI cost: May add cost in design

CONCEPT

Program Management

- HSI role: Support, Consult, Evaluate
- HSI role: Participate in tradespace
- HSI cost: Zero sum

OPERATIONAL ITEM

Test & Evaluation

- HSI role: Set goals and standards
- HSI cost: May add cost in test

FIELDED SYSTEM

Operations and Sustainment

- HSI role: Lessons learned
- **HSI PAYOFF = Mission + $$$**

$$$
HSI PAYOFFS are realized for the lifetime of the system:

IMPROVE
PERFORMANCE and SAFETY

DECREASE
OPERATIONS and SUSTAINMENT COST

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Matrix: Roles and Domains

	Operator	Maintainer	Logistician	Trainer	Security	Supporting 1	Supporting 2	Supported 1	Supported 2	Other
Manpower										
Personnel										
Training										
Environment										
Safety										
Occ Health										
Survivability										
Human Factors										
Habitability										

Include in the analysis all the humans who touch the system

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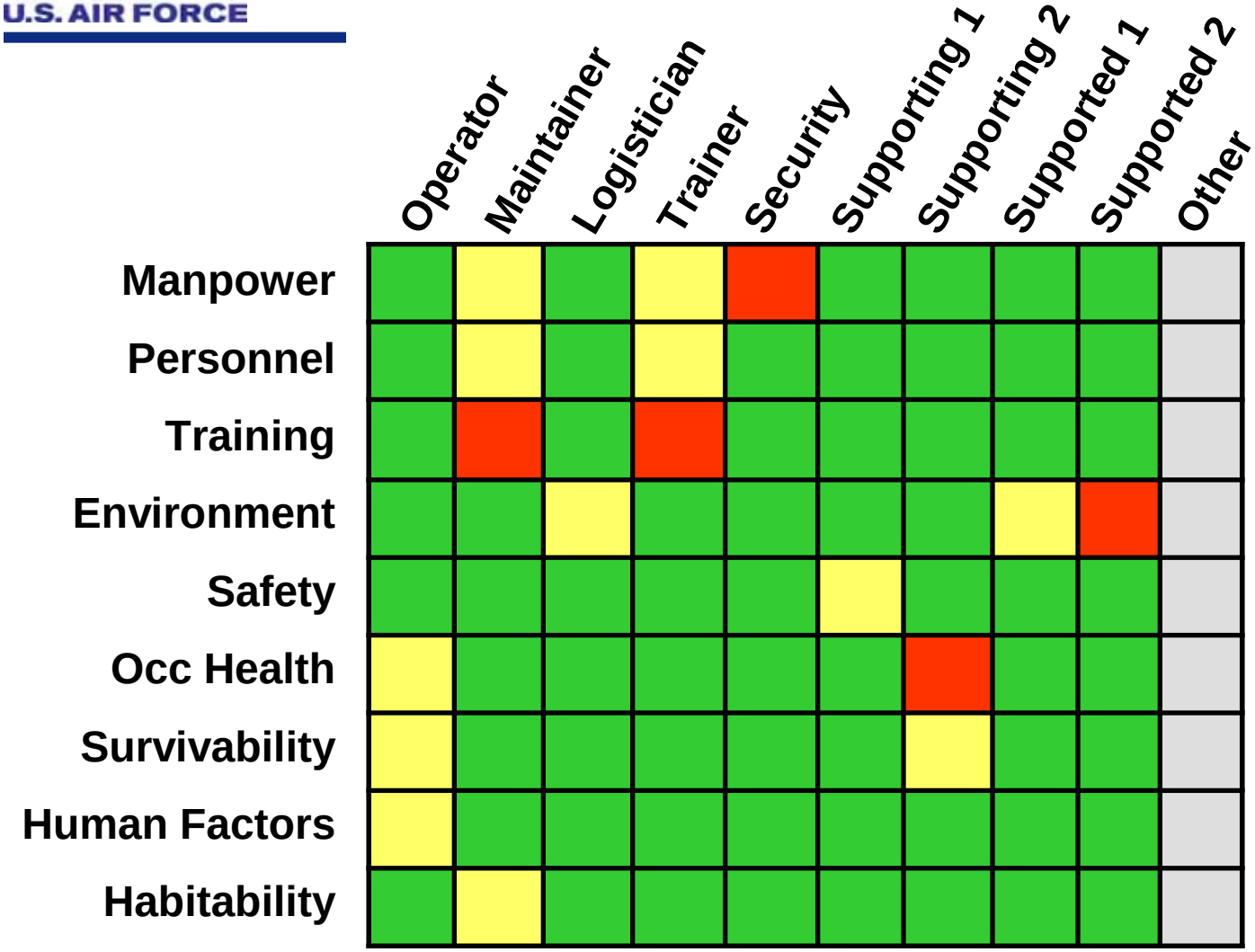
Matrix: Roles and Domains



