JOINT STRIKE FIGHTER
the next generation strike fighter

JSF Digital Product Data

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JSF Modeling Information Sources Action Team
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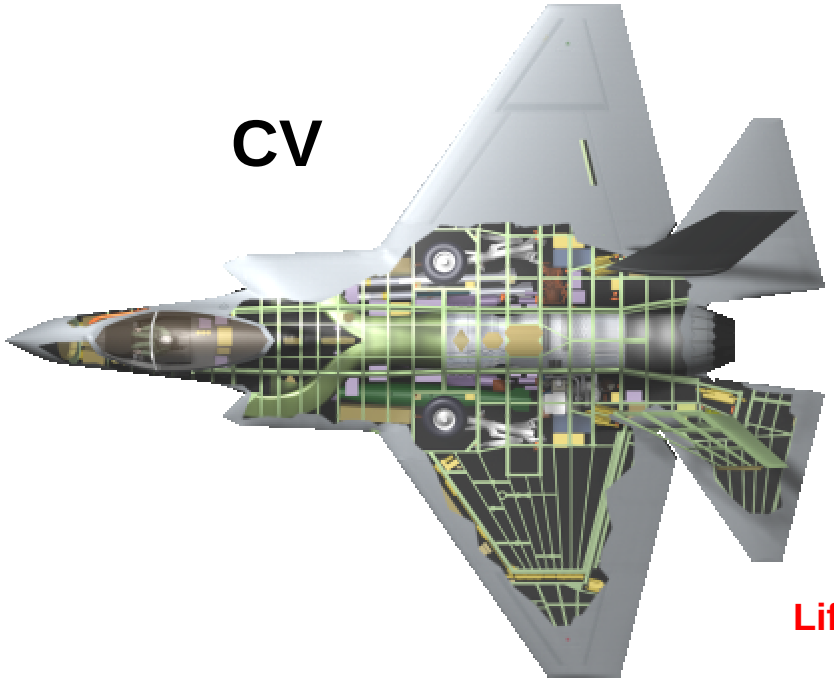
VISION

BE THE MODEL ACQUISITION PROGRAM FOR JOINT SERVICE AND INTERNATIONAL COOPERATION

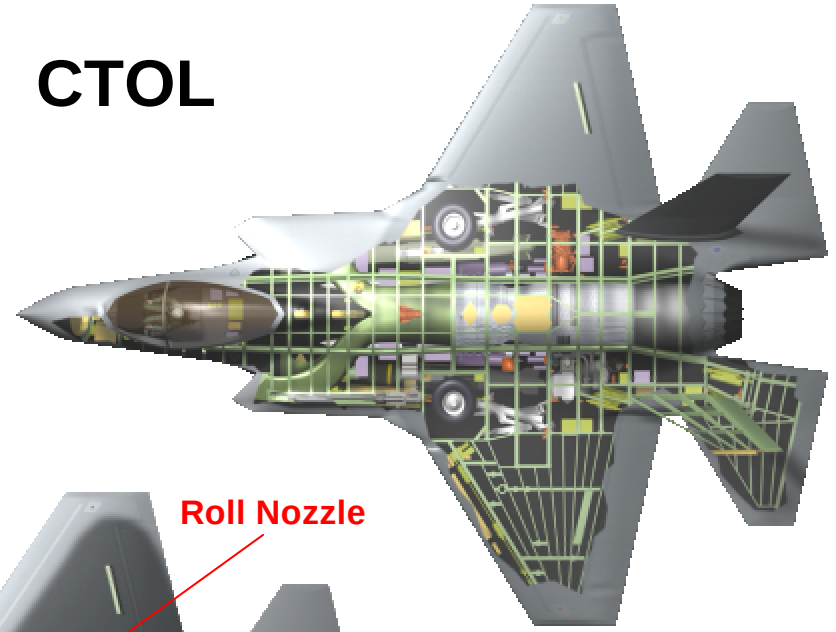
DEVELOP AND PRODUCE AN AFFORDABLE NEXT GENERATION STRIKE FIGHTER WEAPON SYSTEM AND SUSTAIN IT WORLDWIDE

