Product Directorate
Contingency Base Infrastructure

PdD CBI Briefing to
17th Annual Systems Engineering Conference
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Agenda

- Product Directorate Contingency Base Infrastructure
- CBI Overview
- SE Team Mission Support
- Analysis Team Mission Support
- Integrated Toolset Maturation
- Discussion

CBI Vision & Mission

CBI Vision:

To be the Army Materiel integrator by enhancing mission effectiveness for contingency base camp infrastructure through a recursive systems engineering process utilizing modeling and simulation.

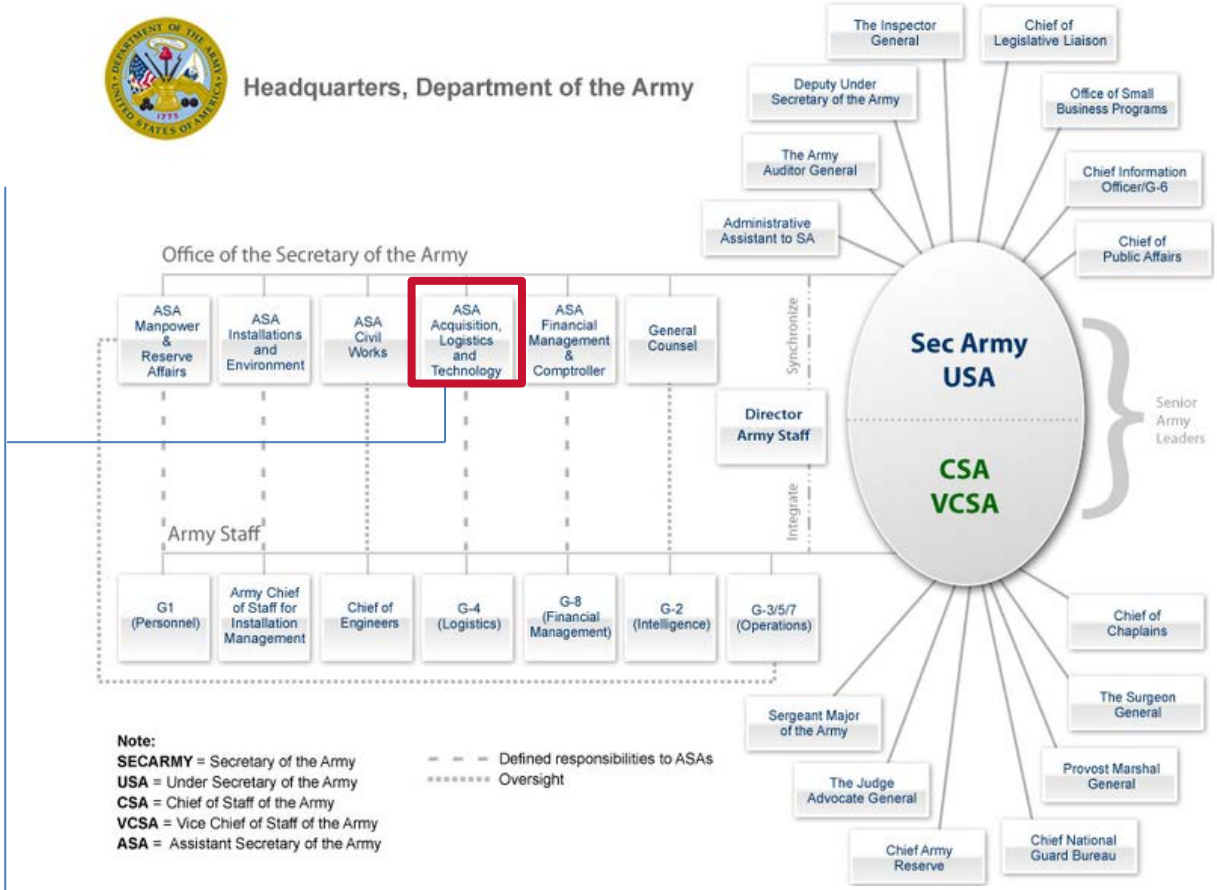
CBI Mission:

Provide systems engineering support to influence contingency base camp infrastructure: investment decisions; materiel recommendations responsive to operational commander needs; DOTMLPF-P considerations for operational requirements; and operate a knowledge management system.

Product Directorate Contingency Base Infrastructure

ASA(ALT)
Contingency Basing Stakeholders

- Program Executive Office Combat Support & Combat Service Support
- Project Manager Expeditionary Energy and Sustainment Systems (E2S2)
- **PdD Contingency Base Infrastructure**
- PdM Force Sustainment Systems
- Joint Operational Energy Initiative
- Project Manager Force Projection
- Joint Program Executive Office Chemical Biological Defense
- Program Executive Office Command, Control and Communications - Tactical
- Program Executive Office Enterprise Information Systems
- System of Systems Engineering & Integration



Contingency Basing Problem

- Ad-hoc nature of planning/designing base camps creates additional logistics burden due to the inefficiencies of systems and increased manpower burden impacting mission effectiveness

- Increased costs due to the lack of informed decisions impacting manpower and resources

- Lack of holistic approach to standardization in planning and design, construction, operations, management, and closure/transfer of base camps

Base Infrastructure Systems

Utilities

Water Management
Wells, Production, Purification, Storage, Distribution, Ice, Water Bottling







Power Management
Prime & Tactical Generation, Control & Distribution






Waste Management
Gray & Black Water, Solid Waste




Life Support
Feeding, Billets, Hygiene, Laundry







Supply Management
Fuel Management, Cold/Frozen Storage, Materiel Handling









Areas, Roads & Grounds
Road Maintenance, Horizontal Construction, Lighting







Structures
Re-locatable Rigid Wall & Soft Wall (Tents) for Command Posts, Medical, Maintenance, Personnel Services; Protective Structures; Heating; Cooling

