Human-System Metrics Applied to Optimize AF Warfighter Capability

13 March 2018

Integrity ★ Service ★ Excellence

NDIA Human Systems Conference
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Human Systems Integration Directorate
711th Human Performance Wing

Overview

- 711 HPW/HP - AF HSI Analysts
  - Providing support across AF
  - Other/joint efforts
- HSI -related requirement activities
  - During early system concept development
  - Throughout the product lifecycle
  - Human-System Requirements
    - ✓ Methodology
    - ✓ Measures and Verification
    - ✓ Metrics
- Example: application of HSI-related requirements in emerging domains: autonomy, human augmentation, and cyber

Human Systems Integration Directorate
711HPW/HP

Mission

Optimize warfighter capability through a human-centric approach to system development, acquisition, and sustainment

HSI Analysts

Optimize total system performance

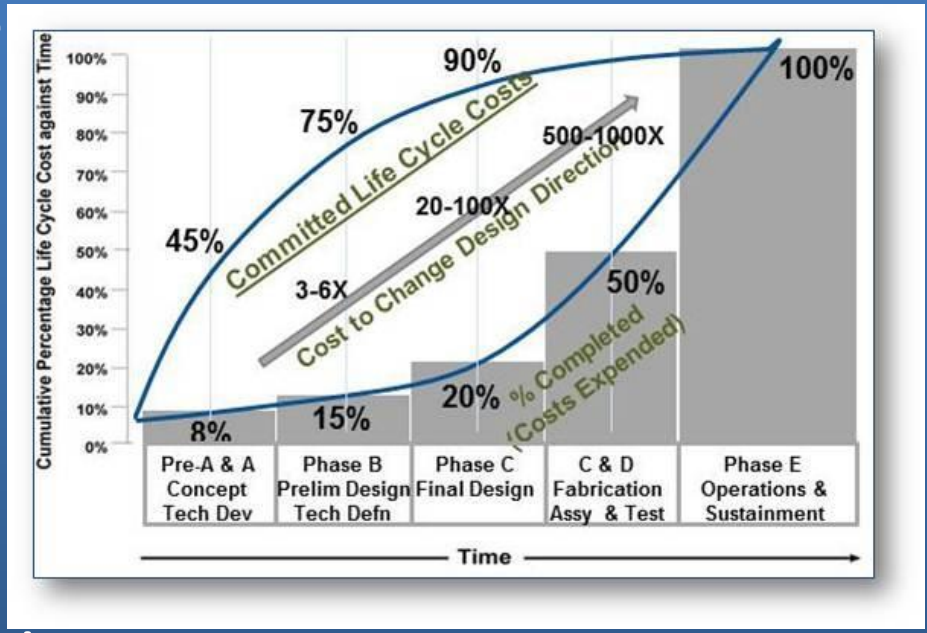
…the relative and combined performance

…human + software + hardware

…trade offs

Optimize total life cycle costs

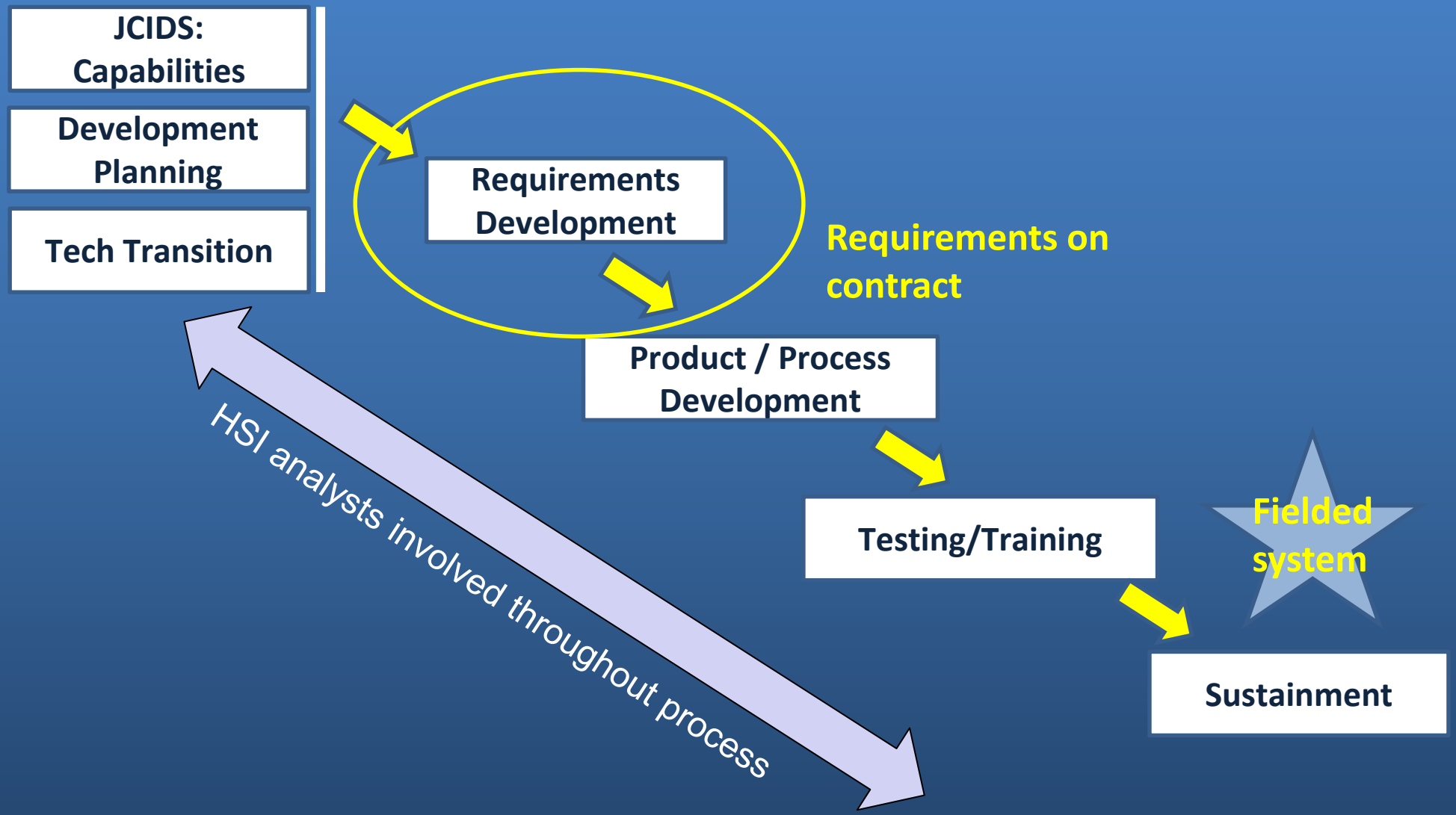
…projecting sustainment costs over 30-70 years (adds up)!