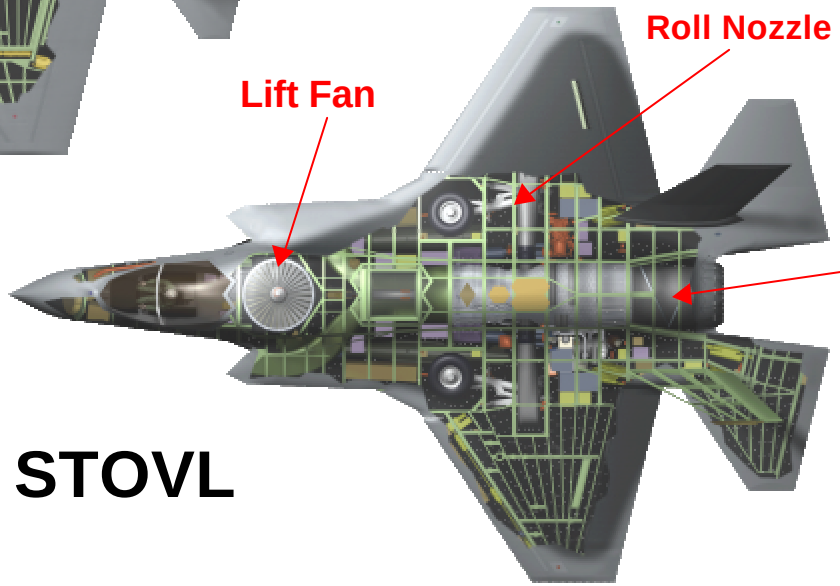
LOCKHEED MARTIN MULTI-SERVICE DESIGN

CV



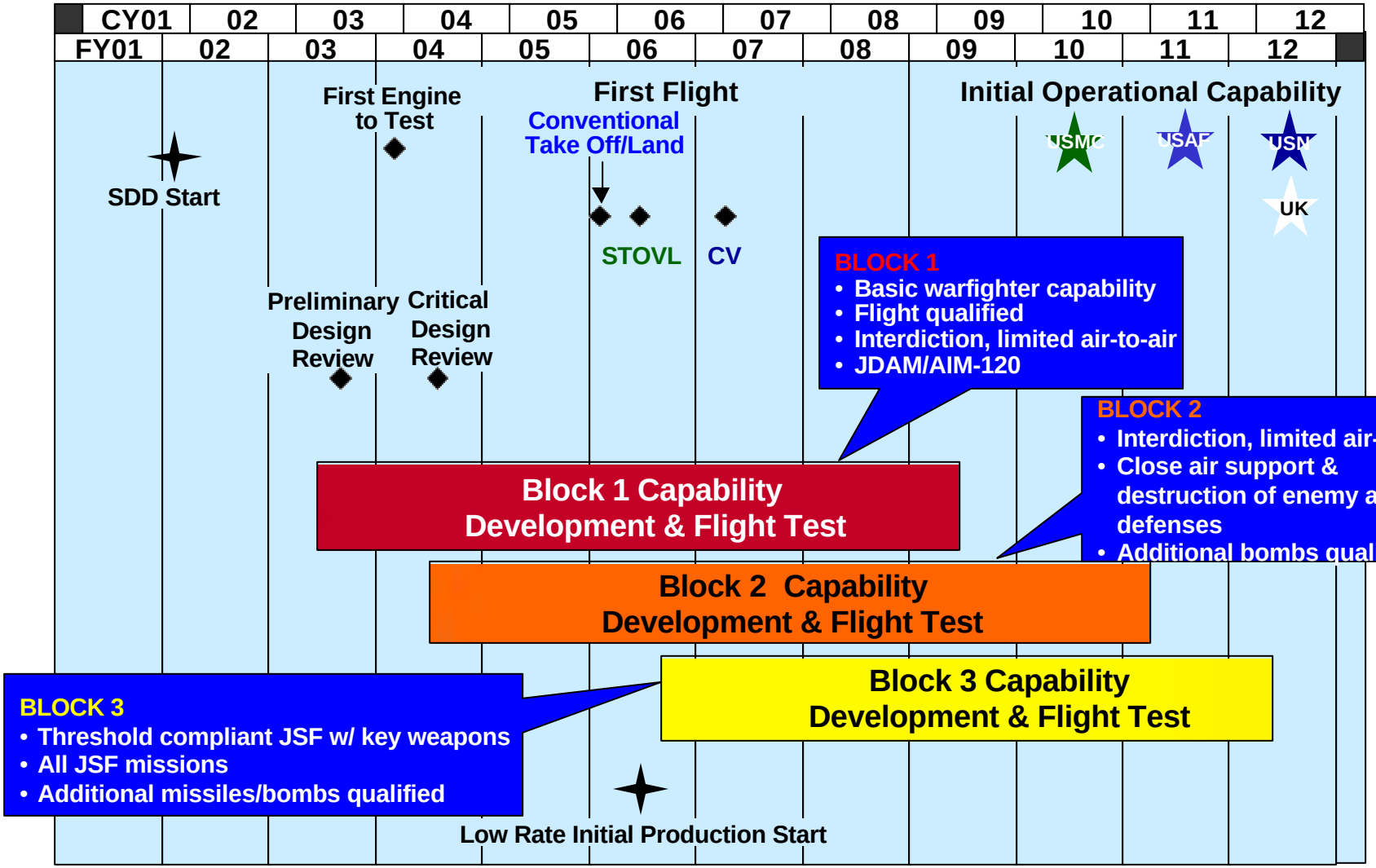
CTOL





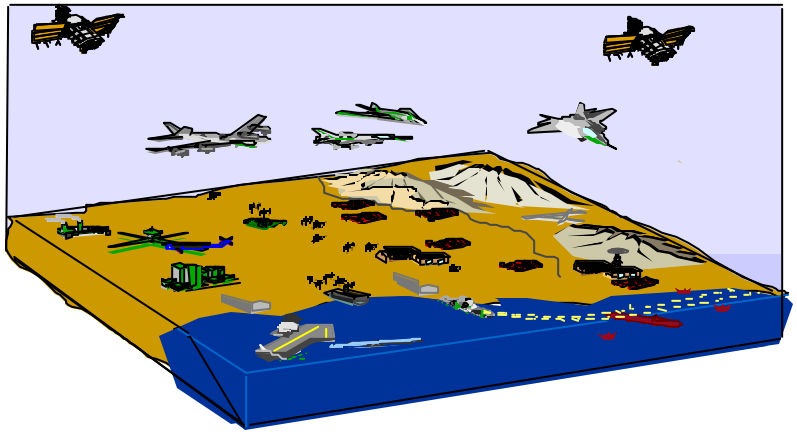
STOVL

SYSTEM DEVELOPMENT AND DEMONSTRATION (SDD) SCHEDULE



GOVERNMENT & INDUSTRY PARTNERSHIP

- **Lockheed Martin provides a Distributed Product Description (DPD) of the Joint Strike Fighter**
  - Includes all authoritative information needed to represent the JSF's operational performance, logistical characteristics, and cost