Emergency Services
Fire Fighting, Ambulance, Hazard Management

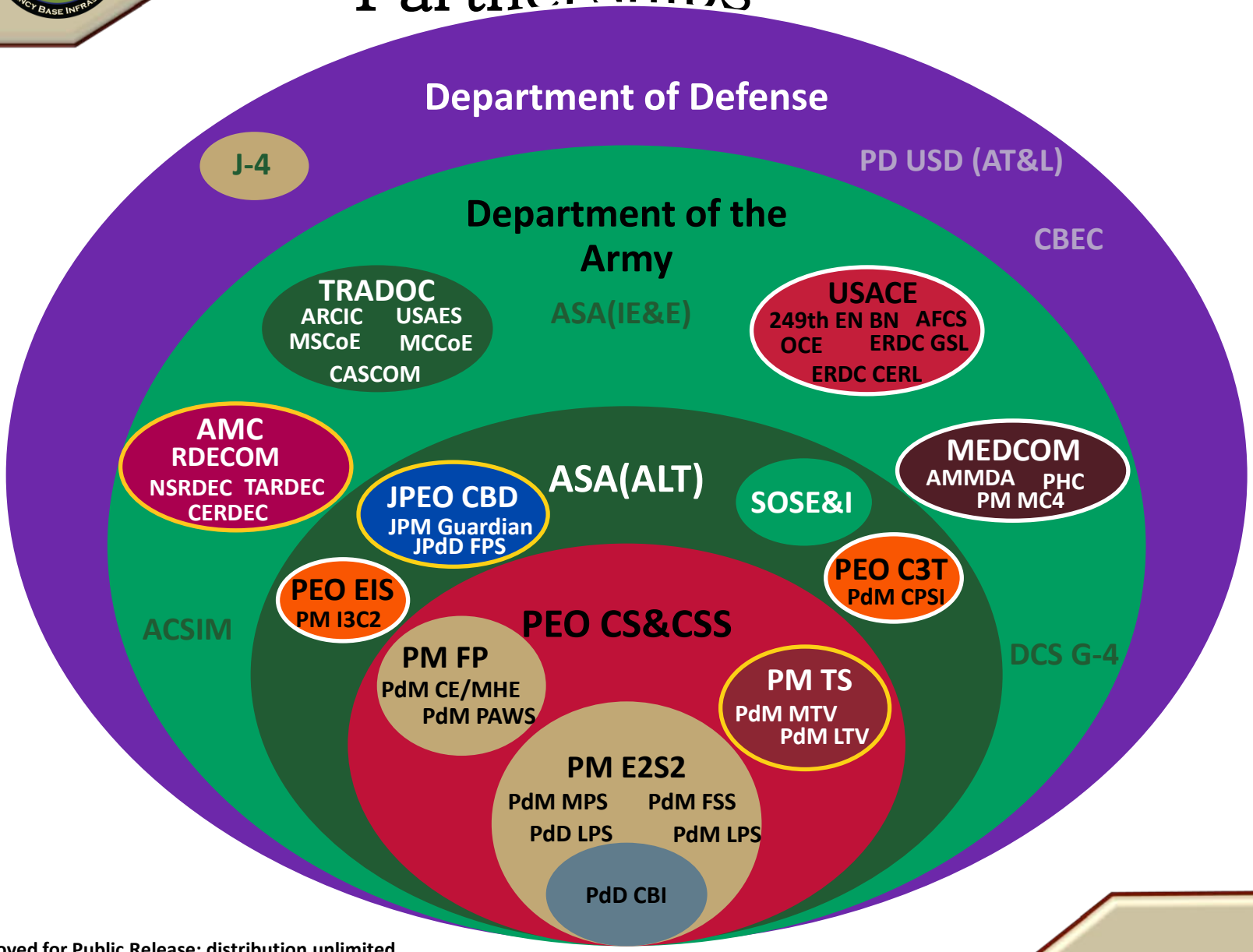
Transportation & Maintenance

Base Management

Medical & Personnel Services Training

CBI - Enabling the Army to provide Contingency Bases as fully integrated systems - enhancing force effectiveness and quality of life

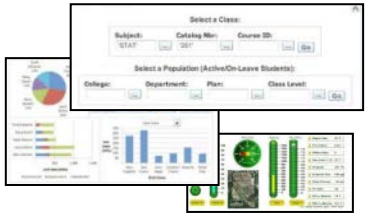
CBI Stakeholder / Partnerships



Lines of Effort/Implementation

Contingency Basing Problem

- Ad-hoc nature of planning/designing base camps creates additional logistics burden due to the inefficiencies of systems and increased manpower burden impacting mission effectiveness
- Increased costs due to the lack of informed decisions impacting manpower and resources
- Lack of holistic approach to standardization in planning and design, construction, operations, management, and closure/transfer of base camps



Contingency Basing Interface to the Warfighter

IWSR Investment Recommendations

PEO/PM CB Product Integration

Contingency Basing Interface with the Warfighter

JCMS

Commander Dashboard Interface for Designing Base Camps:
-Who are the tenants?
-How many tenants?
- What is the mission?
-What is the location?
-How long will you stay?
-Timeframe?

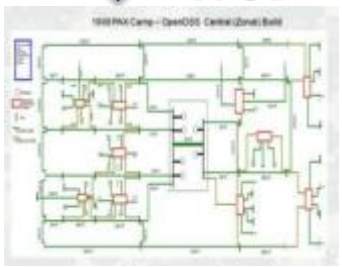
CBI Optimized Materiel Sets

Facility information and a list of systems is generated based on Commanders input – color denotes availability of systems (objective)

VFOB

Systems are placed on GSI based on input and optimized Design (Commander can move as desired)

VFOB



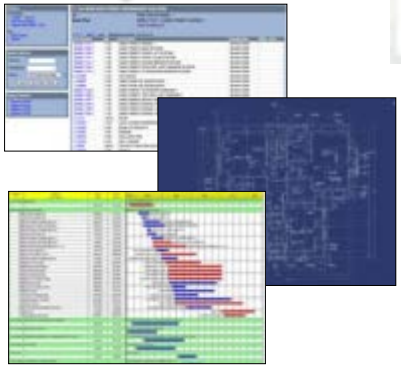
Analyze Design

Army Pre-positioned Stocks

Unit TOE

Inventory Stock

Contingency Contracting



Outputs blueprint, schedule, cost, IBOM and list of required equipment

Distribution approved for Public Release; distribution unlimited.

SE Team Mission Support

Systems Engineering Focus

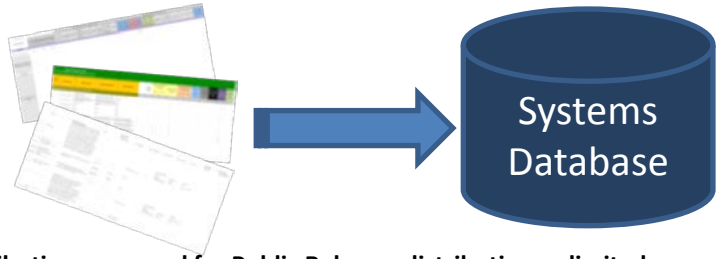
Systems Engineering Approach

Applying analytical rigor to the contingency base allows comparisons between systems making the base, as a system, more efficient and effective; freeing the Warfighter to concentrate on the mission.

Integrated Toolset

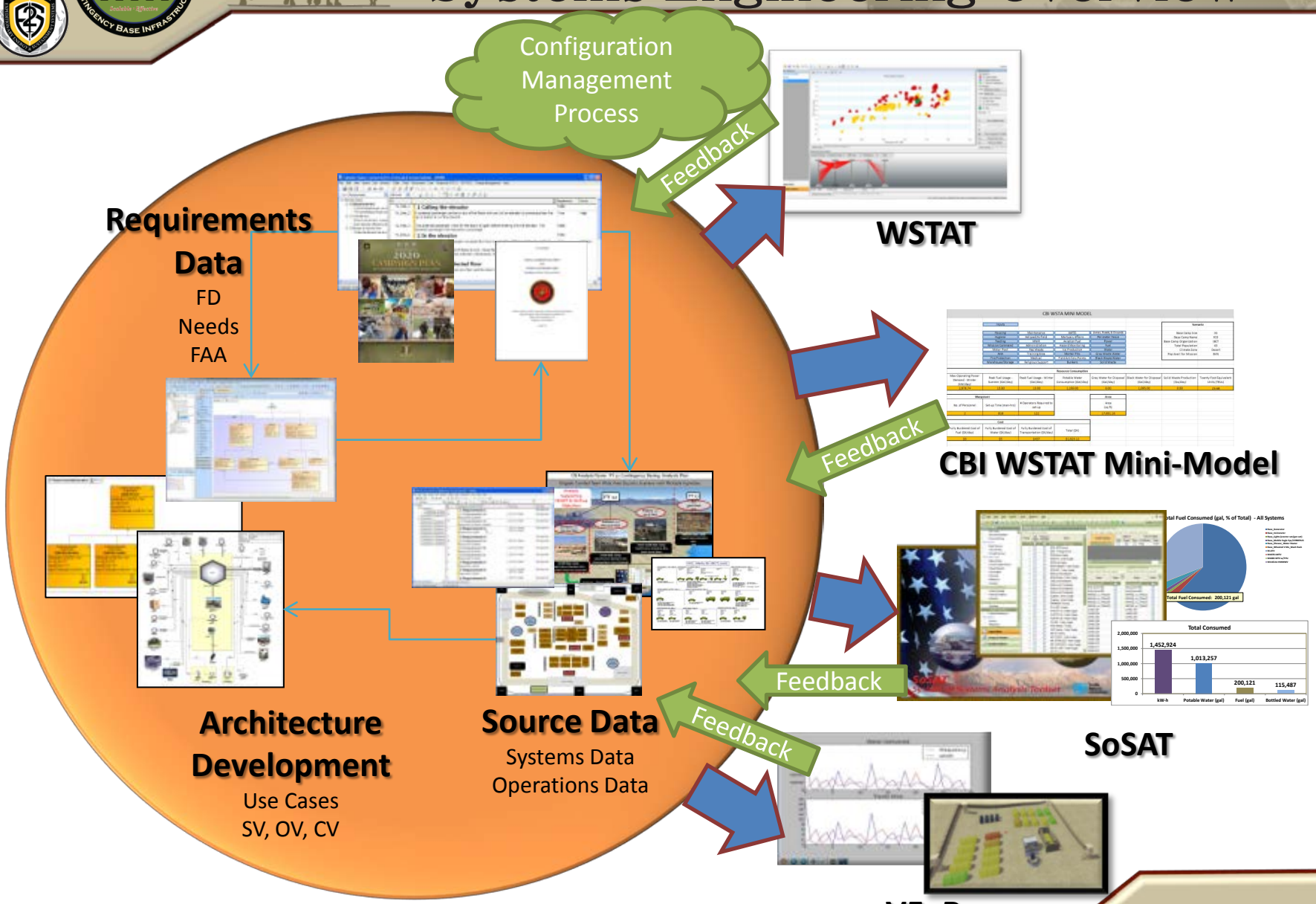
The integrated toolset provides the backbone for the analysis and interface to the field allowing commanders, acquisition activities, procurement organizations, etc. information necessary to make informed decisions.