Enable the users to effectively complete the mission

HSI analysts work to ultimately reduce overall program risk

HSI – the Means



Human-System Requirements

System level HSI-related requirements:

- Are performance based. “A performance-based requirement states ‘how well’ a function must be performed. The performance is usually indicated by a measurable value.”

  Source: USAF HSI in the SRD Guidebook, SURVIAC, 2012

- Are accompanied by verification methodology

- Are often accompanied by SOW tasking for associated analyses, modeling and sim, and formative evaluations

Human-System Requirements

Measures versus Metrics:

- Measure is used here for more concrete attributes
- Metric is higher-level; a standard of measurement
- “Metrics can be used to benchmark and measure performance against. Metrics are measures collected over time for the purpose of seeing trends and forecasting program progress to plan.”
  - DAG Chapter 3

Human-System Requirements

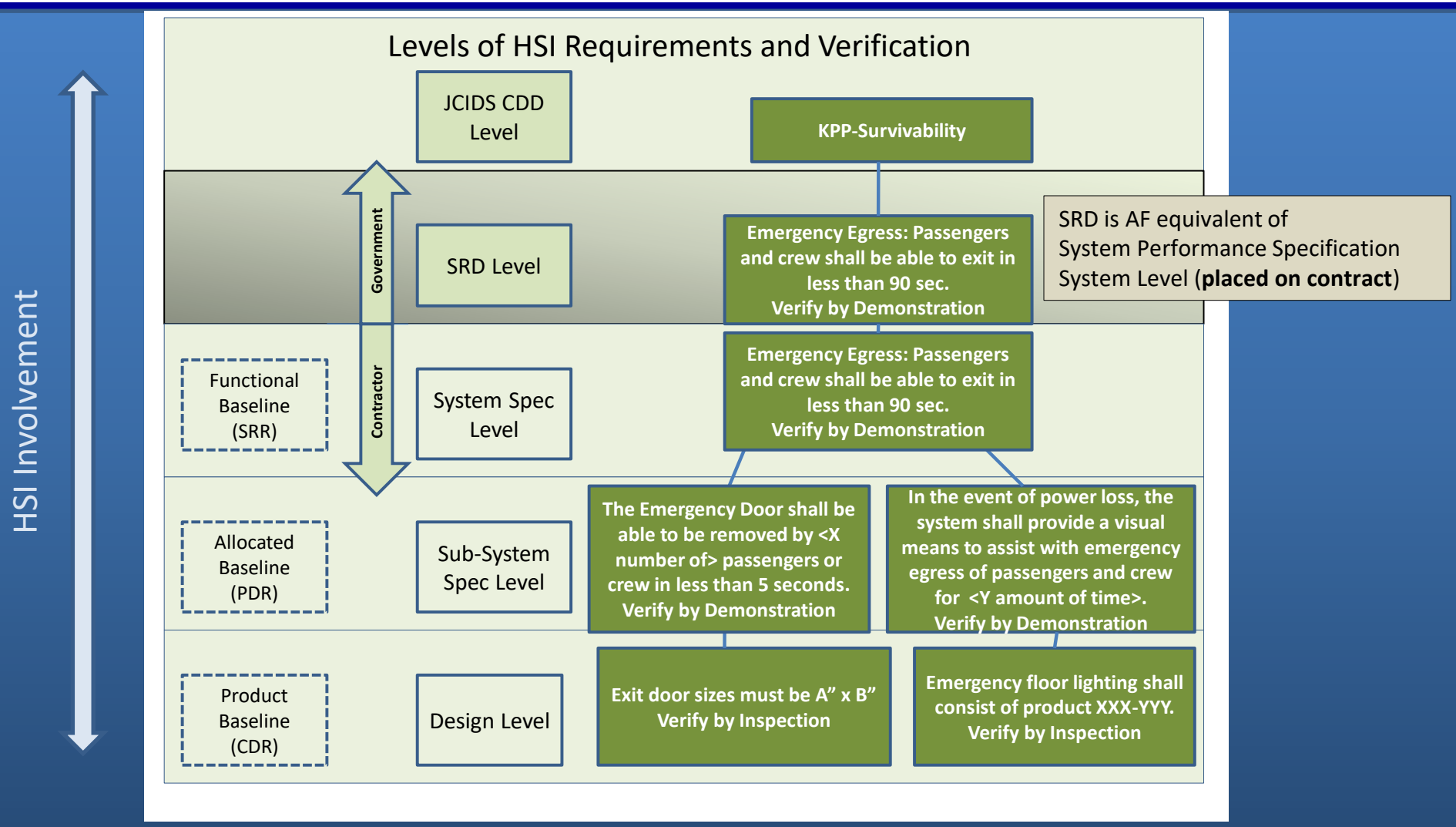
Basic Requirement Statement:

<System D> shall provide <F> feedback within <E> seconds.