  - Spans the engineering, engagement, mission, and campaign levels
- **Government provides the simulation environment in which the DPD-based JSF will operate**
  - Threat systems, friendly systems, logistics resources and infrastructure, Blue & Red C4I, multi-spectral databases, terrain & atmosphere representations

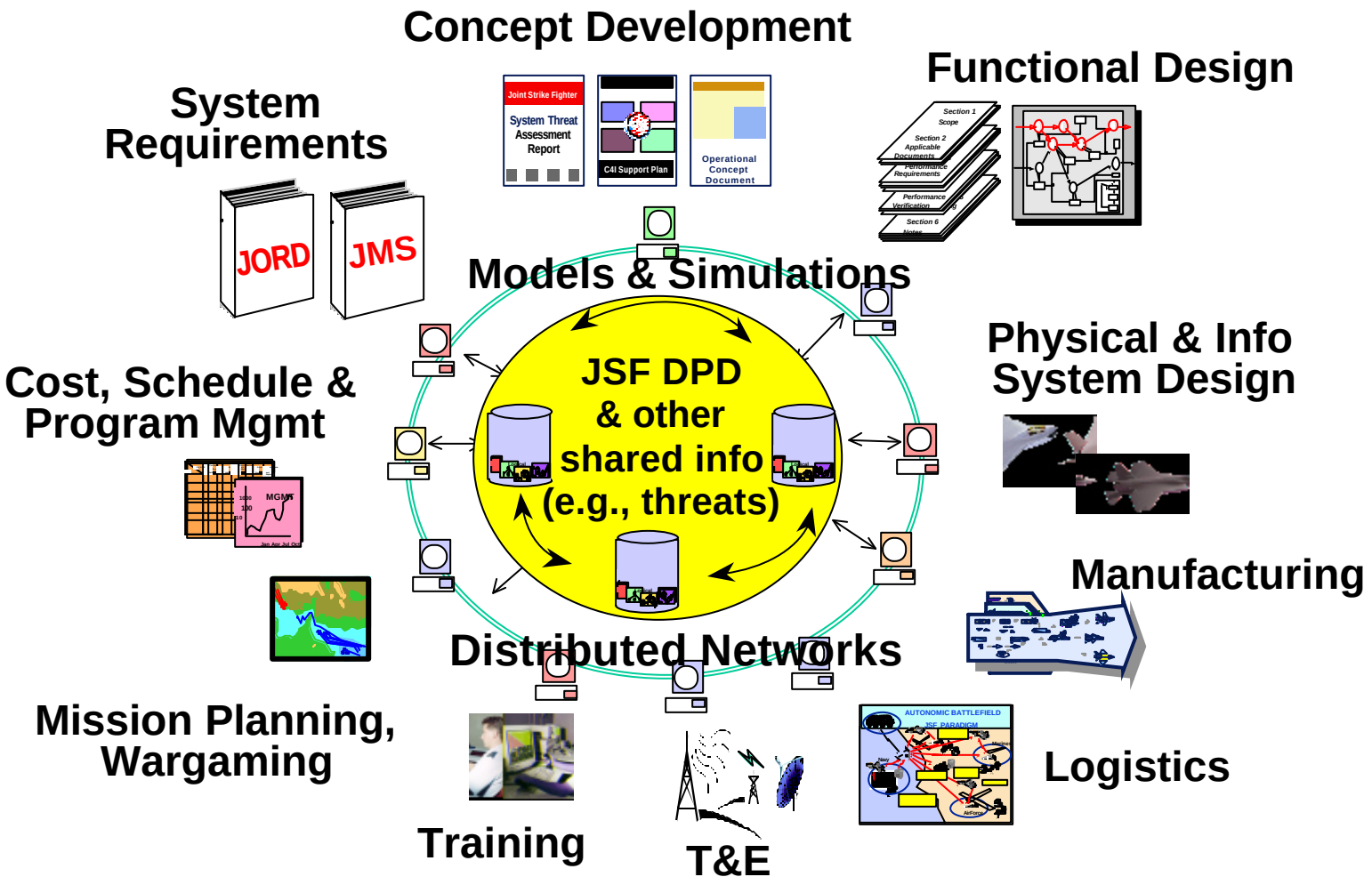


Government and Industry will form a closer M&S partnership than ever before!