Contingency Base Knowledge Base



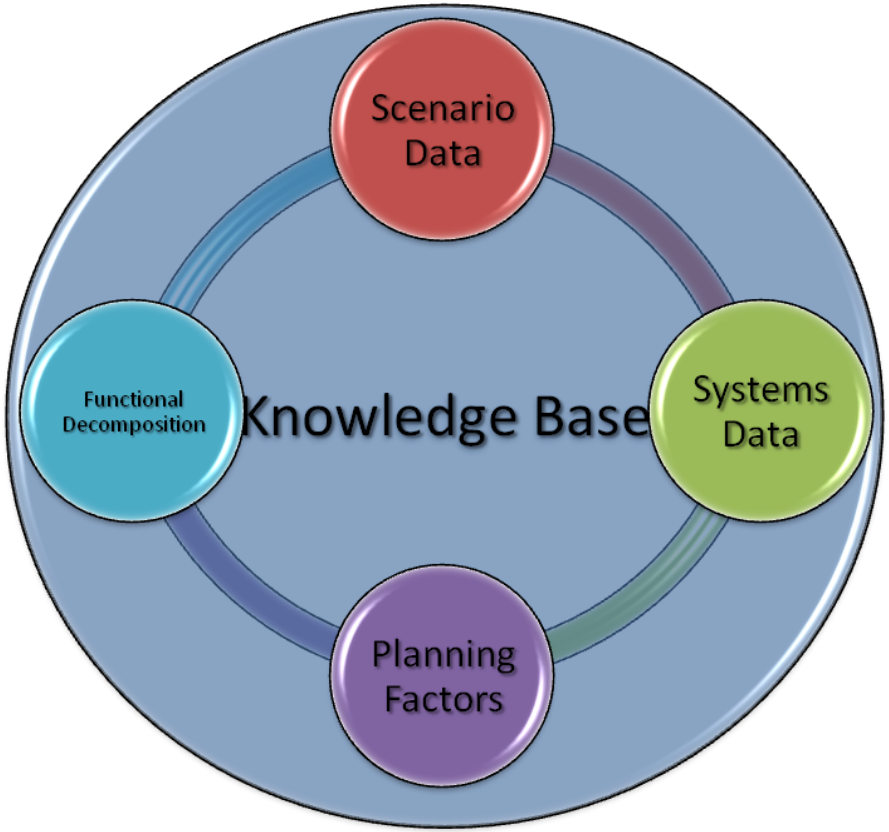
A single repository for contingency base information which will be made available to commanders responsible for bases through a single interface to the field.

PdD CBI Model Based Systems Engineering Overview



Common Knowledge Base Development

Common set of operational data to describe METT-TC, OPTEMPO, unit requirements, MTOEs and additional operationally specific information to facilitate model integration for information transition



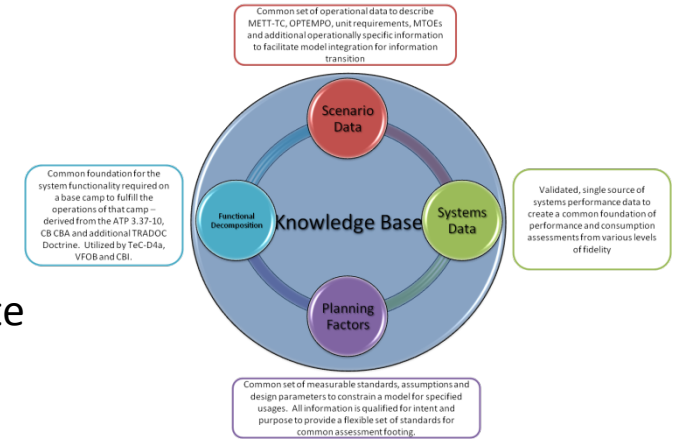
Common foundation for the system functionality required on a base camp to fulfill the operations of that camp – derived from the ATP 3.37-10, CB CBA and additional TRADOC Doctrine. Utilized by TeC-D4a, VFOB and CBI.

Validated, single source of systems performance data to create a common foundation of performance and consumption assessments from various levels of fidelity

Common set of measurable standards, assumptions and design parameters to constrain a model for specified usages. All information is qualified for intent and purpose to provide a flexible set of standards for common assessment footing.

System Data Integration Efforts

- Coordinating with VFOB and TeCD to align baseline set of systems and associated attributes.
- Conducted the mapping of TeCD identified baseline systems to the proposed CBI data call templates (to indicate to VFOB/TeCD which of their systems would be included in the upcoming data refresh effort)



- Collaboration with VFOB/AFCS to understand who will be the gatekeeper of which data sets, in support of Interface to the Warfighter
- "Meet-and-greets" with ONR, TeCD, and LIA to exchange information to see what we can leverage from each other
- Ongoing discussions with VFOB to determine the level of fidelity required in the data characteristics

Army Materiel Systems Analysis Agency

- Authoritative source for System Performance Estimates
  - Core competency #5: Certified system level performance data development to support Army M&S, studies and analyses

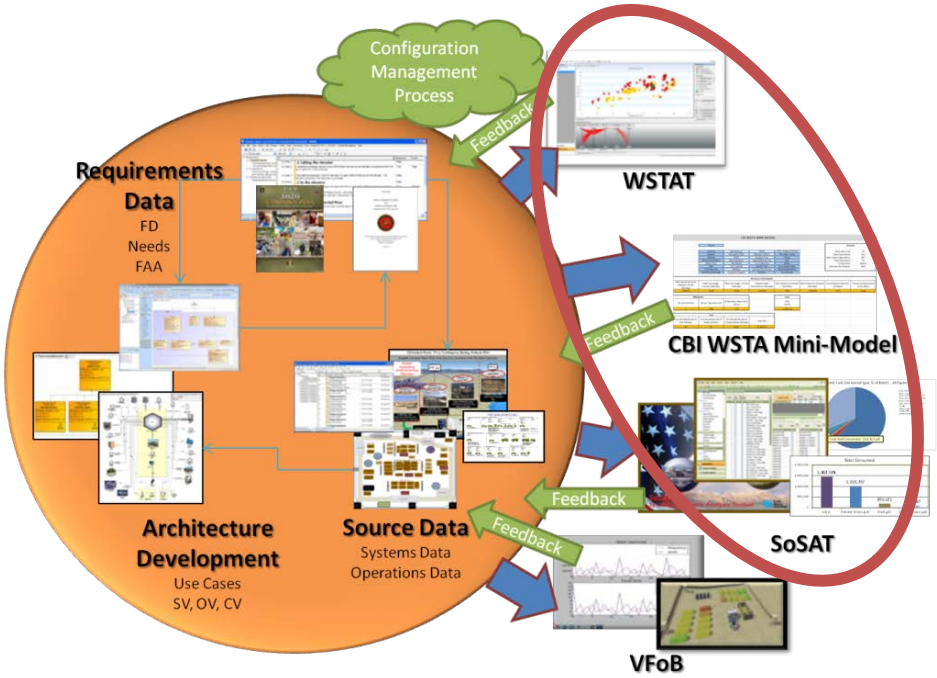
- Joint Data Center (JDC)
  - Manage and integrate data requests
  - Standard file formats
  - Standard nomenclature database
  - Equipment characteristics database

