



AFRL Capabilities for SBA

DPAAS SBA Conference

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AFRL/XP



Overview

- **AFRL Introduction**
- **Description of Capabilities**
- **The Next Step**
- **Summary**



Our Vision and Mission

AIR FORCE MISSION

***TO DEFEND THE UNITED STATES THROUGH CONTROL
AND EXPLOITATION OF AIR AND SPACE***

AIR FORCE RESEARCH LABORATORY MISSION

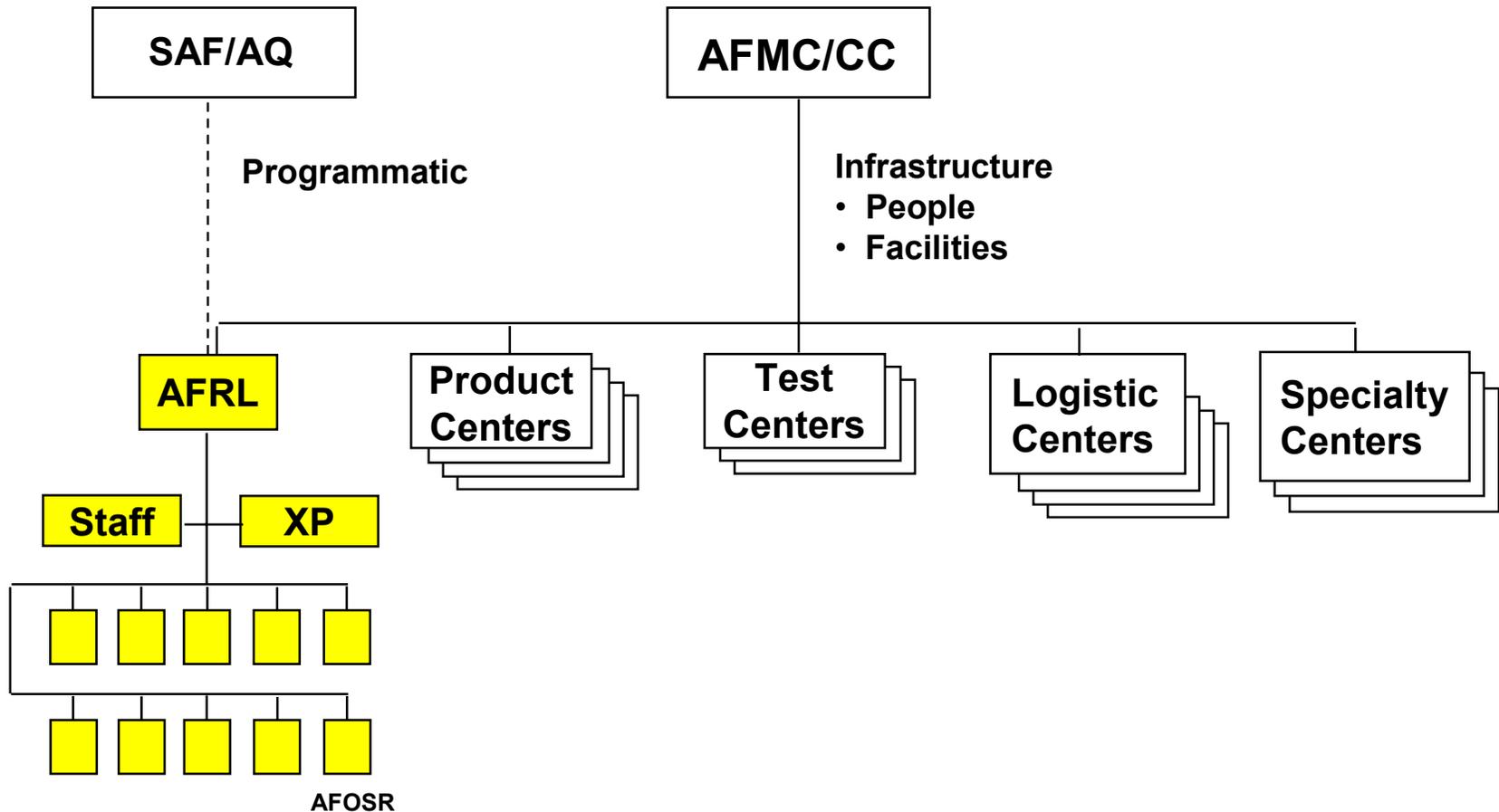
***TO LEAD THE DISCOVERY, DEVELOPMENT, AND INTEGRATION OF AFFORDABLE
WARFIGHTING TECHNOLOGIES THAT MULTIPLY THE COMBAT EFFECTIVENESS
OF OUR AEROSPACE FORCES***

THE AIR FORCE RESEARCH LABORATORY...