Simulation Based Acquisition (SBA):

Shared Info is the Hub of IPPD

(JSF M&S Support Plan Fig. 5-3)

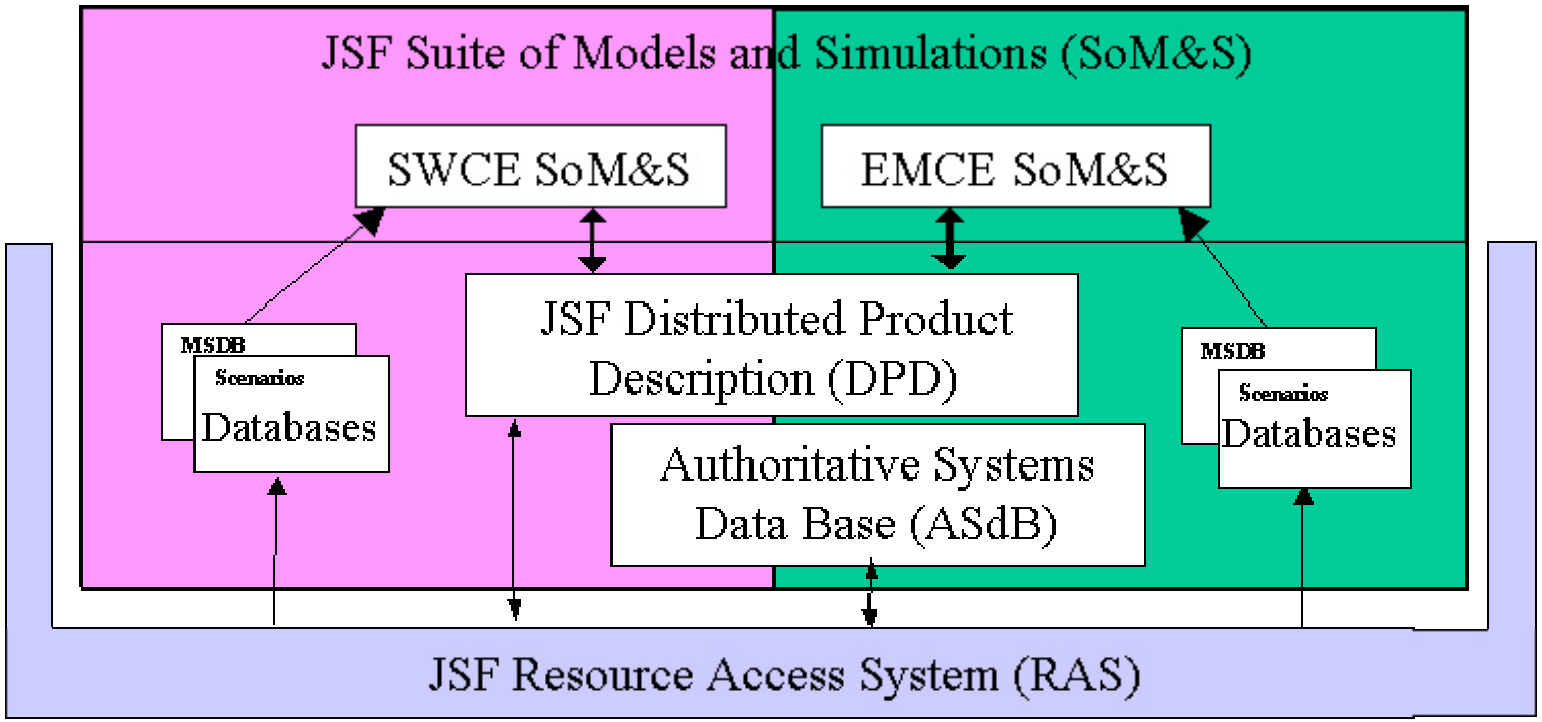


Components of the JSF M&S Toolset

(JSF M&S Support Plan Fig. 5-1)