- Current Progress:
  - AMSAA has reviewed the needs of PdD CBI
  - Action to discuss with leadership at AMSAA effort required
  - Action from PdD CBI to provide database information
  - Identify what information would be owned by AMSAA

Analysis Team Mission Support

Summary of 2012 and 2013 Analysis

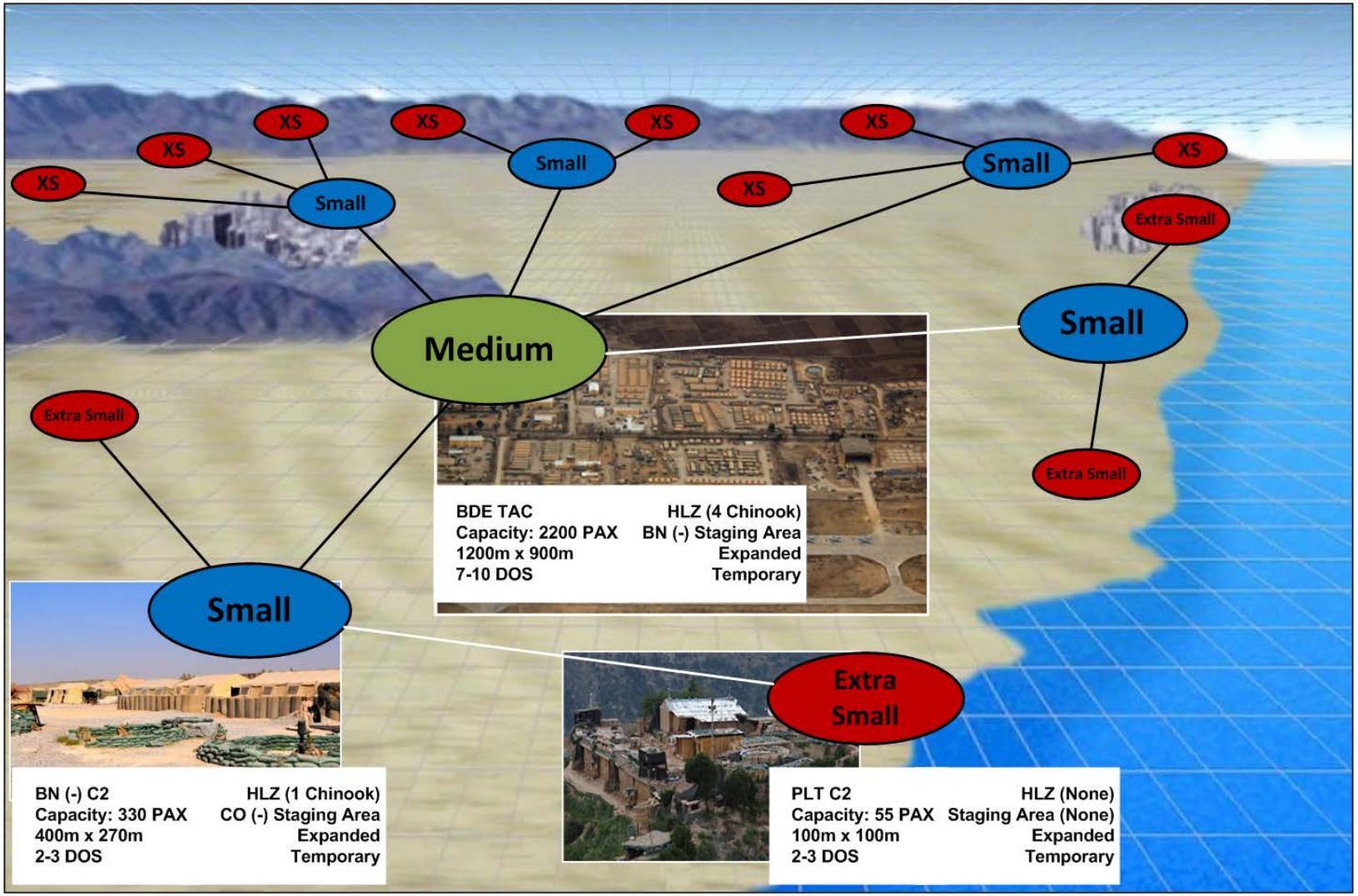
- 300 PAX (Small)
  - Proof of Concept
  - Basis for Cost Benefit Analysis
- 50-75 PAX (X-Small)
- 1000 PAX (Small)
- 2000 PAX (Medium)
  - FY16 CCS (BI Best of Breed)
- 2000 PAX (Medium)
  - FY17 CCS



Base Camp Cluster Analysis – 2014

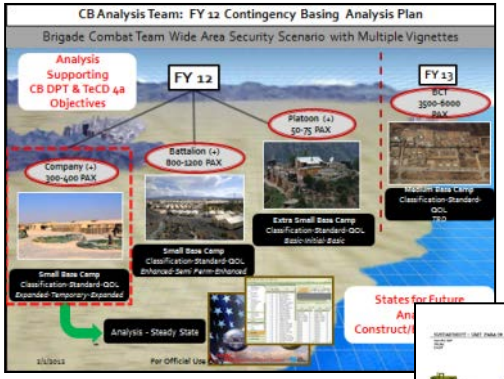
- Develop three base camp cluster models
  - One each for ABCT, IBCT and SBCT
  - 1-5-12 cluster construct (1 M, 5 S and 12 XS)
- Model each individual base camp
- Model movement of logistics within cluster
  - Flow downward from M to S and XS (fuel, water, parts, ammunition, etc.)
  - Flow upward from XS and S to M (laundry, etc.)

BCT Base Concept



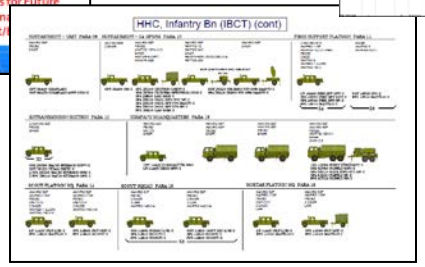
SoSAT Model Development Process & Analysis Approach

OPORD



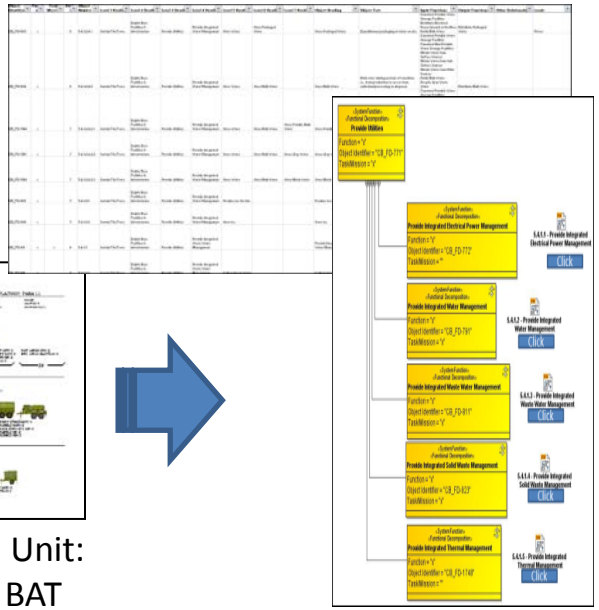
Defines the mission:
-CO+ Wide Area Security Operations
-CONOPS (e.g., sustain)

Tenant Unit

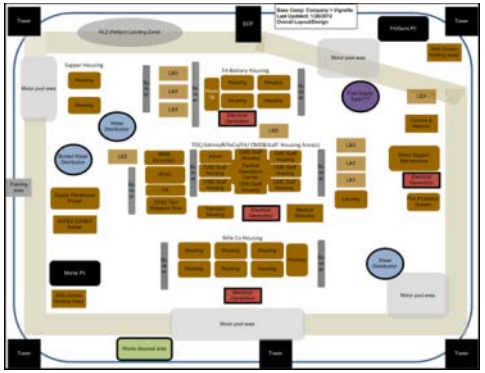


Mission determines Unit:
-IBCT Rifle CO w/FA BAT Augmentation (312 PAX)