Include in the analysis all the humans who touch the system

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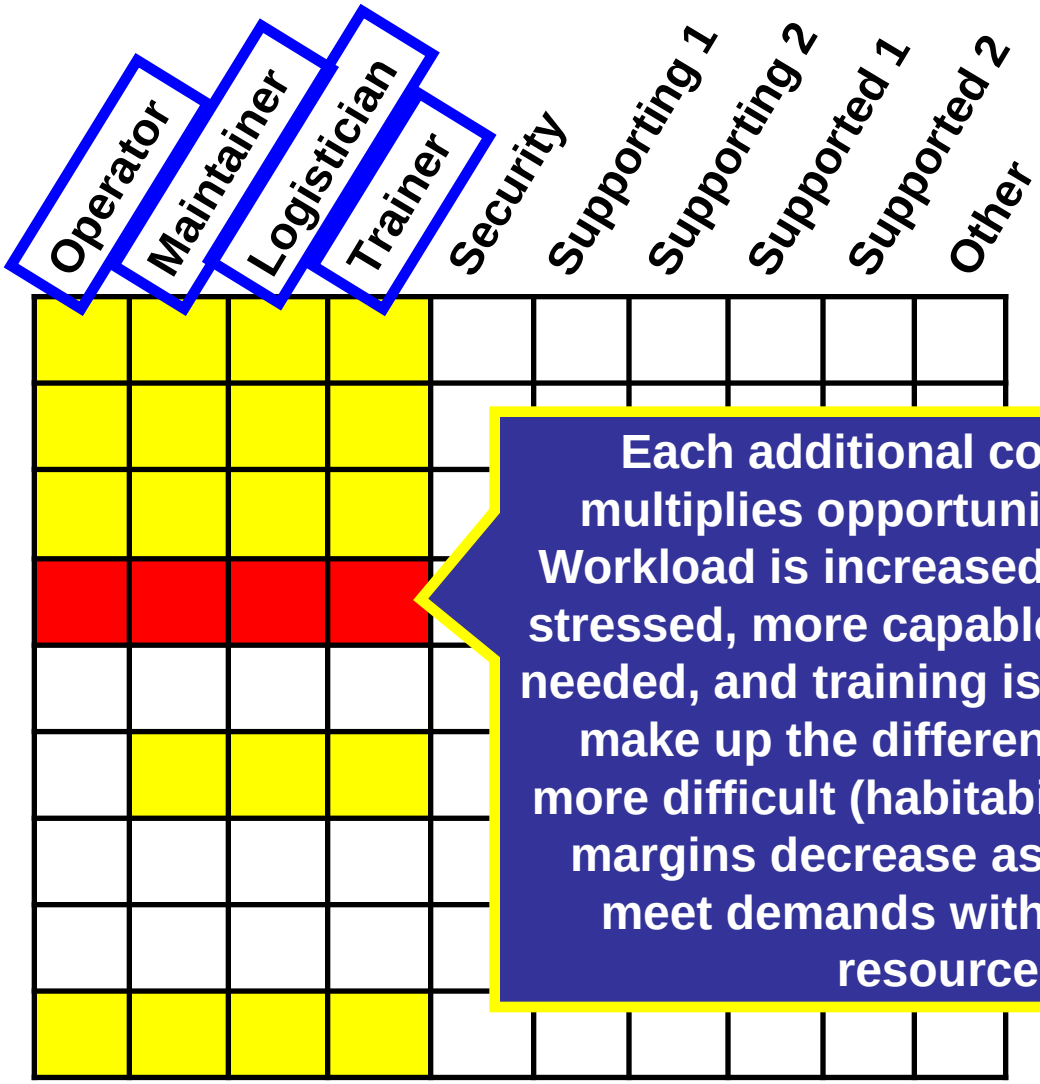
Example: Predator Configurations