***AIR FORCE, INDUSTRY, AND UNIVERSITY PEOPLE
WORKING TOGETHER TO KEEP OUR AIR FORCE
THE BEST IN THE WORLD***



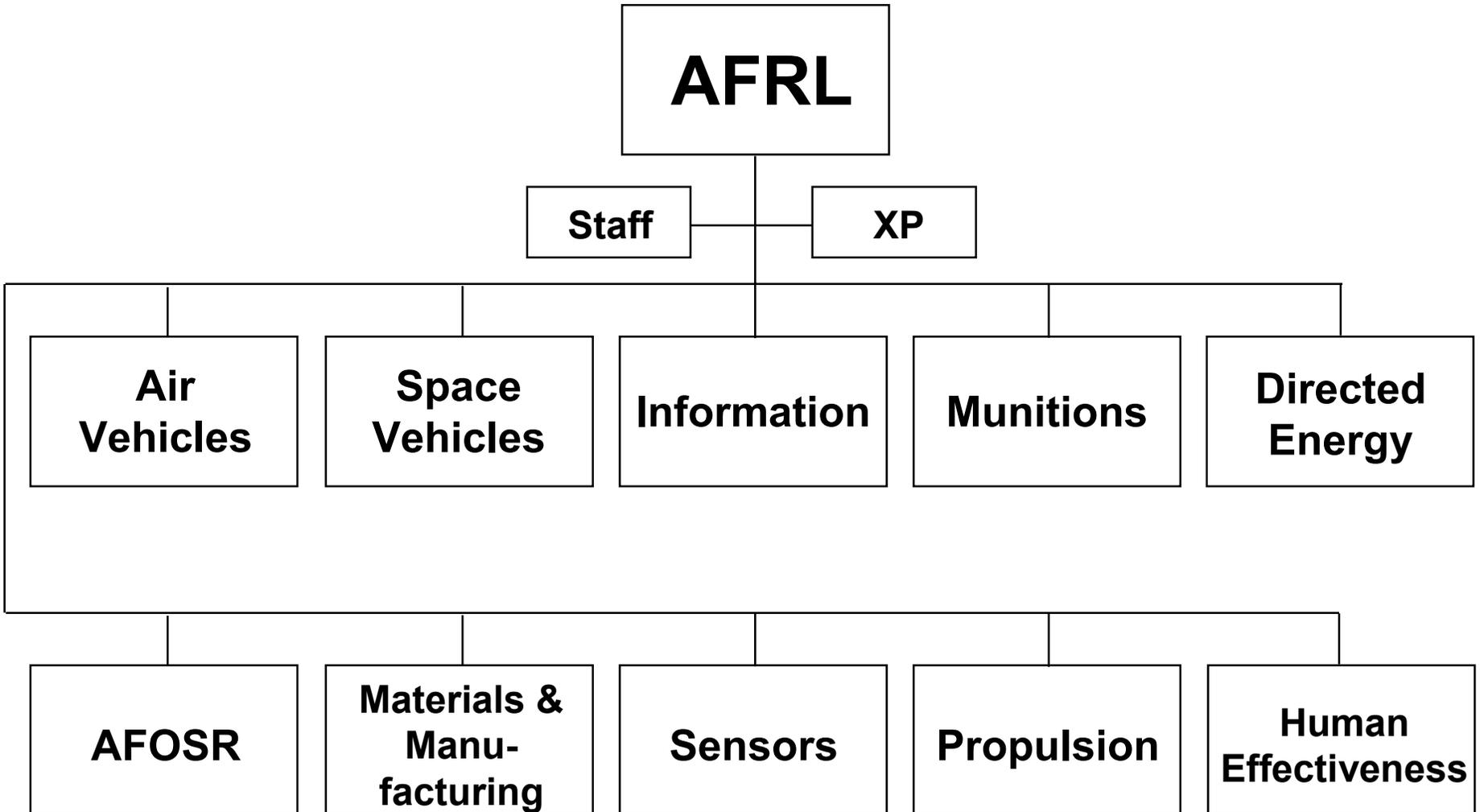
Air Force Research Laboratory



*AFRL/CC is dual-hatted as TEO reporting to SAF/AQ

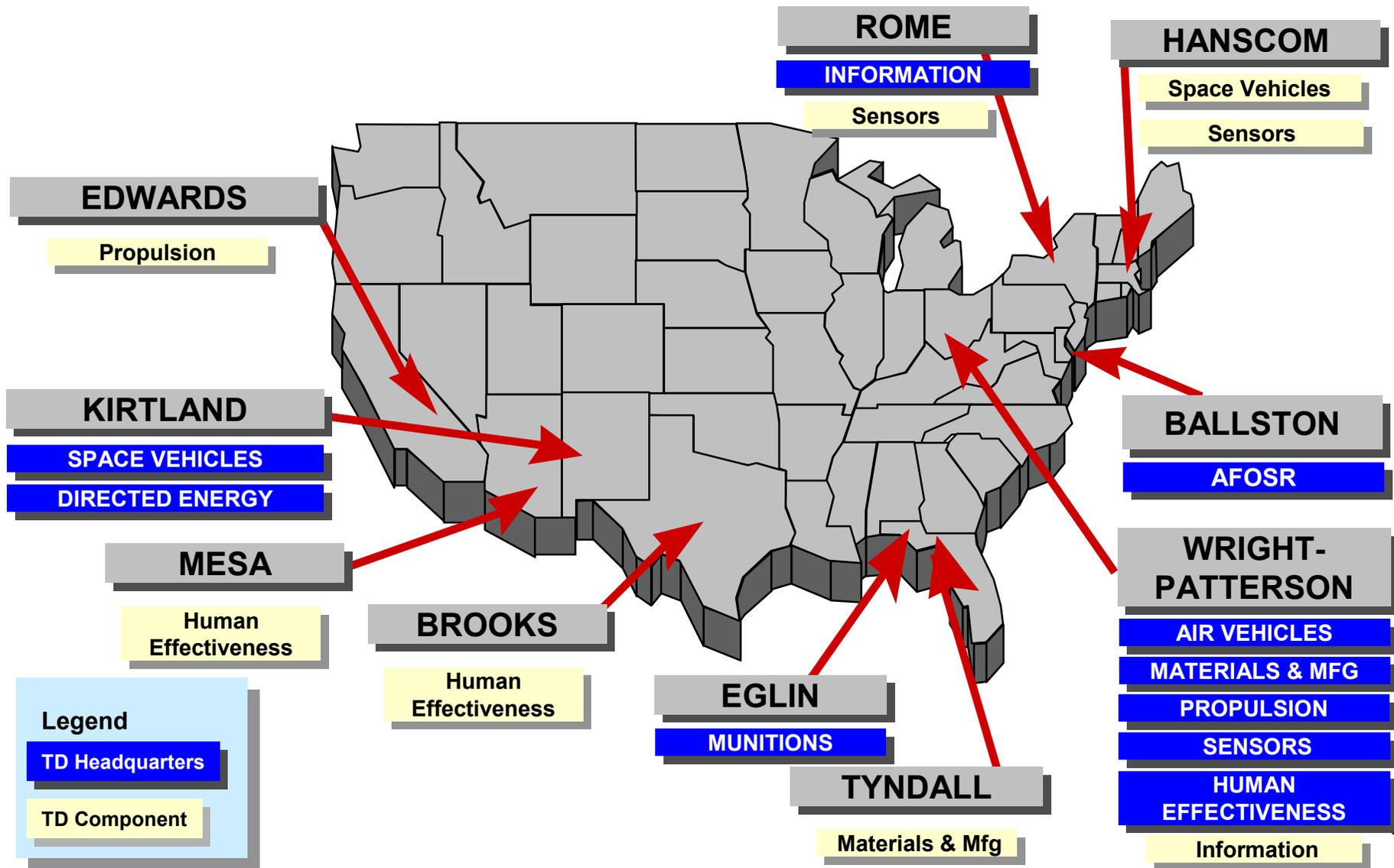


AFRL Technology Directorates





AFRL Locations: SBA a Must!





SBA Capabilities

- **AFRL is a representative microcosm of the Air Force, with strong MS&A emphasis in**
 - **Mission Capabilities**
 - Space
 - Air
 - Weapons
 - Information and Sensor
 - Human Effects
 - **Affordability**
 - Institutionalizing Producibility and Cost Analysis through Integrated Product and Process Development (IPPD)
 - **Collaborative Information Environments**
 - Leading the Air Force in the development of an engineering Collaborative Enterprise Environment (CEE)