Functional Decomposition



Base Camp Design



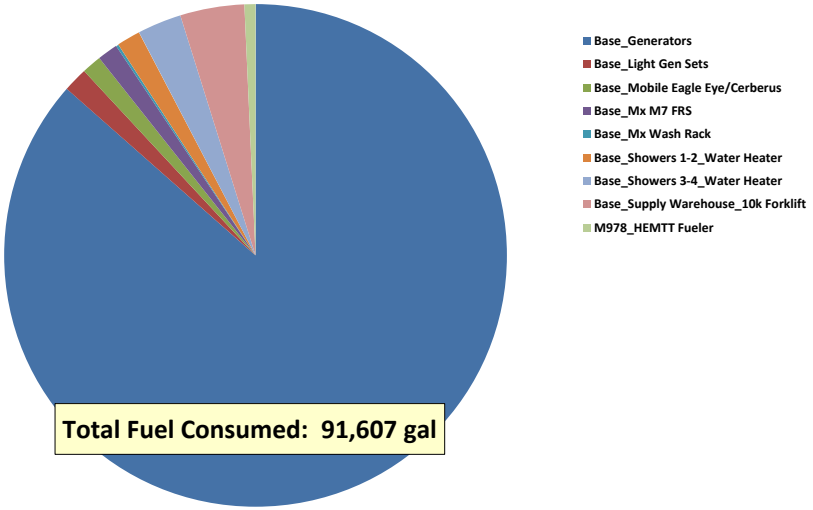
FD & Unit determines base camp required capabilities/systems

- SoSAT Base Case - "As Is"
- SoSAT Future State - "Improved Systems"

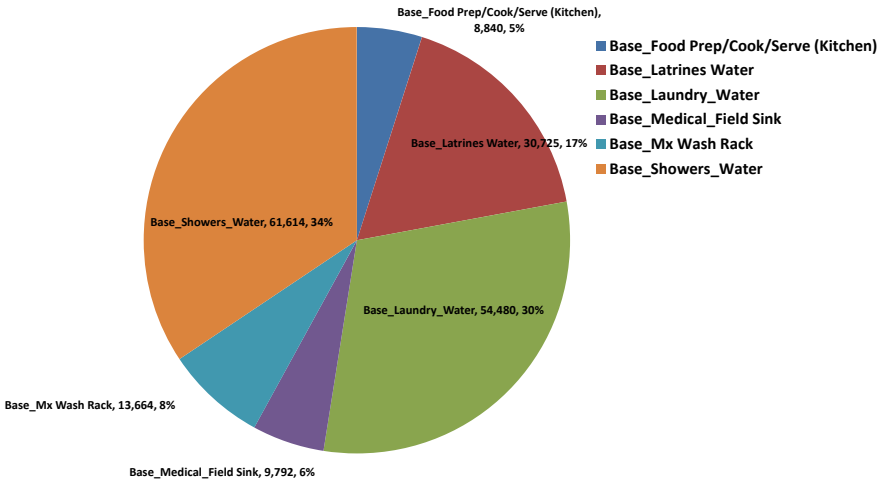
- Assess improvements against base case via operational metrics (e.g., fuel consumption, water consumption, etc.) – define the "unit value" of improvement

Fuel and Water Analysis by System

Total Fuel Consumed (gal, % of Total) - BASE Systems



Total Potable Water Consumed by System (gal, % of Total)



Fuel		
System Type	Total Consumed (gal)	% of Total
Base_Generators	79,249	86.5%
Base_Light Gen Sets	1,440	1.6%
Base_Mobile Eagle Eye/Cerberus	1,152	1.3%
Base_Mx M7 FRS	1,200	1.3%
Base_Mx Wash Rack	151	0.2%
Base_Showers 1-2_Water Heater	1,394	1.5%
Base_Showers 3-4_Water Heater	2,592	2.8%
Base_Supply Warehouse_10k Forklift	3,780	4.1%
M978_HEMTT Fueler	648	0.7%
Total	91,607	100.0%

Potable Water		
System Type	Total Consumed (gal)	% of Total
Base_Food Prep/Cook/Serve (Kitchen)	8,840	4.9%
Base_Latrines Water	30,725	17.2%
Base_Laundry_Water	54,480	30.4%
Base_Medical_Field Sink	9,792	5.5%
Base_Mx Wash Rack	13,664	7.6%
Base_Showers_Water	61,614	34.4%
Total	179,116	100.0%

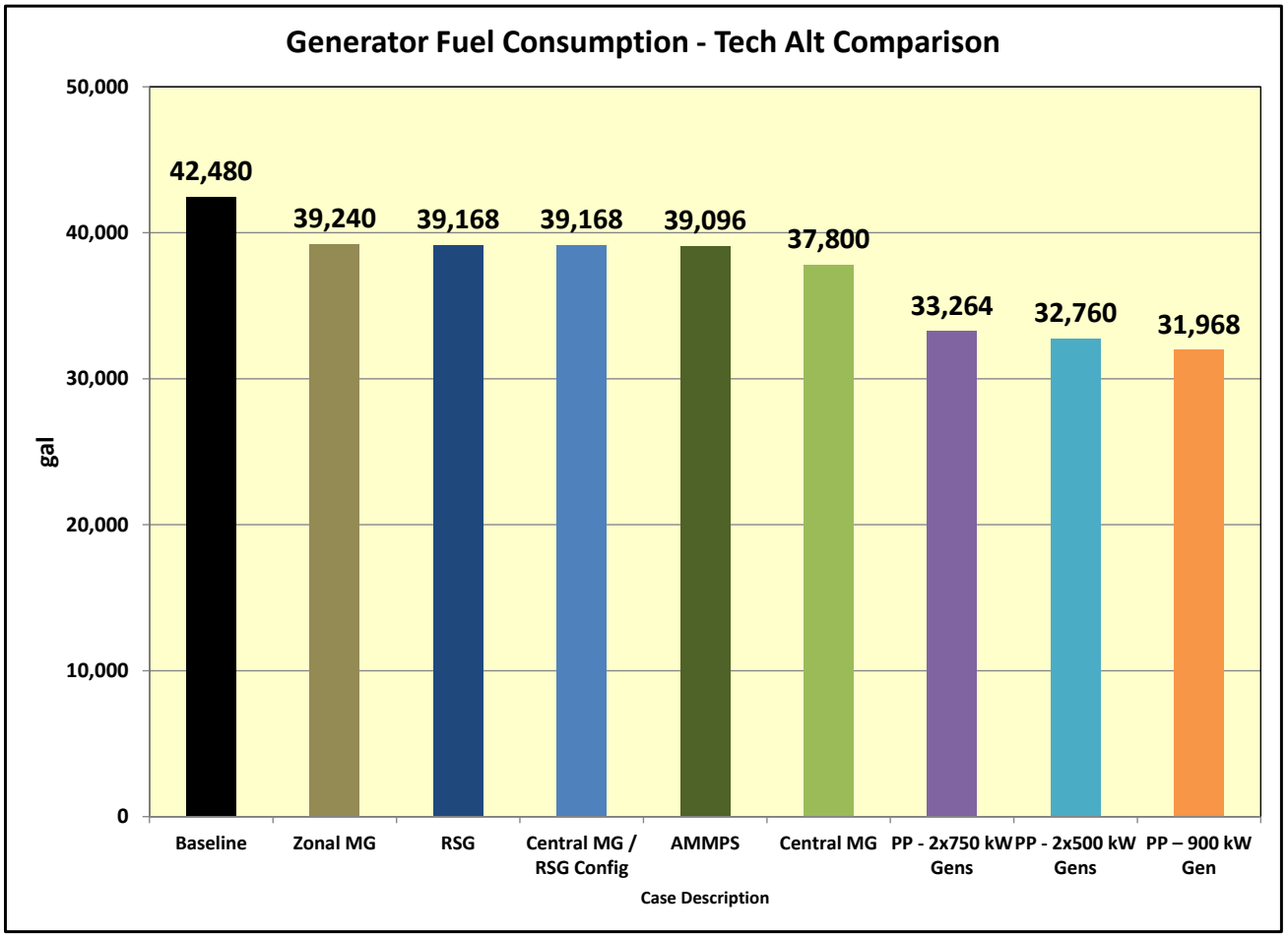
Fuel consumed during 30-day operations: ~92k gal