- How many configurations on one flightline?
- Imagine the cost of:
  - Parts stocked
  - Training required
  - Different weapons loading
  - Technical orders maintained
  - Maintenance tools required
  - Opportunities for human errors

Predator Configurations



Each additional configuration multiplies opportunities for error. Workload is increased. Manpower is stressed, more capable personnel are needed, and training is often tasked to make up the difference. Jobs are more difficult (habitability) and safety margins decrease as people try to meet demands with insufficient resources.

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Lessons Learned

- Army and Navy Lessons Learned
  - Army HSI (MANPRINT)
  - Naval HSI in multiple SYSCOMs
  - Air Force is studying their programs to build ours
- Challenges:
  - "Requirements creep"
  - Technology readiness –readiness of (or for) the human
  - Budget constraints (especially sustainment)
  - Costs: Acquisition vs. Lifecycle vs. Total Ownership
  - Systematic application of lessons learned from legacy
- Results:
  - Insert HSI "left of A"
  - Work collaboratively with all stakeholders

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Inserting HSI into JCIDS "Left of A"

- **Ensure that human concerns are addressed in capability based analyses (CBA), Analysis of Alternatives (AoA) and JCIDS requirements documents**
- **Write testable human requirements for all users, not just the operators, to help ensure more effective and sustainable systems in the future**
- **Work collaboratively to support Early Systems Engineering, Continuous Capability Planning and Developmental Planning**

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Where Does HSI Fit in These Processes?

- **Analysis:**
  - Analyze operator surveys and provide lessons learned to document Total System capability gaps
  - Provide realistic cost data on human factors engineering, integration, manpower, personnel, and training
- **Requirements:**
  - Address "human issues" within mandatory KPP/KSAs, and attributes related to maintenance, integration, safety
  - Insert correct safety, manpower, personnel, training, logistics and maintenance information in CDD/CPD sections 14 and 15
  - Provide the appropriate hook so system engineers can further clarify design needs in follow-on documents
- **Acquisition:**
  - Translate the CDD/CPD hooks into acquisition requirements
  - Assist in technology development/engineering and design
  - Participate in IPTs writing technical documents, test plans and cost/manpower assessments

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HSI in AoA/Post-CBA Analysis

- AoAs are now done for all ACAT programs – challenge yet an opportunity for HSI to be inserted/considered
- Post-CBA Analyses are intended to take it to next level of granularity
- HQ Air Force Material Command's Office of Aerospace Studies (OAS) guides all AoAs
  - AFHSIO and 711th Human Performance Wing are working with OAS to begin more active participation in AoAs and other analyses
  - OAS facilitators are enthusiastic about Human Systems Integration's ability to positively affect outcomes of analysis and development of systems