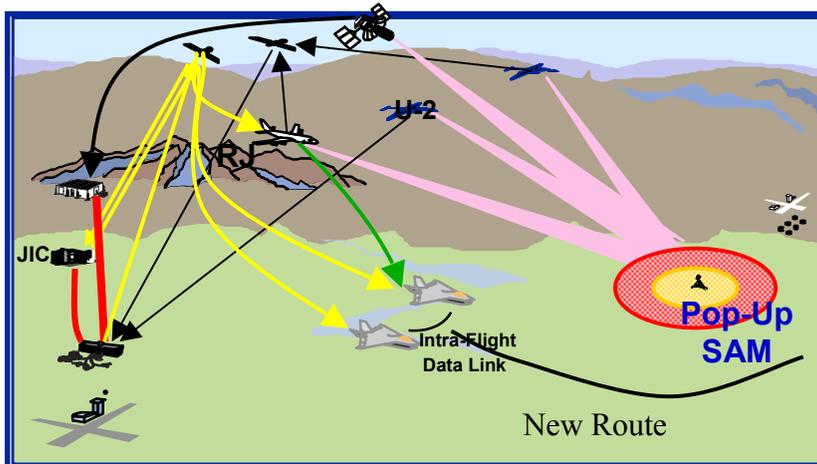
Space Capabilities

- **Spacecraft Simulation Toolkit (SST)**
 - Flexible, visual-programming-based environment for building and exercising simulations; DIS compatible, soon to be HLA compliant
 - Being used for tech trades, systems engineering, analysis, and exercises including the following:
 - Space-Based Radar (SBR) simulation: Models AMTI and GMTI functions
 - Hyperspectral simulation (HYSIM): Modeling of dispersed element sensors, high/low resolution scenes, and platform effects
 - Large, deployable space optics: Simulation to support long dwell, global coverage systems development
- **Space environments and weather effects simulation**
 - Atmospheric Effects Server (AES); affected target acquisition distances and TBM engagement timelines in Weather Wargames
 - PLEXUS: user friendly interface to space environments models
- **Advanced Space Vehicle, Propulsion, and Power**



Air Capabilities

- Advanced Propulsion and Power
- Computational Fluid Dynamics and Electro Magnetics
- Multidisciplinary Technology Assessment
 - Eliminating technology conflicts
 - Define synergistic combinations
- Operator-in-the-Loop Simulations
 - Technology Assessment, System Requirements Definition, and Performance Optimization Studies at the Engagement and Mission Levels
 - System of Systems Testing