Note: Generators consume 79k gals or 86.5% of BASE systems fuel

Total potable water consumed during 30-day operations: ~180k gal

Power Management Technology Alternatives

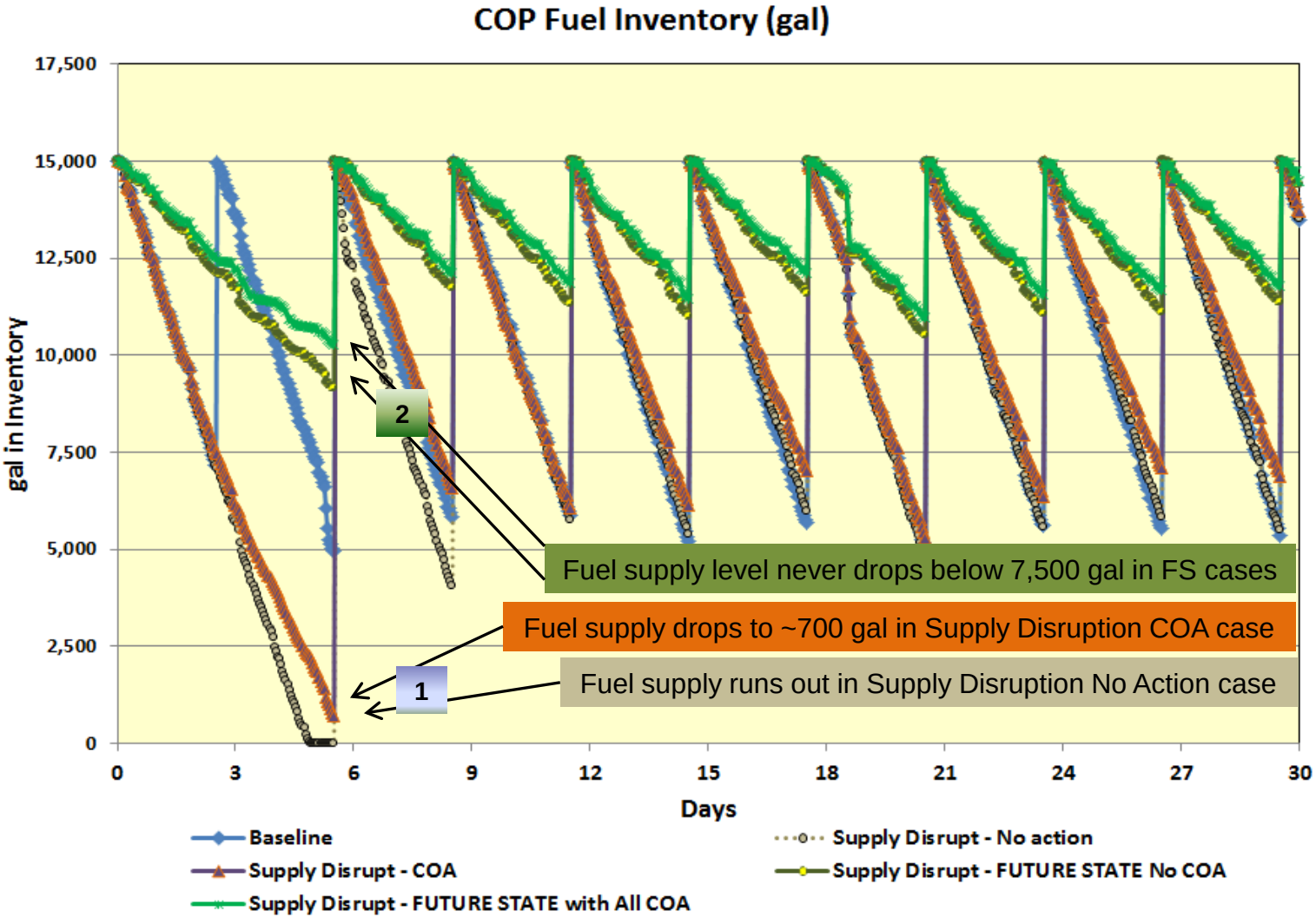
Summary Results



Total Generator Fuel Consumption Over 30-Days

Power Management Tech Alts reduce total generator fuel consumption over 30-day mission (as compared to baseline), ranging from ~3k gal to ~10.5k gal

Sandstorm Use Case – Fuel Results



1. Resupply disruption has largest impact on fuel inventory for COP without FS techs:

- Drops to 0 without COAs
- Drops to ~700 with COAs

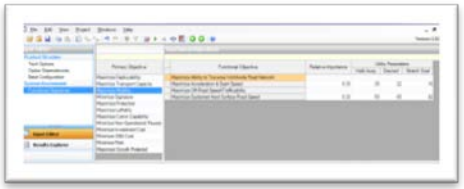
2. Resupply disruption has lesser impact on fuel inventory for COP with FS techs:

- Drops to ~9,100 without COAs
- Drops to ~10,200 with COAs

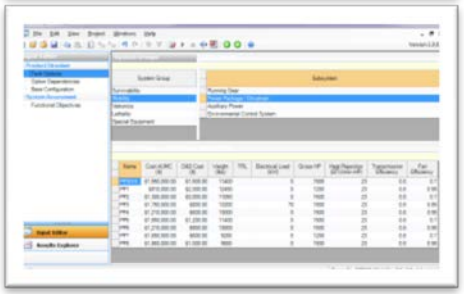
Integrated Toolset Maturation

What is WSTA and Why Is It Needed?

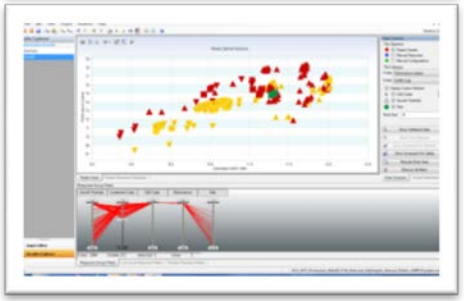
Input Stakeholder Objectives



Input design choices and relationships



View Holistic System Consequences in terms of stakeholder value



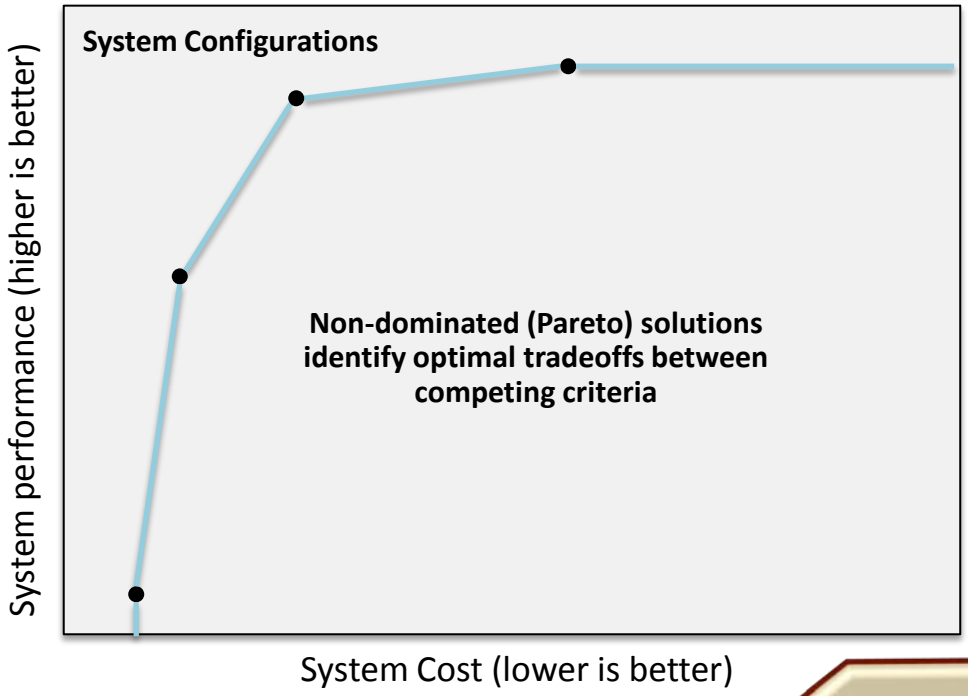
- **What**: A decision support tool that integrates otherwise separate subsystem models into a holistic system view mapping critical design choices to consequences relevant to stakeholders.
- **Why**: Contingency Bases are complex systems with many interrelated subsystems. Finding the sweet-spot among competing objectives (performance, affordability, risk, scalability and commonality) is a non-trivial task.