HSI Opportunities in the Process

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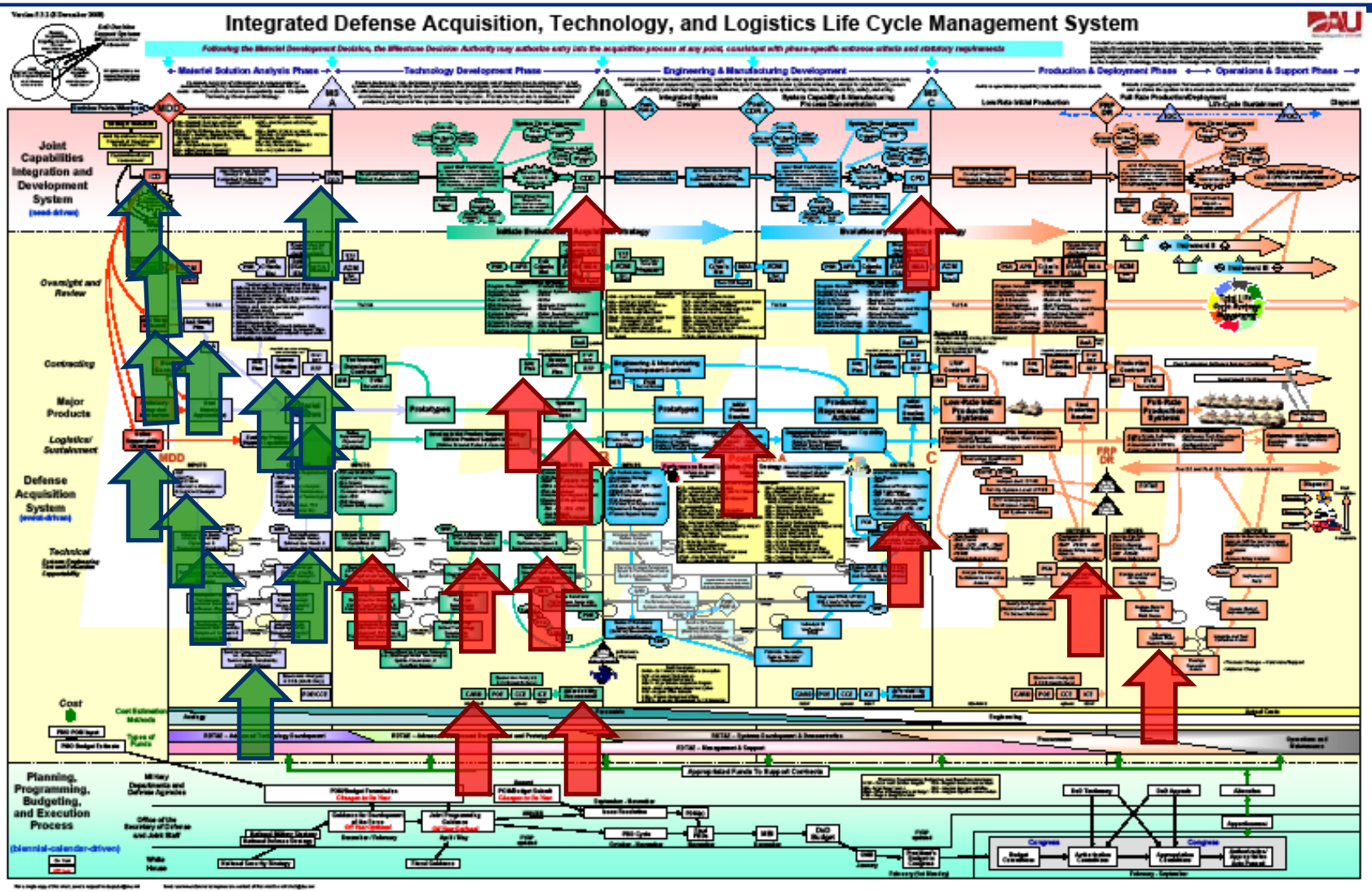