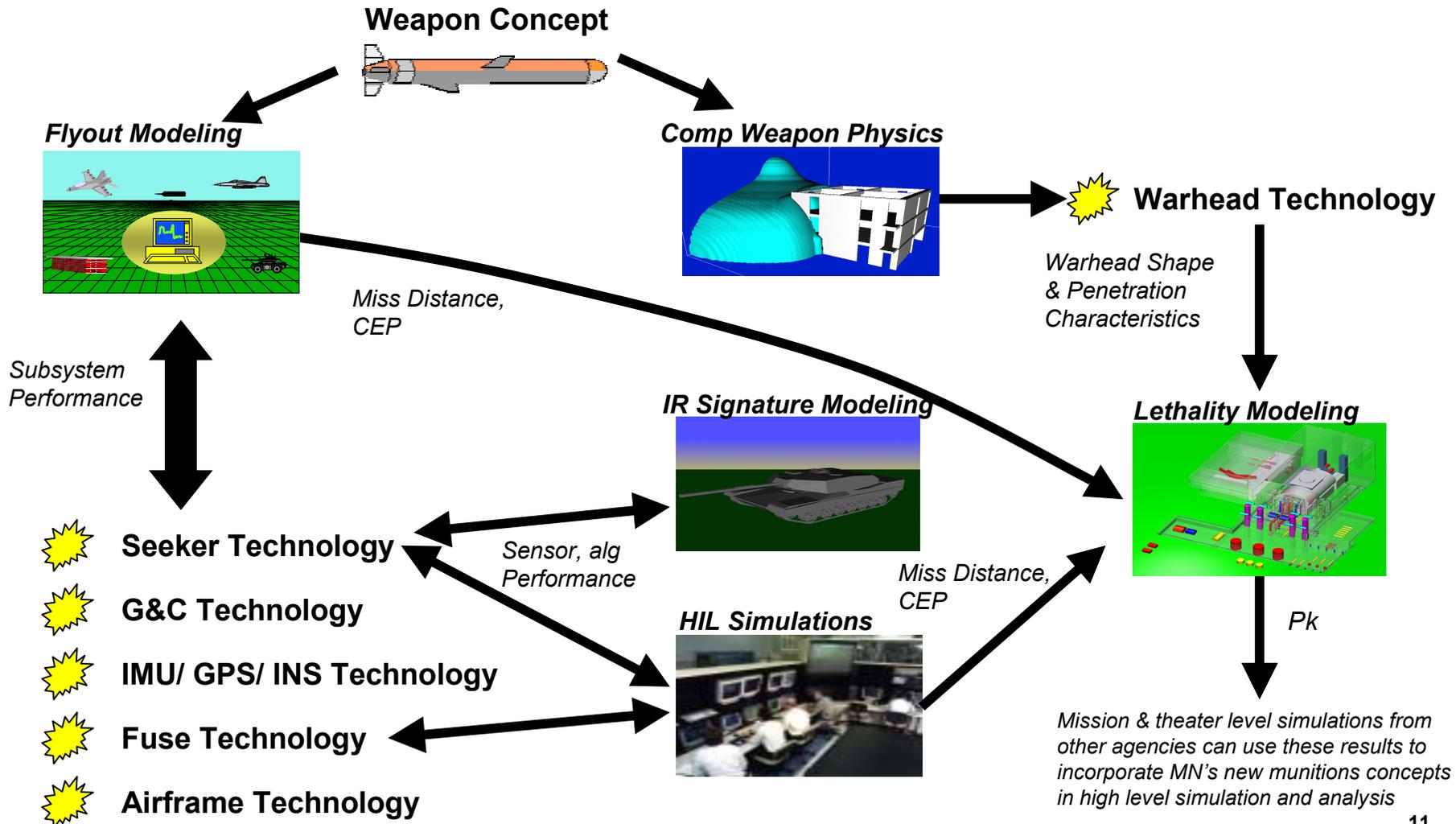
Human Effects Capabilities



- **Human-in-loop simulations**
 - Cockpit Design (single and multiple seat)
 - Console design (UAV, C2)
 - Training, including DMT
 - Tactics development/evaluation
- **Workload modeling**
- **Analytic models**
 - Chemical/biological dispersion analysis
 - Energy absorption (humans & buildings)
- **Integrative architectures for modeling cognition**
 - Human behavior representation
 - Intelligent agents



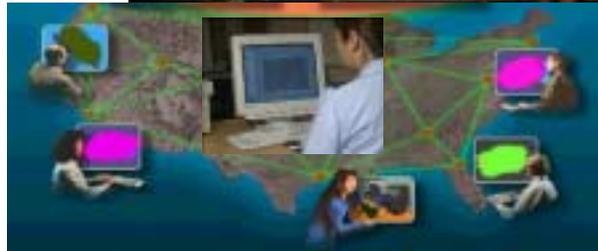
Weapons Capabilities





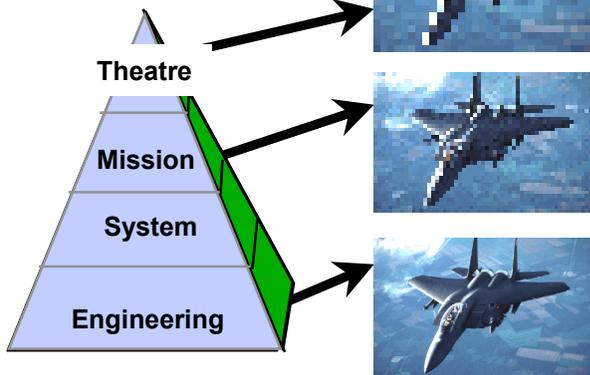
Information Capabilities

Collaboration & Simulation



- **Collaborative Enterprise Environment**
 - Product & Process Modeling
 - Workflow
 - Agent-based Architecture
 - Web Viewers
 - Domain Models
 - Data bases
- **Model Abstraction Technologies**
 - Essence of detailed phenomenological models
 - Appropriate form for mixed resolution simulations
- **Advanced Visualization**
 - JVIEW: platform-independent JAVA-based tool
 - Visualization of “intangibles” (e.g., radar coverage, chemical clouds, weather, etc)
 - Accepts live feeds (e.g., radar hits, intel)
- **C4ISR Modeling**
 - Applications of Model Abstraction Techniques
 - Improvements in speedup and accuracy
 - Predictive C2, based on Evolutionary Computation
- **AFRL wide SBA Collaborative Environment Experiments**