Systems engineering is a discipline that concentrates on the design and application of the whole (system) as distinct from the parts. It involves looking at a problem in its entirety, taking into account all the facets and all the variables and relating the social to the technical aspect.

(Federal Aviation Administration [USA], *Systems Engineering Manual,* definition contributed by Simon Ramo)

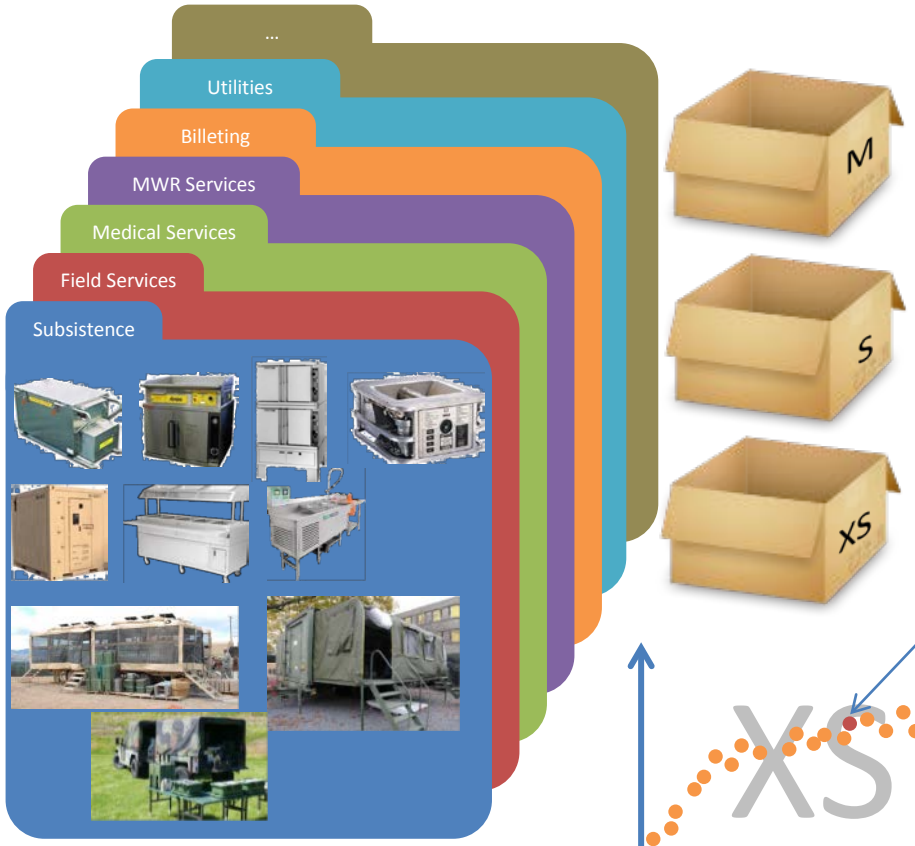
WSTAT Introduction

- WSTAT looks at the design of a single system, aggressively examining many potential configurations in an effort to meet multiple competing requirements and objectives
- WSTAT uses multi-objective genetic algorithm to find design "sweet spots" that balance multiple competing criteria
  - Consider only 2 criteria, cost and performance
  - Same idea applies when balancing more criteria, except that higher-dimensional spaces are required

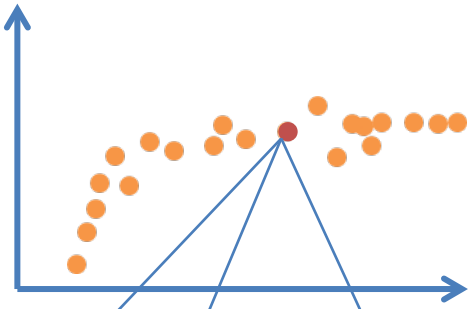


WSTA Tool Overview

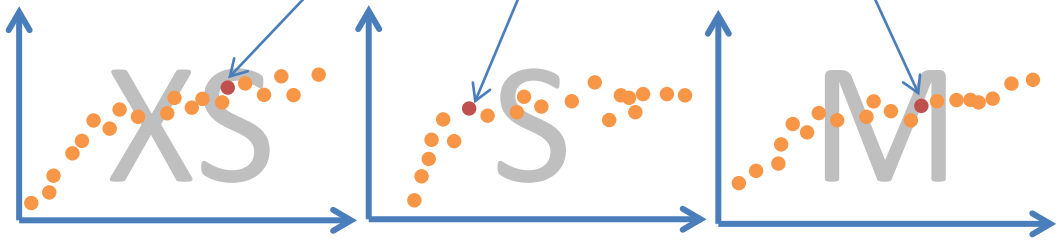
Collection of Available Technology Options



Similarly, three configurations can be represented as a point in 5-dimensional value space representing a collection of bases (one of each size)



The resulting COB optimal set can be filtered to view the solution set for each base size



The "collections of bases" (COB) solution set can be used to determine the effect of commonality on performance and affordability