Strike Warfare Collaborative Environment (SWCE) Toolset

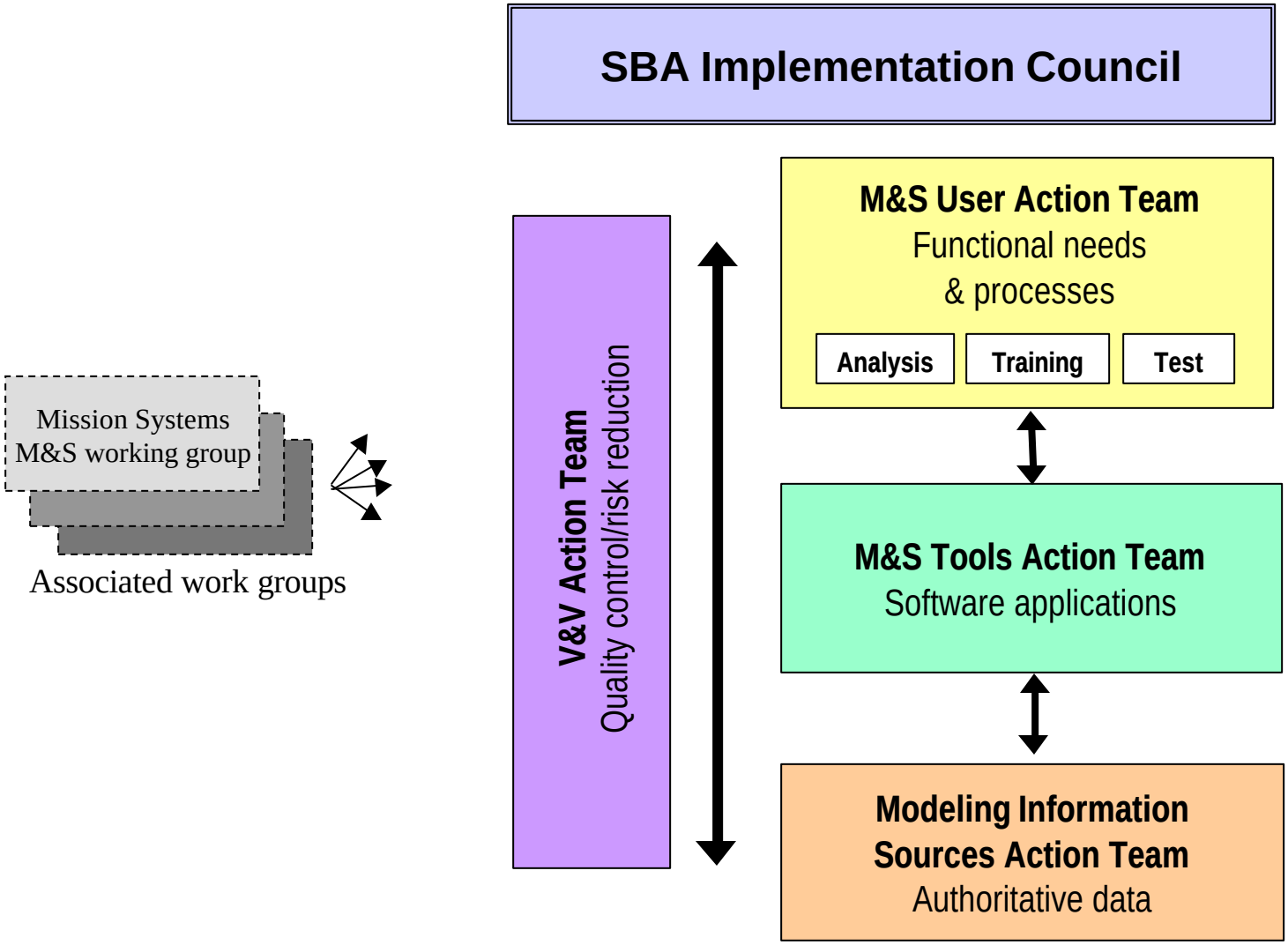
Engineering & Manufacturing Collaborative Environment (EMCE) Toolset



Consistent, Authoritative Information Sources Are Vital

- **To ensure M&S-derived answers are correct**
  - Establish validity by tracing analyses back to authoritative information
  - Verify JSF meets requirements
  - Reduce the confusion and bad analysis that arise if operating on wrong or logically inconsistent information
- **To conserve resources, improve efficiency**
  - Avoid having to repeatedly find, produce and/or translate the same information
  - Provide more timely analyses, resulting in shorter decision cycle times and more efficient systems engineering
  - Avoid the costs of correcting mistakes discovered late in program