Model Abstraction





Sensors Capabilities



- **Engineering level & Performance Modeling**

- EO/IR
- RF
- Components
- Targets
- Phenomenology
- Electromagnetics



- **Automatic Target Recognition Spiral Development**

- **Evaluation Science**

- **Integrated Applications and Demonstrations**

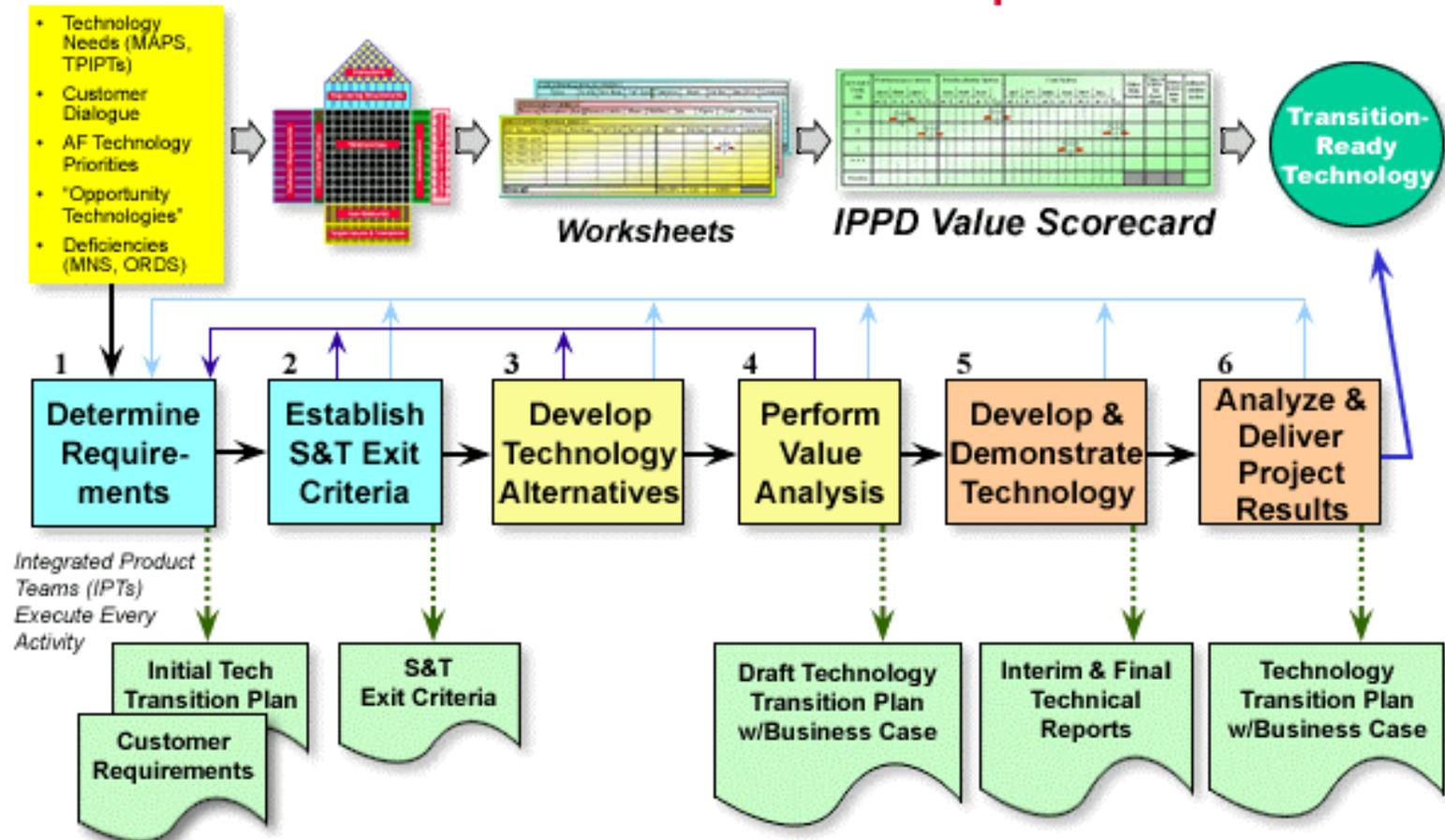


- **Joint SN & IF SBA Collaborative Environment Experiments**



Integrated Product and Process Development: Part of the AFRL Culture

S&T IPPD Process Model - Top Level



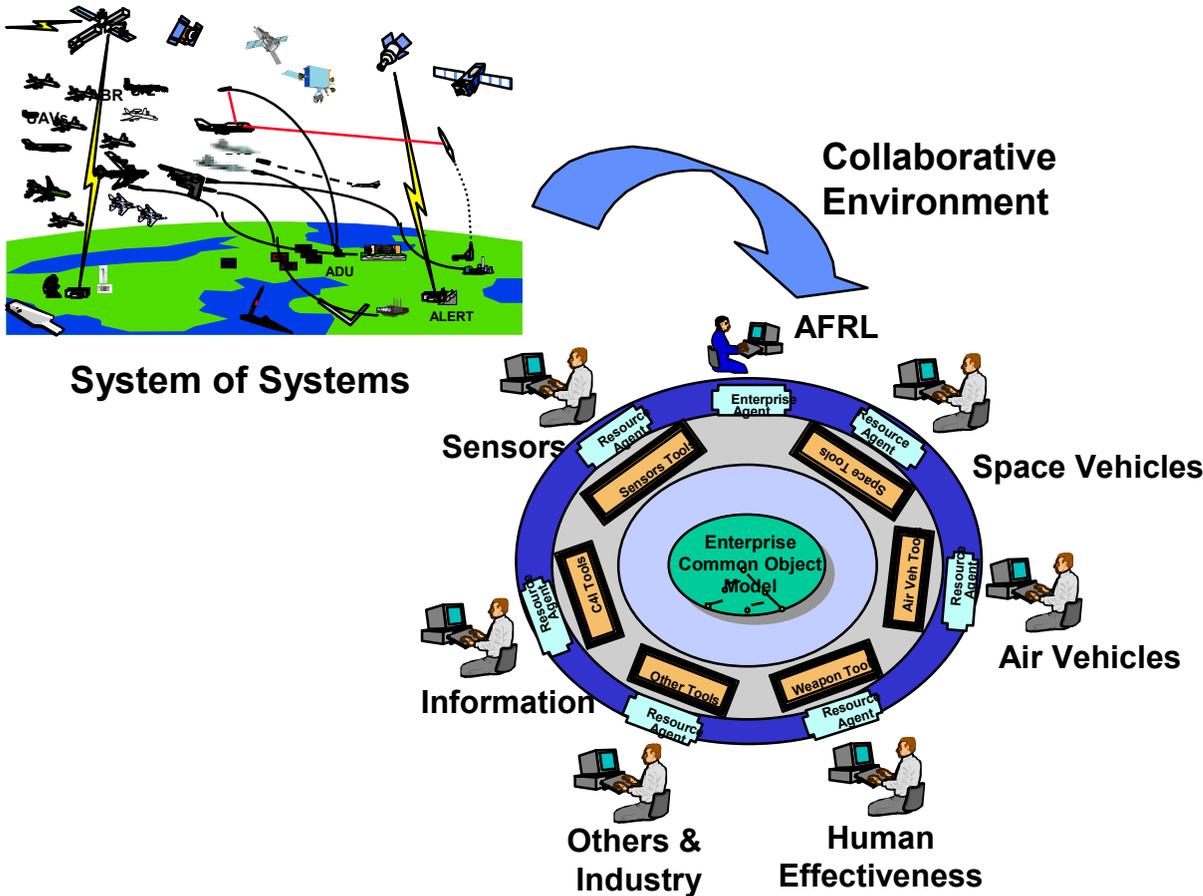


IPPD: Exporting the Culture

- **Product Affordability & Realization Testbed (PART)**
 - **Affordability analysis using Web enabled collaboration tools**
 - Requirements Capture/Analysis
 - S&T House of Quality
 - Desirability Analysis
 - Document Sharing/Management brainstorming, voting, action planning and tracking
 - Multi-variable optimization
 - Automated Value Scorecard
 - Decision Analysis
 - Designed Experiments
 - Online meetings, planning and tracking
 - **Cost Modeling and Estimation**