Measure: a clear and measureable pass / fail criterion

Source: USAF HSI in the SRD Guidebook, SURVIAC, 2012

Levels of Requirements



JCIDS = Joint Capabilities Integration and Development System; SRR = System Requirement Review; PDR = Preliminary Design Review; CDR = Critical Design Review.
Source: USAF HSI in the SRD Guidebook, SURVIAC, 2012

Requirements Development

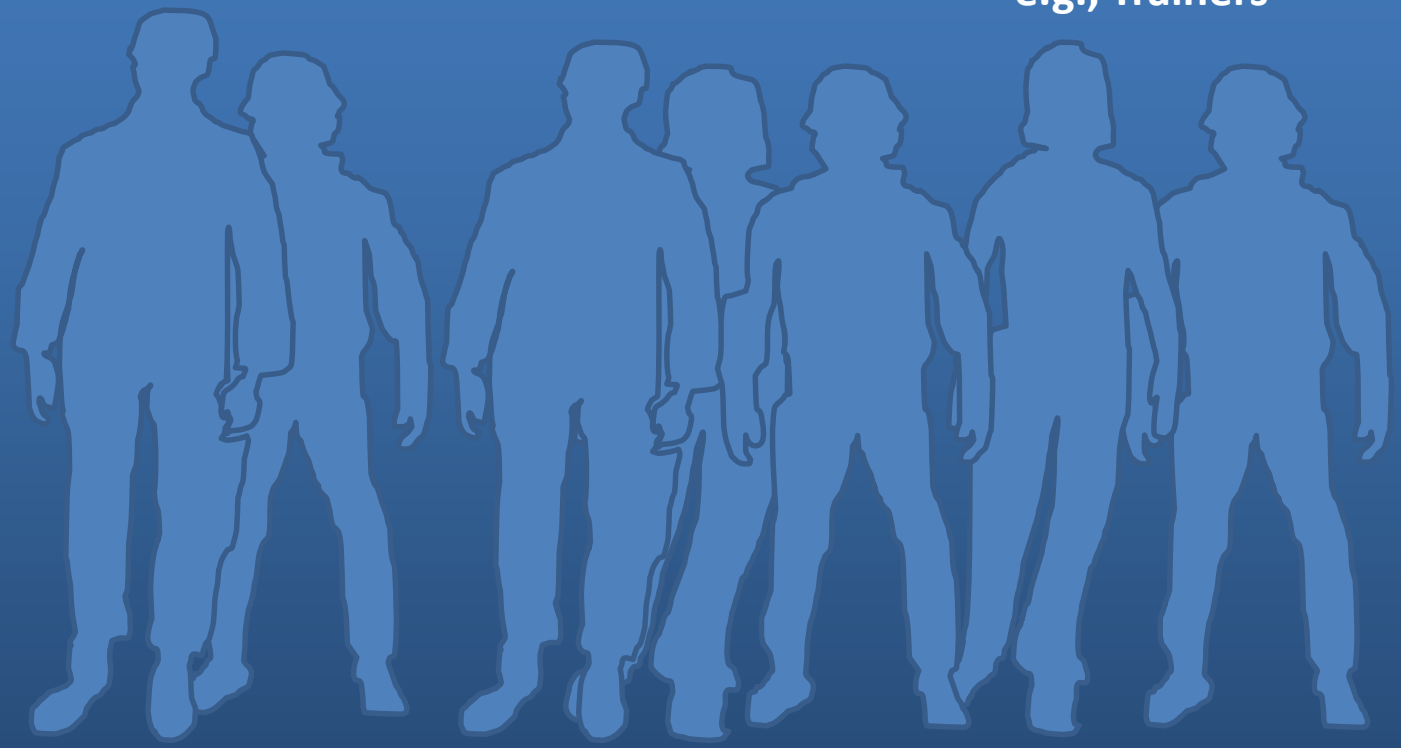
Methodology

Target Audience Description

Operators

Maintainers

Support Team
e.g., Trainers



Other

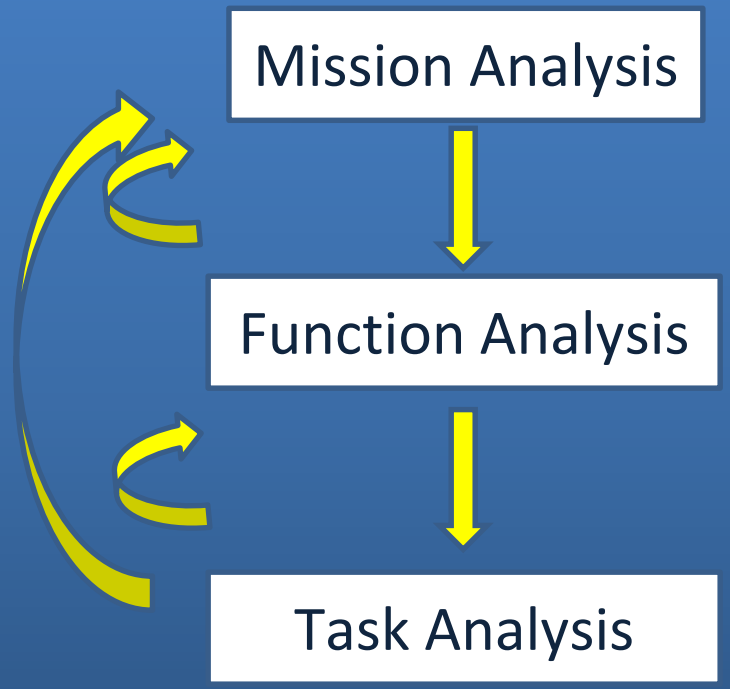
?