JSF SBA Implementation Team

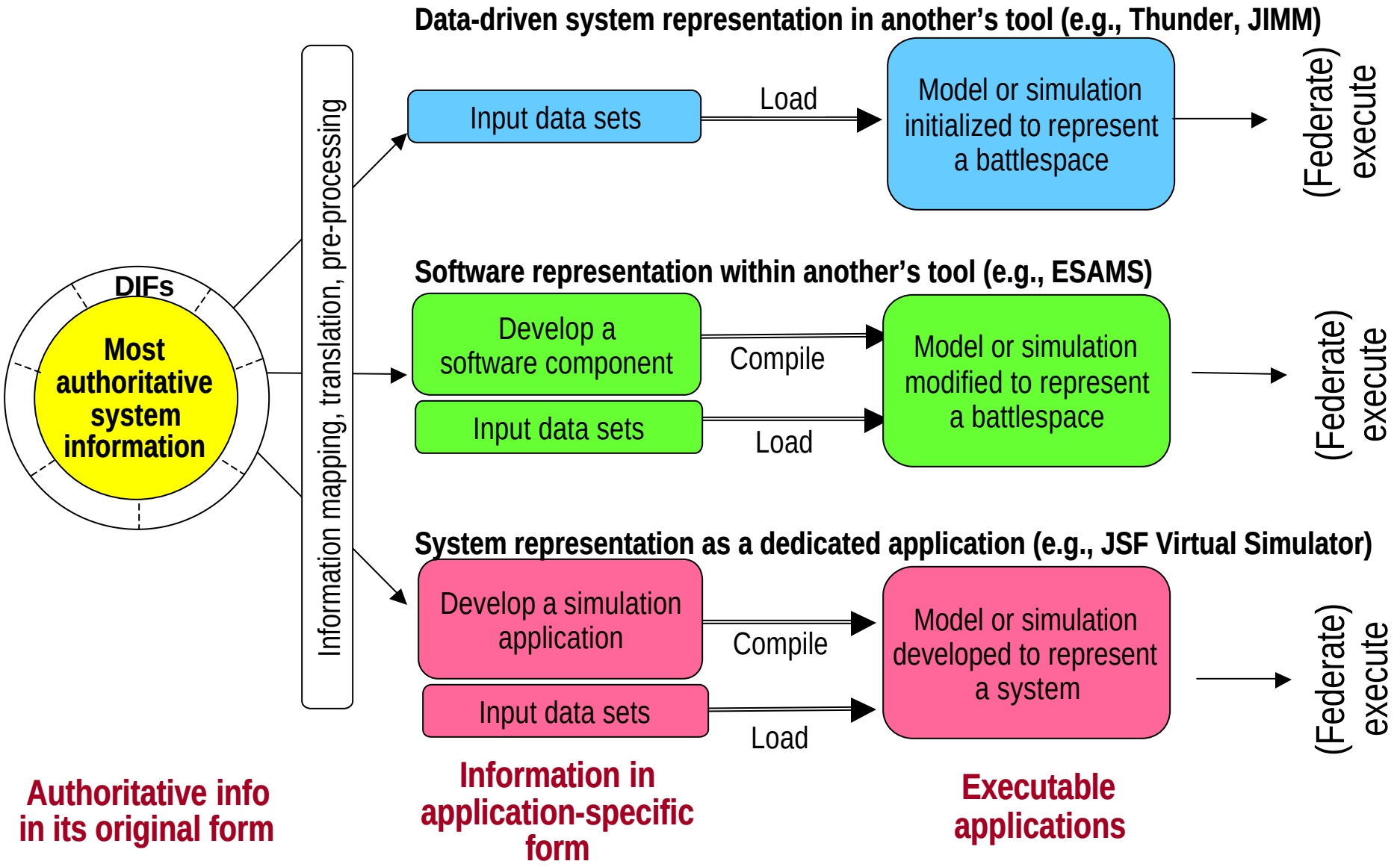


Modeling Information Sources Action Team Primary Deliverables

- **Electronic access to all information needed for representations in SWCE and EMCE tools**
- **Accompanying glossaries and metadata to convey information lineage and guide its use**
- **Training and technical support**

Paths to System Representations

(refinement of JSF MSSP Figure 5-5)



Information Types

- **Parametric data**
- **Algorithms**
- **Software code**
- **Publications**
- **Subject Matter Expert knowledge**