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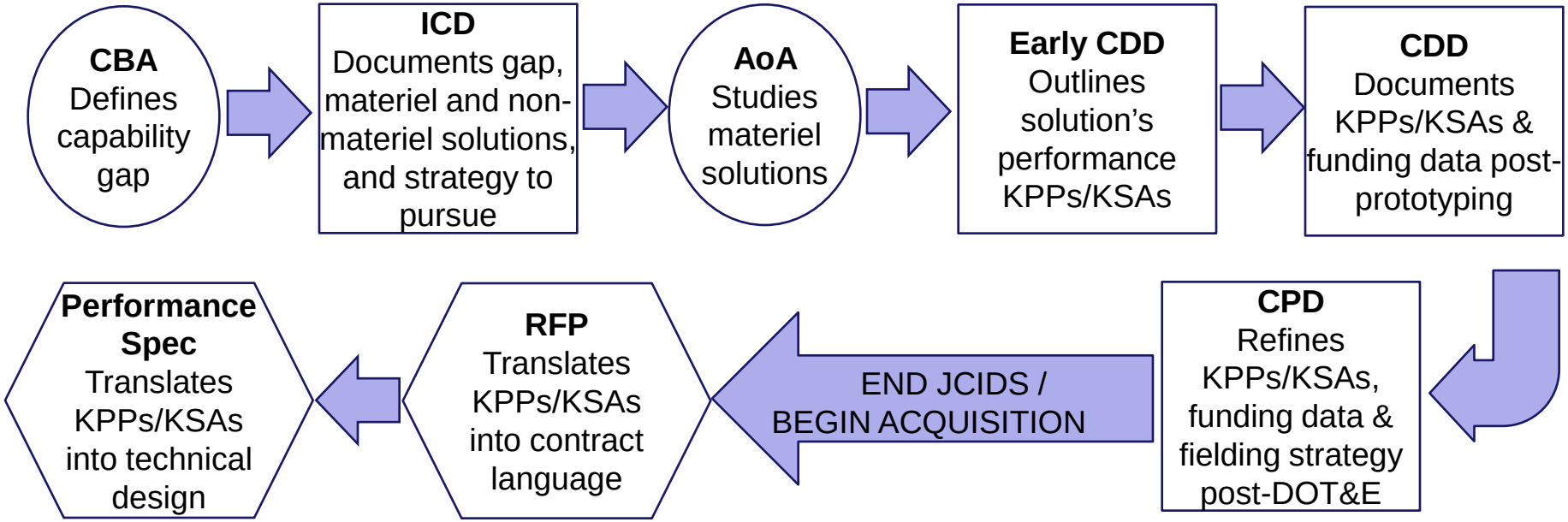
Translation between JCIDS and Acquisition

- **Humans must be considered at each step in the process in order to be adequately represented in the acquisition. Waiting until acquisition documents to introduce HSI invites problems:**
  - **Cost overruns: Unfunded "requirements creep"**
  - **Schedule delays: Re-design or integration problems**
  - **Performance lag: System performance relies on humans**



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HSI Requirements Pocket Guide

- Air Force HSI Tiger Team, held January 2009
- Pocket Guide can be used by HSI practitioners to assist requirements writers
- Can also be used by requirements writers to help them consider human centered requirements
- Contents include: What is HSI?, Critical Nodes, Writing Requirements, DOs and DON'Ts, Key Word Reference, Personnel Resources
- AFIT course SYS 161 will utilize the Pocket Guide and address how to use it in writing requirements

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Decision Authority Issues Addressed by CBAs and AoAs

- Is the functional/mission need understood well enough?
- What capabilities are needed? When must they be introduced to the field or fleet?
- What is the best approach to develop these capabilities?
- Has a capability baseline been identified?
- How much will the options cost?
- Is the option affordable?
- Have alternative solutions been reviewed?
- Why was this solution selected?
- Has risk been assessed?
- Is the solution operationally effective and suitable?
- Can it be supported?

- Source: AFIT, REQ 111

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Summary

- HSI integrates people and technology
- Consider the human equally with other aspects of the system:
  - Hardware
  - Software
  - Liveware (human)
- HSI takes a holistic view to consider ***all*** users of a system: operator, maintainer, logistician, trainer, support, customer, coalition partner, etc.