e.g., Passengers, Other FoS Users, Bystanders

Mission Task Analysis

Part of the overall systems engineering process – a team effort

Decompose mission capabilities into functions and tasks



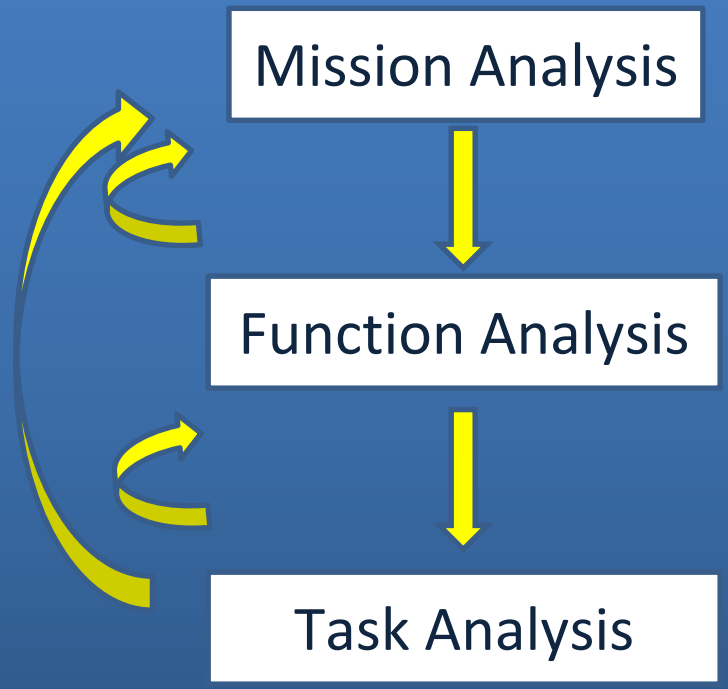
Consider the human as part of the overall system

Human capabilities and limitations factored into the design EARLY

MIL-STD-46855A

Mission Task Analysis

Commercial off the shelf or transitioning technologies



Allocate functions to hardware, software, and/or human

Factors into Systems Engineering top down requirements decomposition process

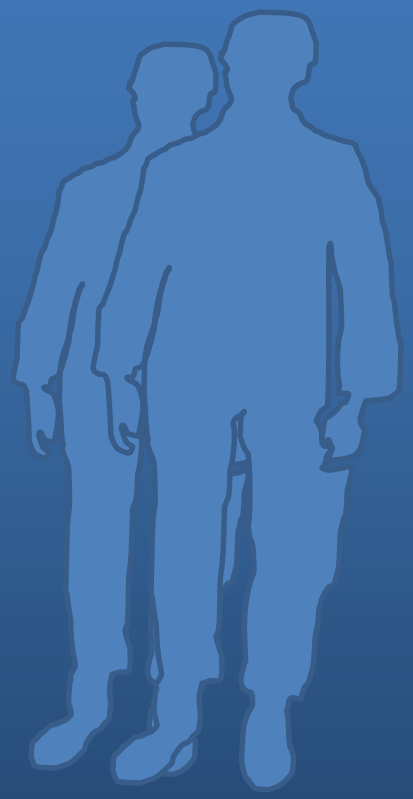
Empowering the human to excel in tasks that they do better than machines

Designing hardware and software to assist humans when machines can do tasks better

Example

Notional example:

Security Forces need assistance patrolling military bases and apprehending threats.



The following capabilities will be acquired to augment the existing forces:

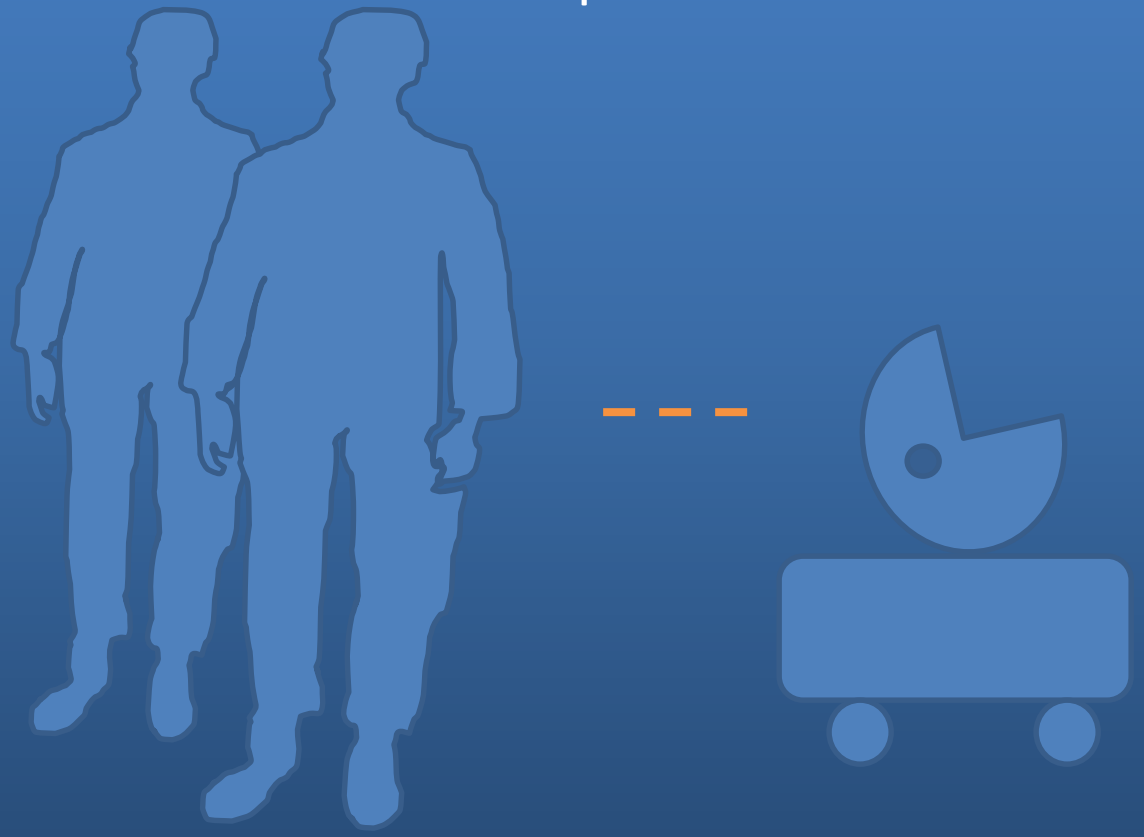
‘Security Forces Bot (SFB)’