 - Using DOD/industry approved and accepted models
 - Emphasis on ease of access and use
 - ICE: *Integrated Desktop Analysis and Planning System Cost Estimation*
 - **Product Development Tools**
 - 3D product modeling
 - Assembly and ergonomic analysis
 - Discrete event simulation



Collaborative Enterprise Environment (CEE): Information Available to Influence Decisions



Requirements Definition

- Systems Architecture
- Integrated Sensors
- COTS Components

Technology Demos

- Architecture
- Critical Technology
- Cost Savings

Technical Integration

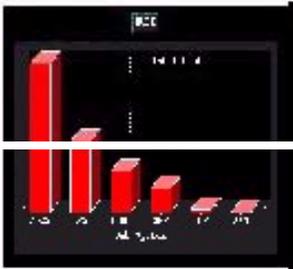
- Cost/Benefit Trades
- Virtual Systems Engineering
- Virtual Flight Test

Distributed, Virtual Integrated Process and Product Development, Demonstration, and Testing

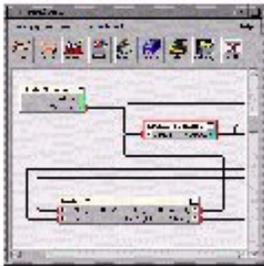


CEE Technology Description

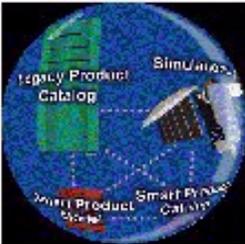
Cost Tools



Process Flow



Commercial Data Bases



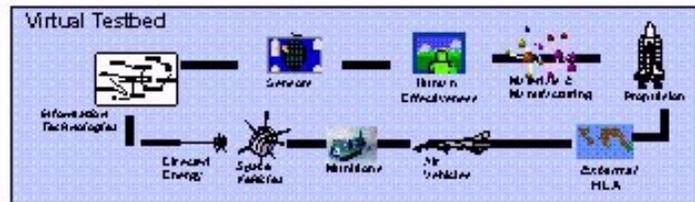
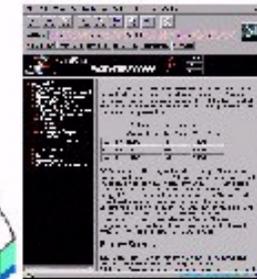
Collaborative Network