Integrated Analysis

CBI Integration

TeCD4a

LIA

JOEI/ OEATF

VFOB

ONR

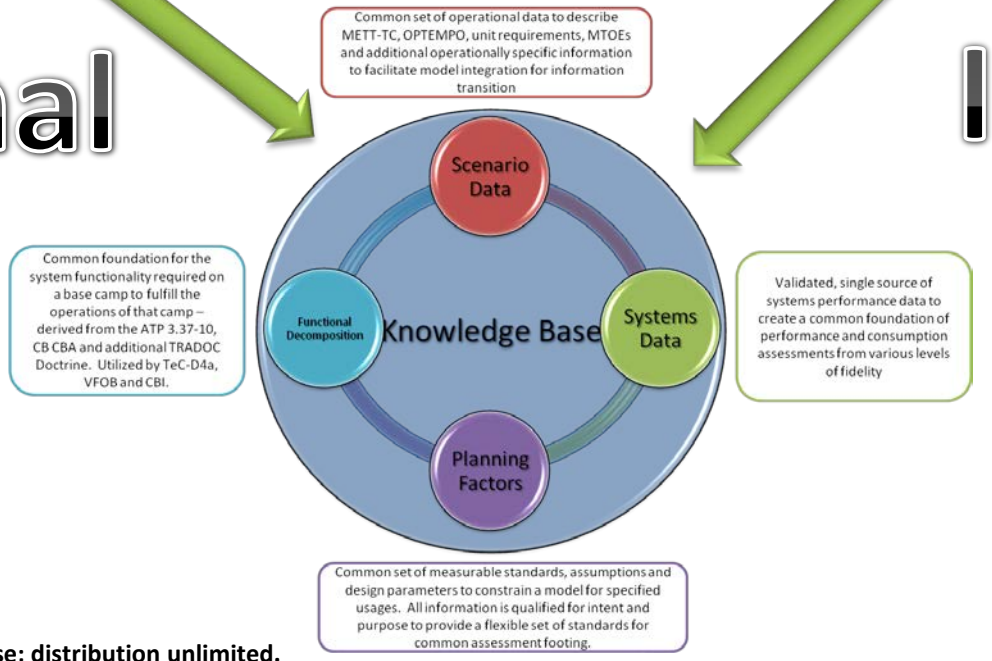
External

SoSAT

WSTAT

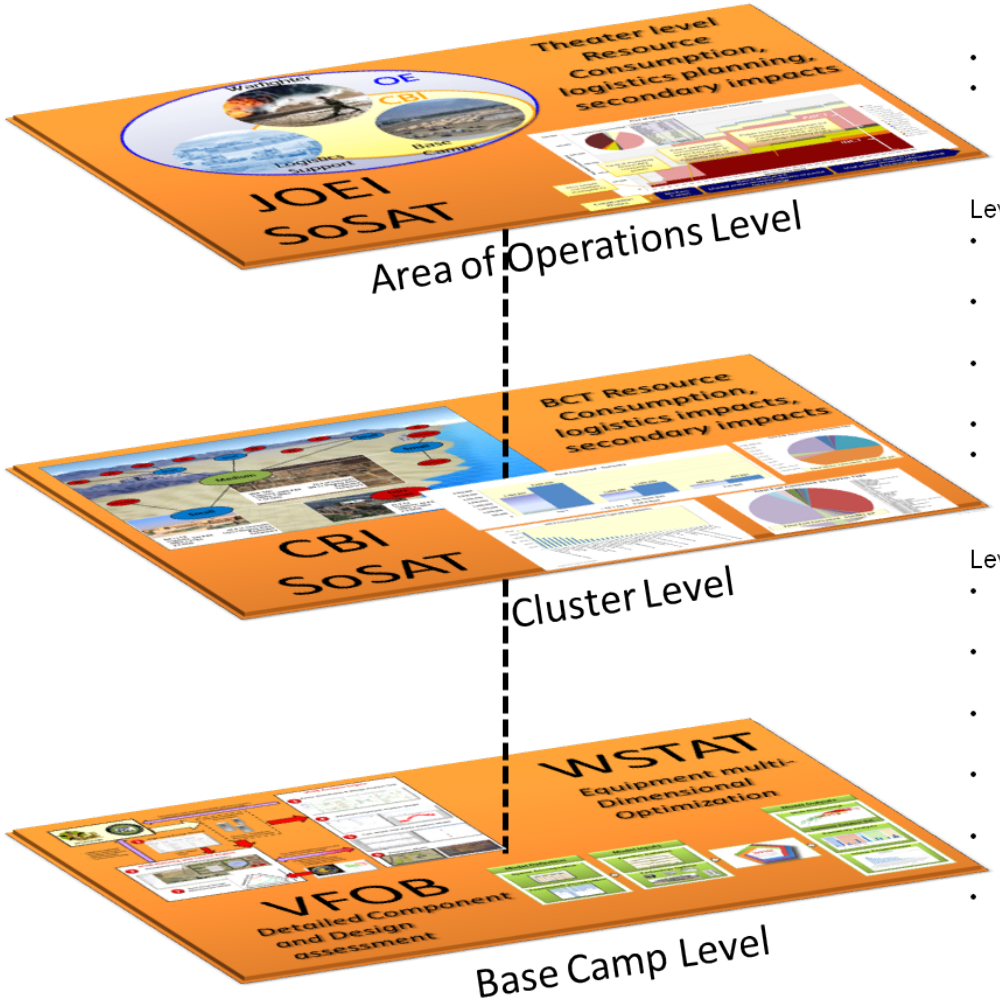
CBI WSTA Mini-Model

Internal



Base Camp Analytical Layers

Integration of the capabilities: VFOB/CBI/JOEI -- build up of capability from detailed component analysis and design (VFOB), thru base camp consumption/Base Camp Clusters (CBI), thru theater level analysis identifying logistics impact (JOEI).



Leverage for:
- Assessment of vehicle or basing technology impacts on logistics planning
- Informing investment decisions from technology implementation based on echelons above brigade analysis
- Assessment of configuration decisions on usage rates
- Interdependencies between systems, both on and off camps, to identify secondary and tertiary effects impacting overall mission effectiveness

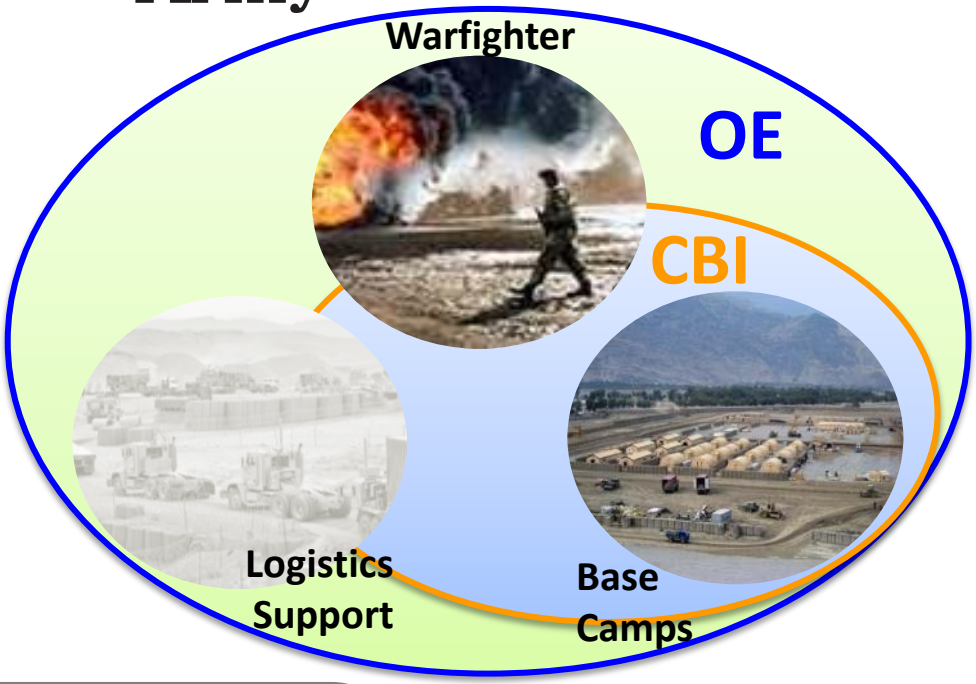
Leverage for:
- Assessment of basing technology impacts on logistics planning
- Informing investment decisions from technology implementation
- Assessment DOTMLPF decisions on resource consumption
- Assessment of configuration decisions on usage rates
- Interdependencies within and between camps to identify secondary and tertiary effects – ie reliability, people, consumption etc.

Leverage for:
- Assessment of technology impacts on base camp operations
- Detailed analysis of systems and subsystems to inform technology decisions – sensitivity analysis
- Optimization of equipment for specified parameters – ie size, location, BCT
- Informing investment decisions through technology implementation within a camp
- Assessment of design effectiveness for planning a base camp
- Analysis of interconnections of systems within a base camp

Contingency Base Infrastructure/ Operational Energy Analytics Supporting Army

Objectives

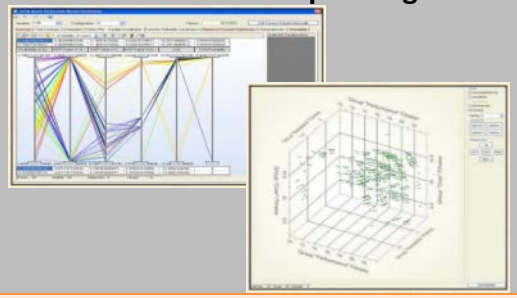
- Provide M&S support to demonstrate effectiveness and value of applying systems engineering fundamentals to life cycle management of base camps
- Provide system of systems (SoS) modeling capability to assess Base Camp performance
  - Base camp system functional performance
  - Energy (power), water, and fuel usage
  - Energy, water, and waste production
- Evaluate proposed technology solutions for impacts on Base Camp sustainment metrics
- For Joint Operational Energy Initiative (JOEI), expand analysis to cover Area of Operations (AO)



SoSAT Operational Analysis

Evaluates operational performance of Base Camp configurations (CBI) and for overall Area of Operations (OE)

WSTAT Multi-Objective Optimization of Base Camp Configurations



Evaluates designs and provides set of optimal Base Camp configurations per functional objectives and cost (CBI)

Multidisciplinary Team of Collaborators

- OSD ASD (OEPP)
- Army IE&E
- G4 / LIA
- USMC Expeditionary Energy Office
- ATEC
- TARDEC
- AMSAA
- Engineer School
- MCOE / SCOE
- CASCOM
- ARCIC
- TRAC-Lee, TRAC-FLVN
- RDECOM M&S WG
- ACE CERL
- RDECOM (Tech Demo)
- NSRDEC
- ARDEC
- Sandia National Laboratories
- Booz, Allen, Hamilton

Discussion