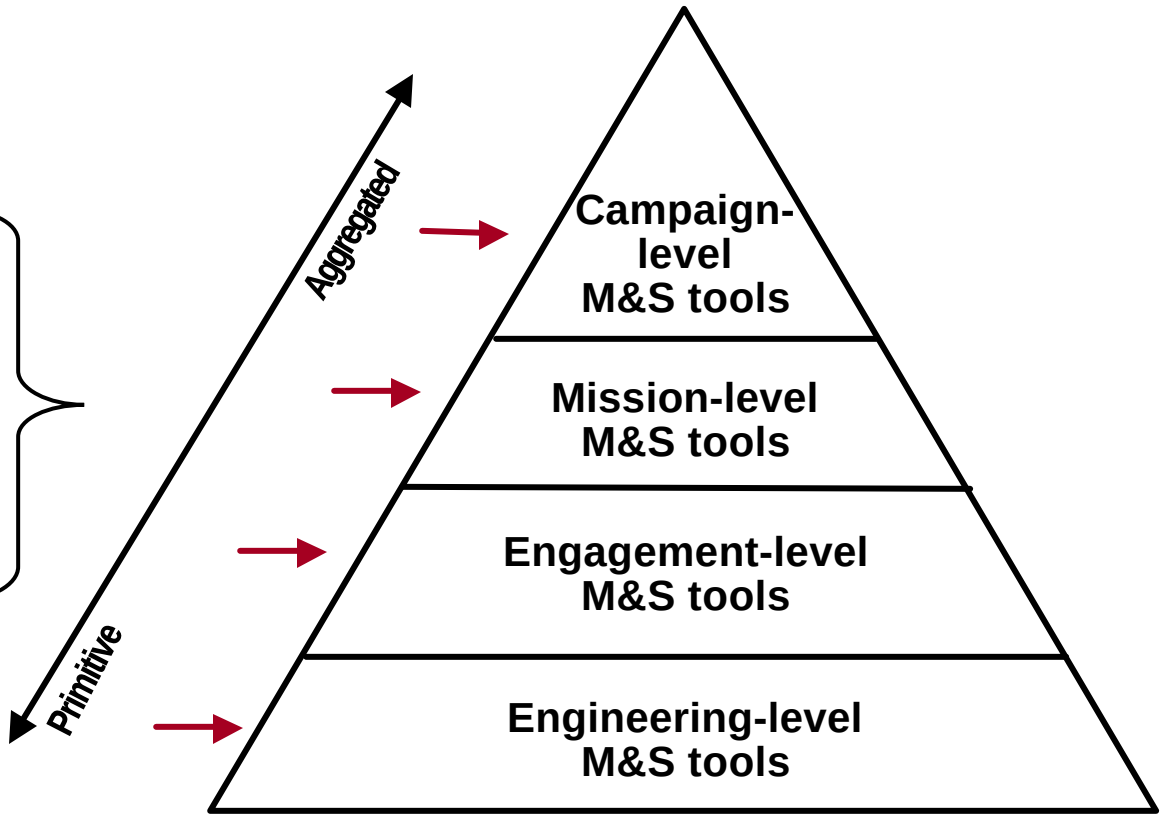
Initial focus has been on parametric data

Data Characterization

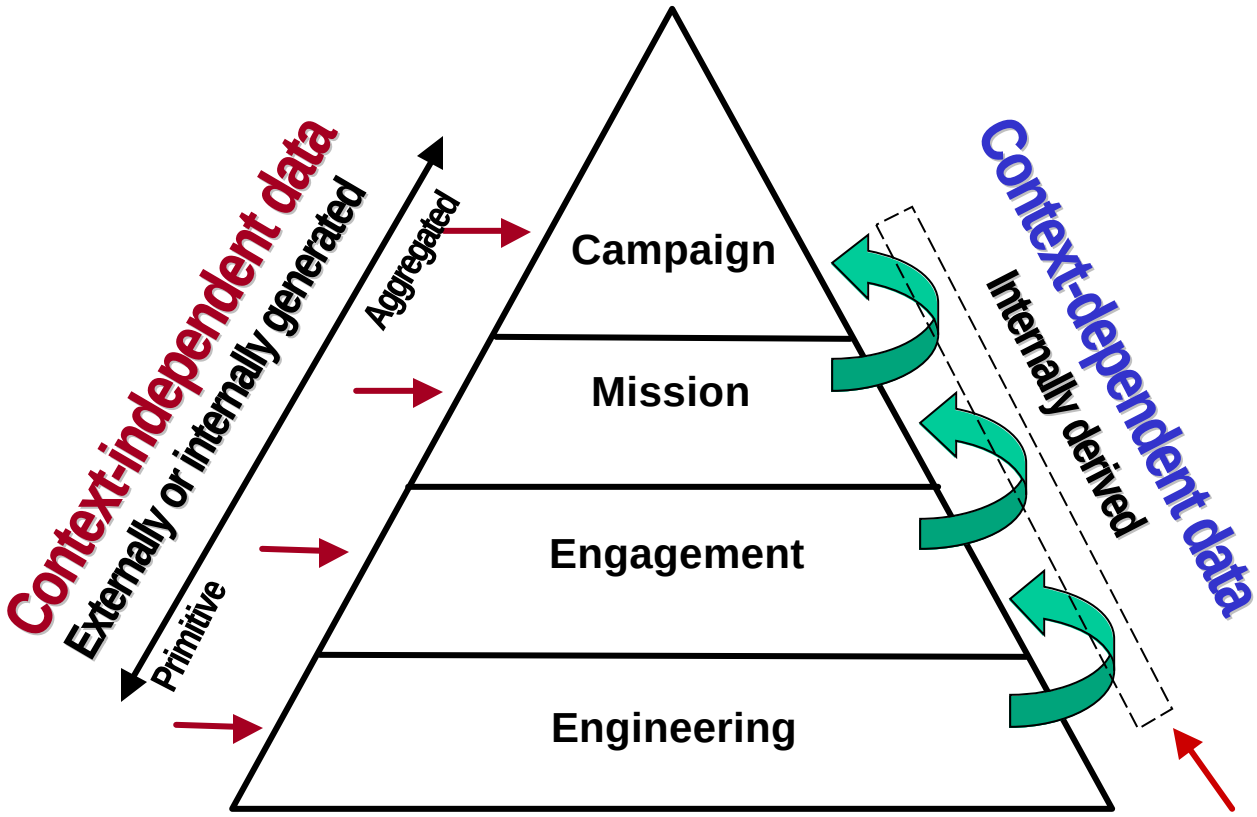
- **Regardless of its subject, data may be characterized by its:**
  - Trustworthiness: "authoritative" or "non-authoritative"
  - Evidence in the real world: "empirical" or "derived"
  - Context dependency: "context-independent" or "context-dependent"
  - Granularity: "primitive" or "aggregated"
  - Structure: "atomic" or "complex"
  - Source (relative to the enterprise): "external" or "internal"
- **Above characterizations are orthogonal**
  - A data element could be described by any combination