Three-Dimensional Visualization



Requirements Definition



Virtual Testbed

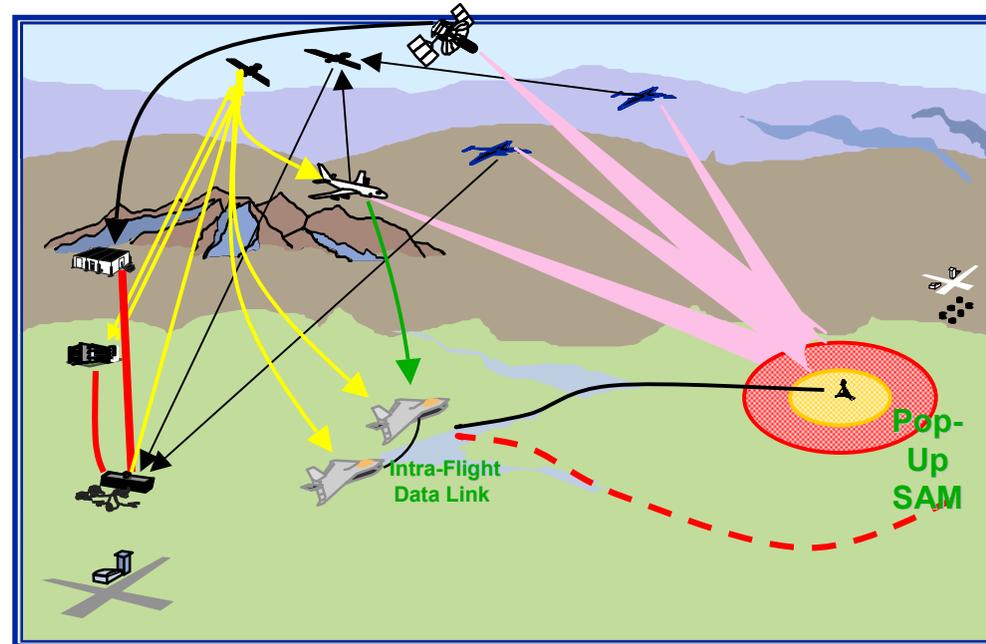
M&S Tools





The Next Step: Simulation-Based R&D

Use scenario-based operational simulations to evaluate the mission-level Measures of Effectiveness (MOE's) impacts for an applicable set of AFRL technologies in a system-of-systems context to support development of the S&T POM



Goal: Use Warfighter Utility in developing an integrated aerospace S&T investment strategy



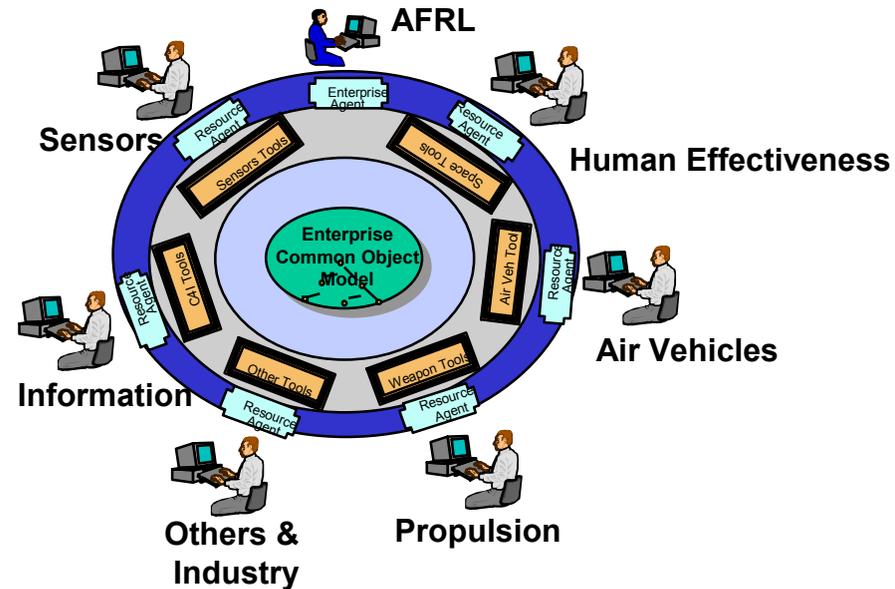
Simulation-Based R&D

- **Build on existing capability**

- VSWE
- SIMAF
- CEE
- GAVTB
- IPPD

- **Employ spiral development of process**

- Begin with limited scope: Technologies for an ISR UAV
- Encourage broad involvement: TD's, User, Product Centers, Industry
- Apply developed process and lessons learned in next cycle
- Grow to encompass all AFRL Integrated Technology Thrusts (ITT's) ¹⁹





Summary

- **AFRL is heavily involved in MS&A across the Air Force domains**
 - Mission Capabilities
 - Affordability
 - Collaborative Information Environments
- **Working enablers for SBA**
- **AFRL is looking ahead: Incorporate Simulation-Based R&D into technology business culture**