- Autonomous, mobile patrolling of perimeters of military bases
- Sense and detain airborne intruders (UAVs)
- Sense and detain intruders on foot
- Work as a team with other SFBs and also with [human] security forces

Example

Total system performance

…the relative and combined performance of humans and systems



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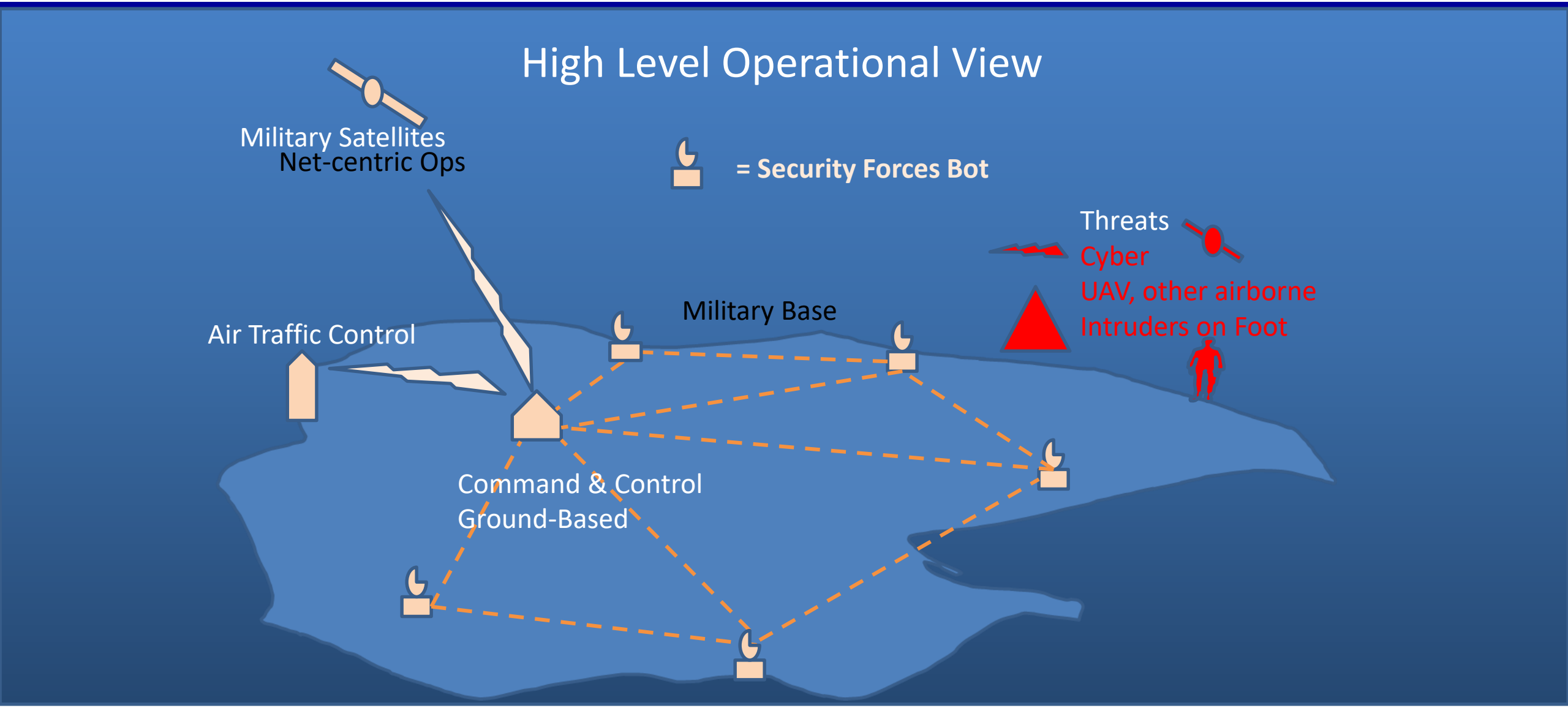
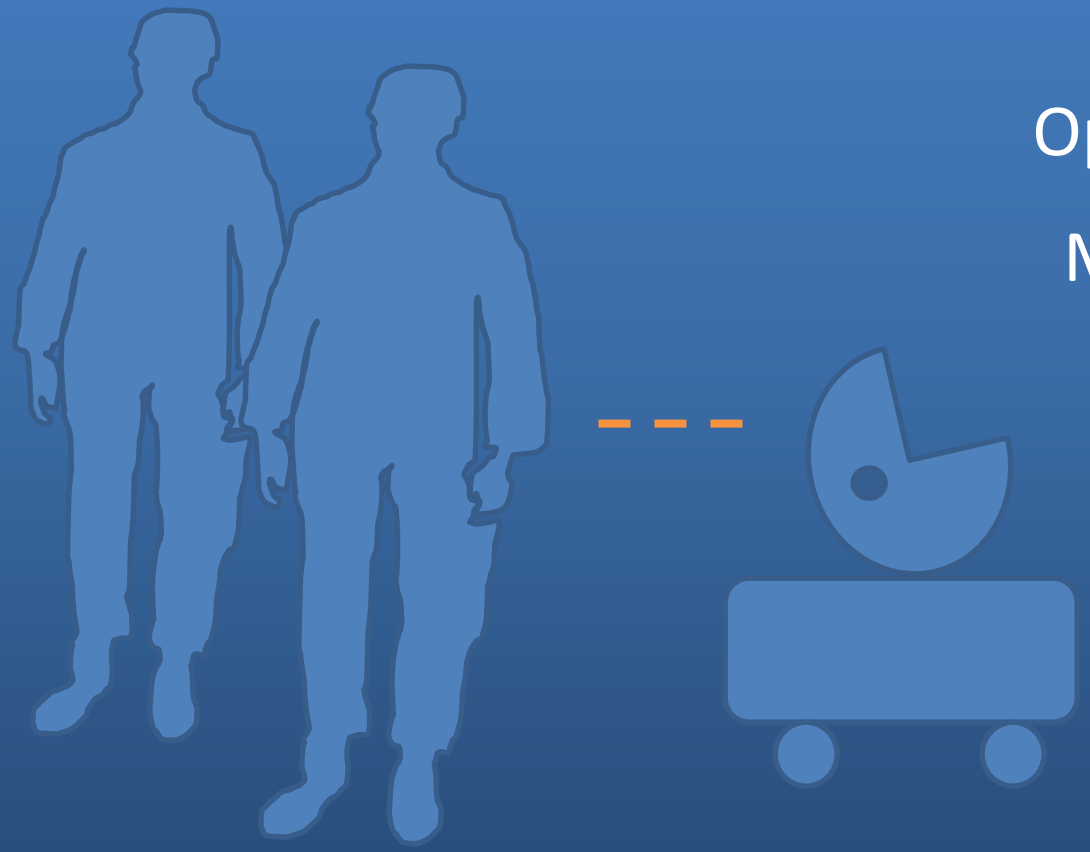
Example