Human Systems Integration is a key process by which affordable, more capable systems are acquired

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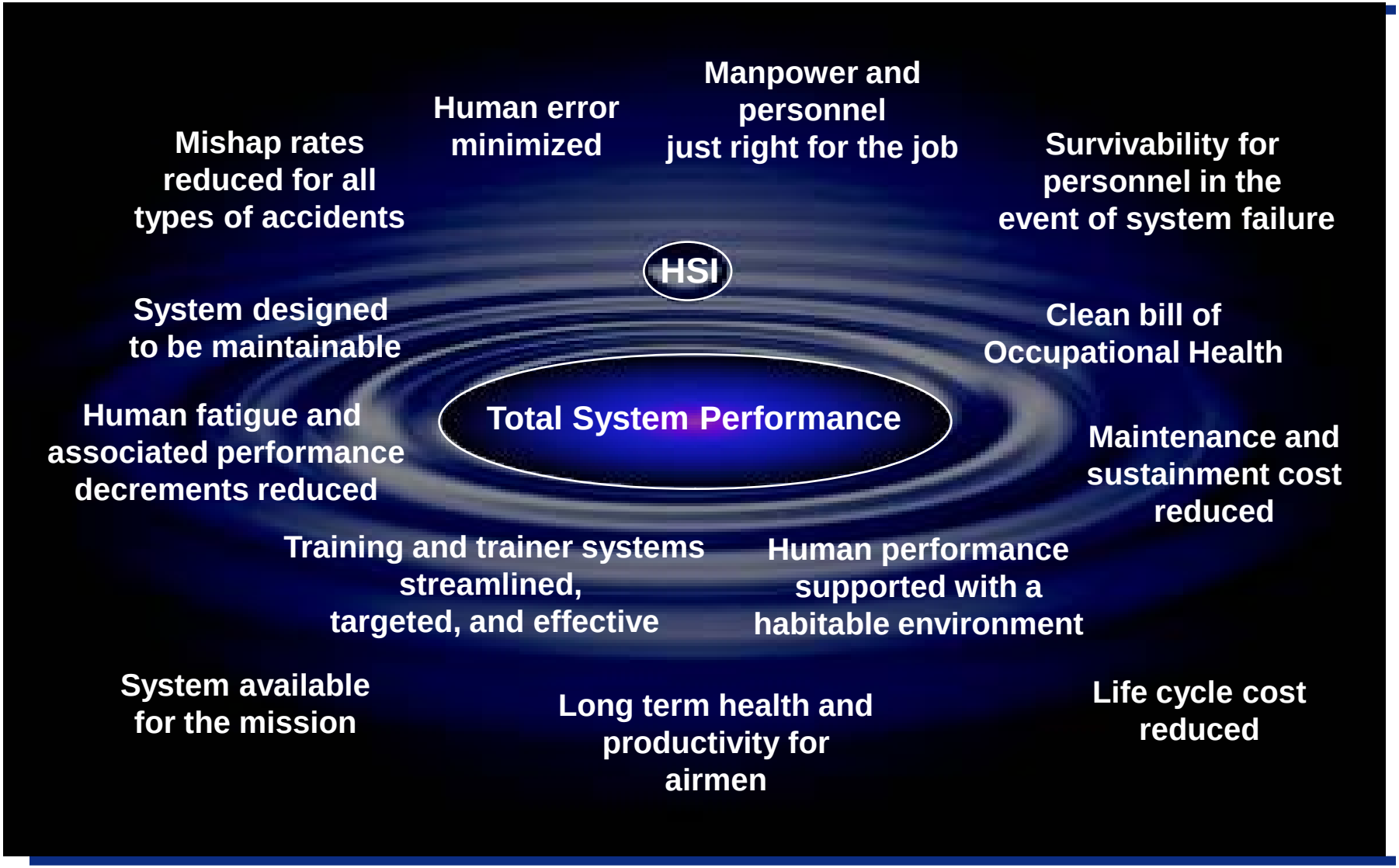
Ripple Effect of Early HSI



QUESTIONS?