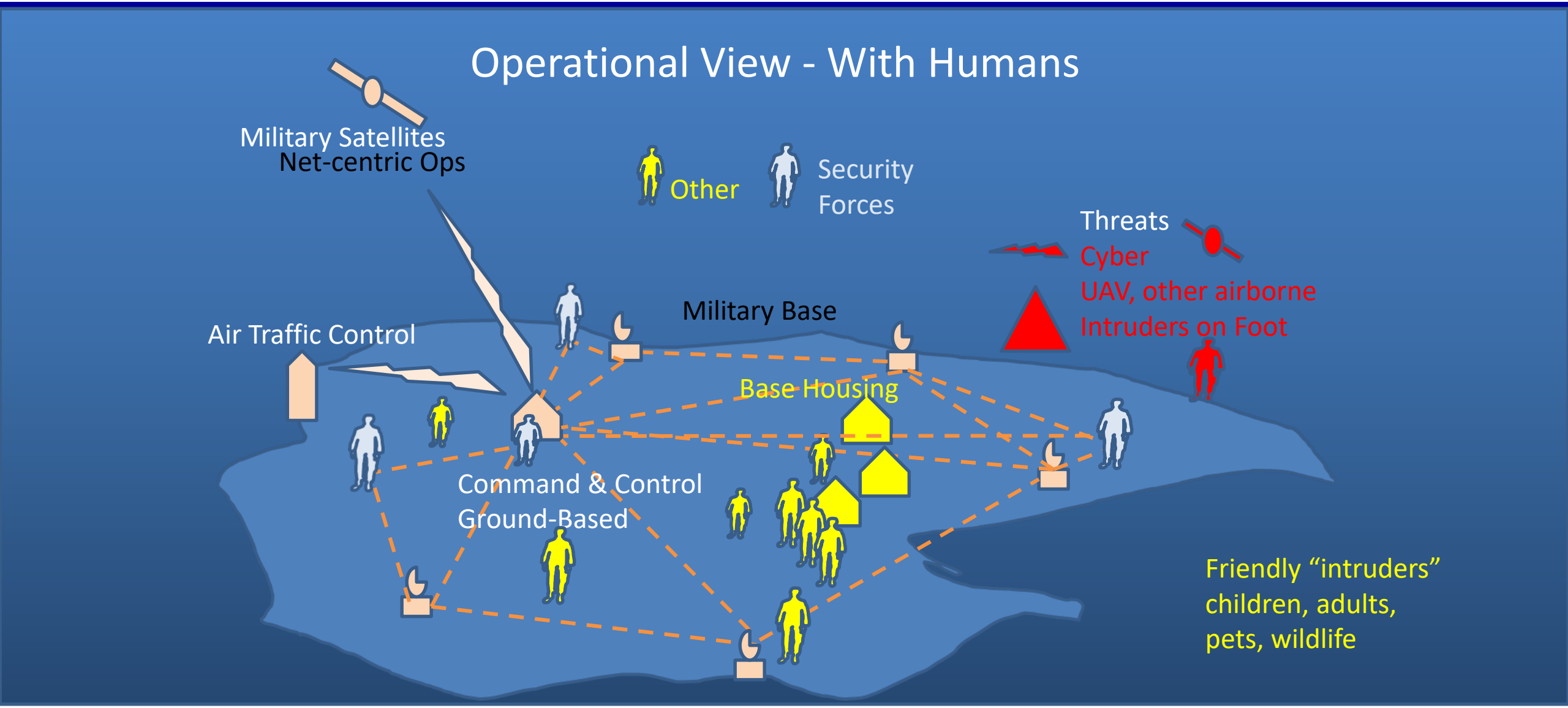
Example

Methodology: Begin with the Target Audience Description



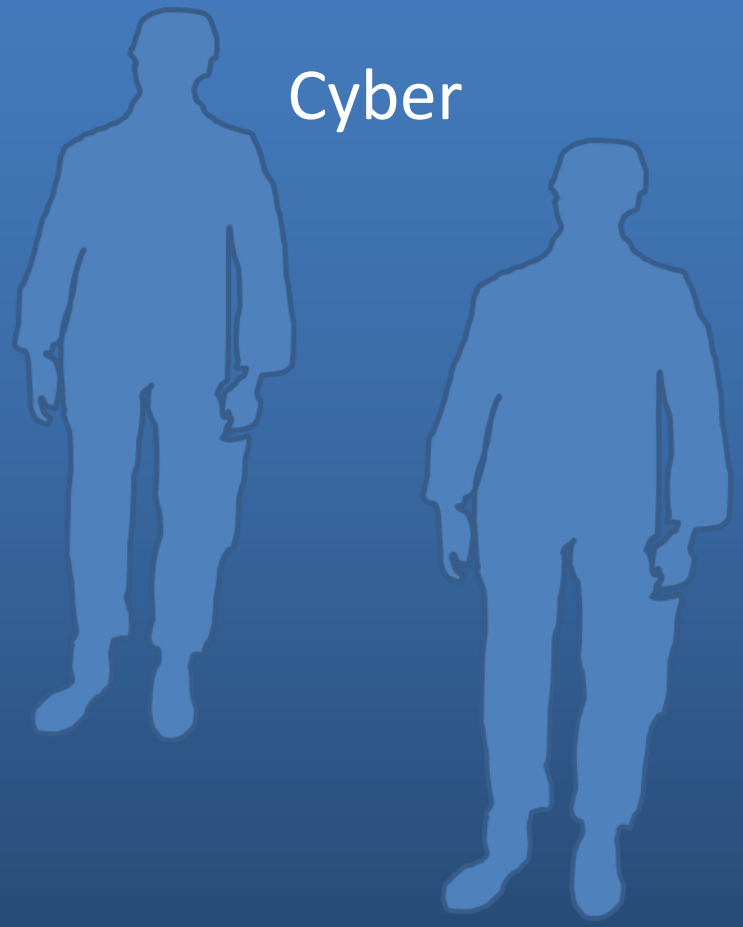
- Operators
- Maintainers
- Support Personnel
- Other

Example



Example

Consider the following areas of focus:



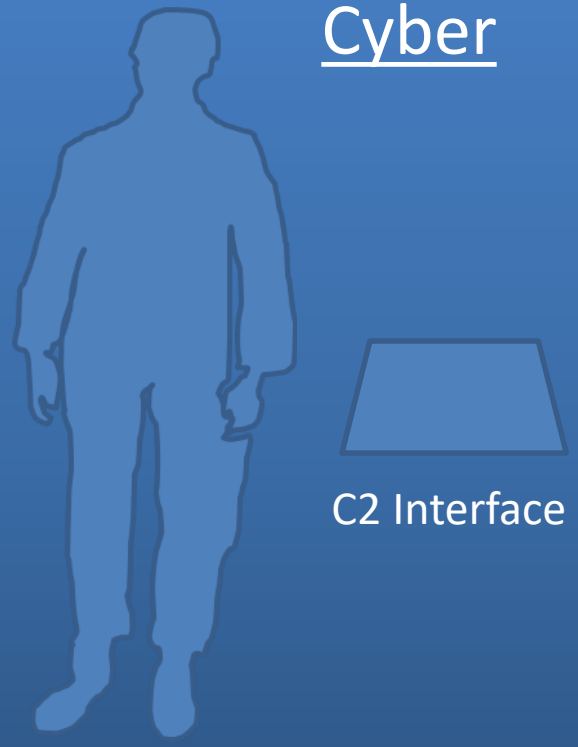
Cyber

Augmentation

Autonomy

Example

Cyber



C2 Interface

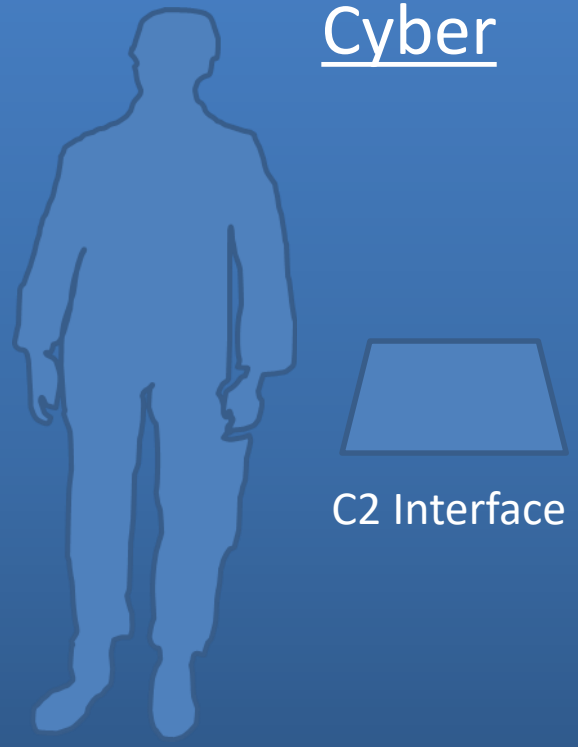
Command and Control (C2) Operator

Human- System requirements might address:

- Alerting/notification of cyber threats
  - Software-related
  - Hardware-related
  - Overall system
  - Individual SFB cyber issues
- Decision-aiding
  - Responding to cyber threats
  - Understanding the impact/scope of cyber threats
- Ability to easily update system to respond to new emerging threats

Example

Cyber



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  - Responding to cyber threats
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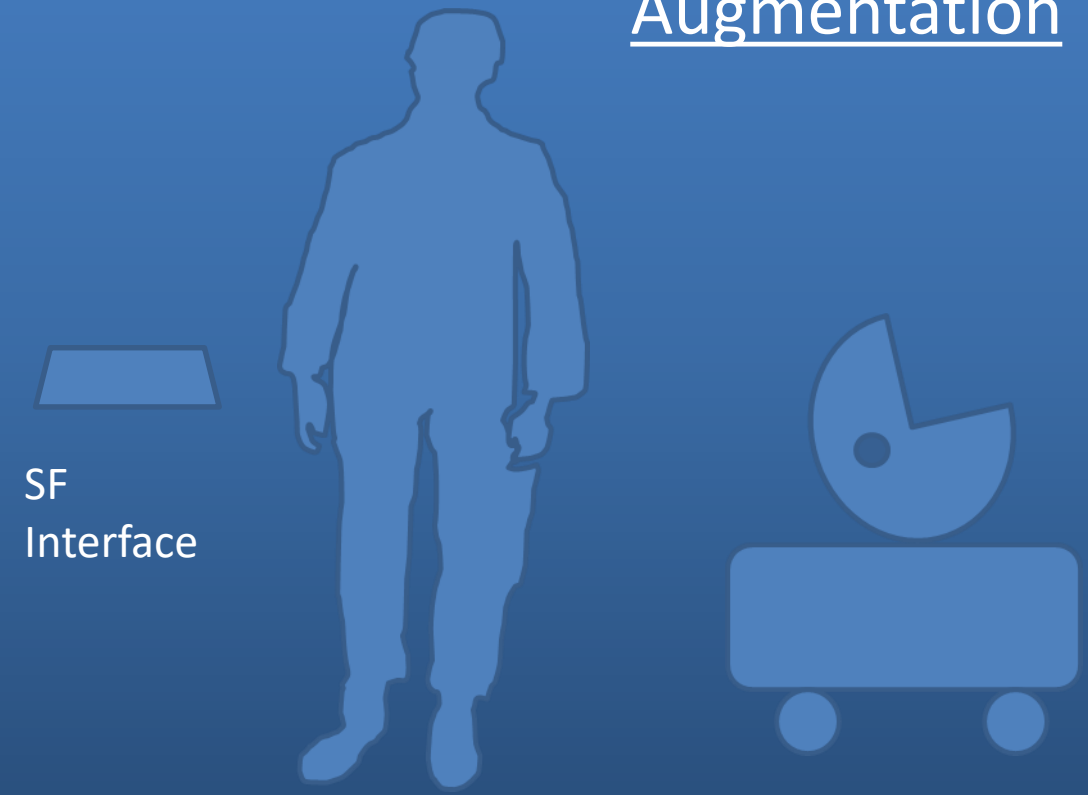
The C2 Interface shall provide recommended courses of action to avert <type A> threat to the C2 Operator within <D> seconds of detection. Verify by demonstration.

respond to new emerging threats

Example

Augmentation

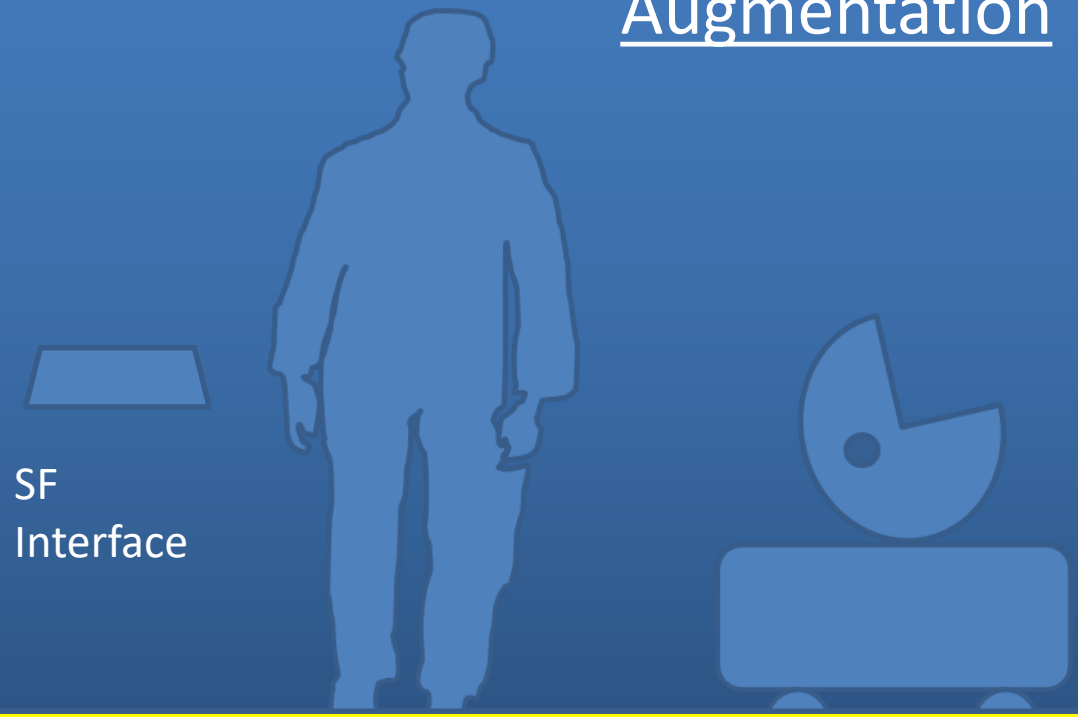


Human- System requirements might address:

- Teaming
- Communication
- Decision-aiding
- Override of automation
- Training
- Socialization/trust
- Safety
- Survivability
- Maintainability

Example

Augmentation



Human- System requirements might address:

- Teaming
- Communication
- Decision-aiding
- Override of automation
- Training
- Socialization/trust
- Safety

The SF Interface shall allow the trained SF Operator to override autonomous operation of a single SFB to manual control within <C> seconds. Verify by demonstration.

Example

Human-Systems requirements might address:

- System protected from unauthorized users
- Easy changes to software modules (by authorized users) – command, control, and teaming “rules”
- Communication
- Decision-aiding
- Safety
- IFF/Survivability – Friendly “intruders”
  children, adults, pets, wildlife
- Maintainability- diagnostics
- Sustainment- # of people required to support and sustain over the lifetime of the system
- Training- understanding evolution of changes to SFB

Autonomy

Example

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- Sustainment- # of people required to support and

Autonomy

The SFB software shall be capable of field updates for <teaming rules> performed by trained SF Maintainers within <D> minutes. Verify by demonstration.

Postured to Optimize Warfighter Capability

711 HPW/HP - AF HSI Analysts

- Postured to optimize warfighter capability within current and emerging technologies

HSI Lab

- Anthropometrics
- Task Analysis
- Usability
- Exoskeleton augmentation

Expanding talented HSI analyst workforce

- Cyber SMEs
- Engineers
- Acquisition professionals
- Doctors
- Physiologists

Contact Information

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