Simplistic View of Data Inputs

- JSF data sources
- Threat data sources
- Friendly data sources
- Natural environment data sources

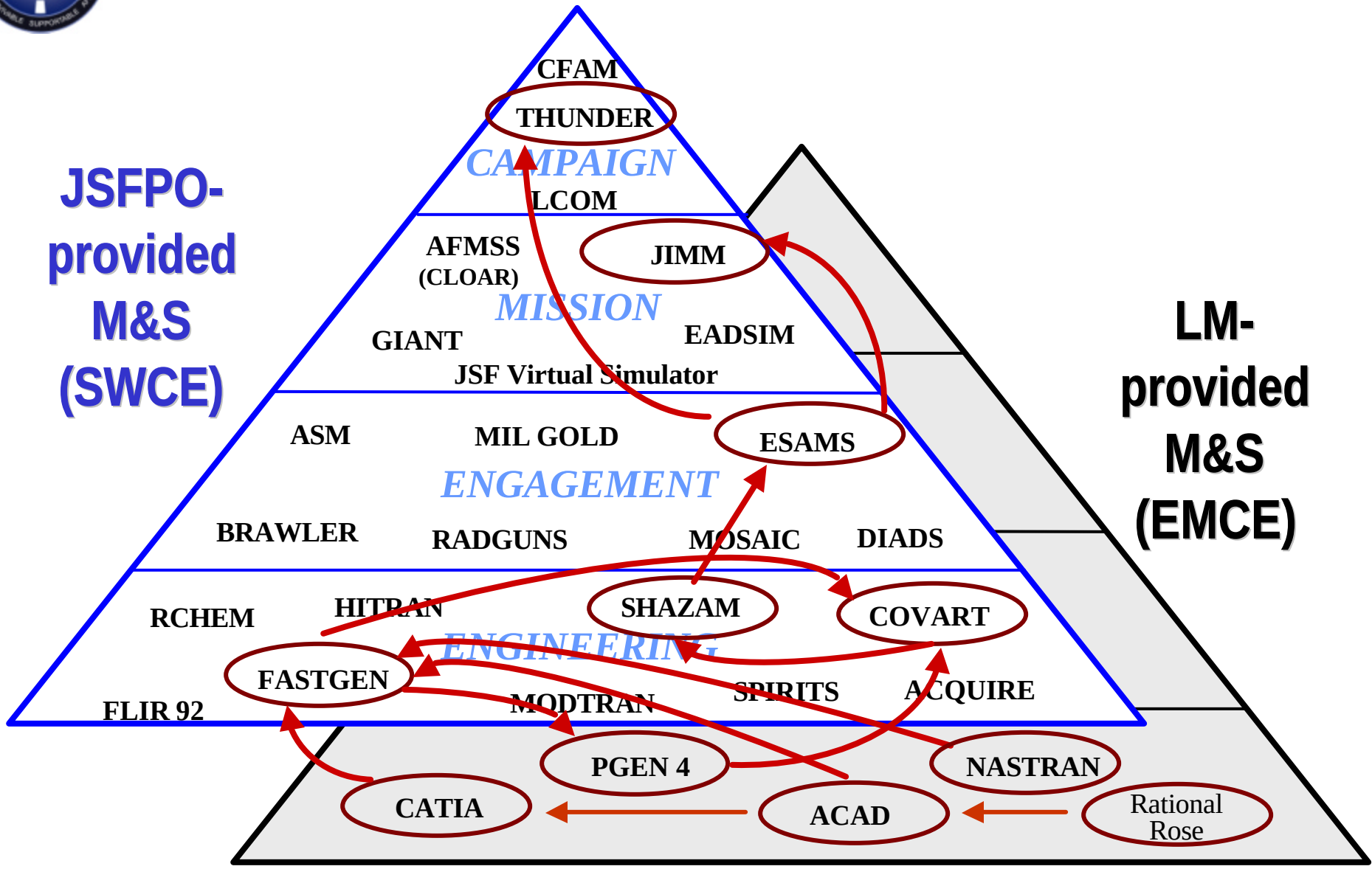


A More Complete Picture



Normally some preprocessing (e.g., smoothing, adjustment) as data is moved between tools

An Example Thread (simplified)

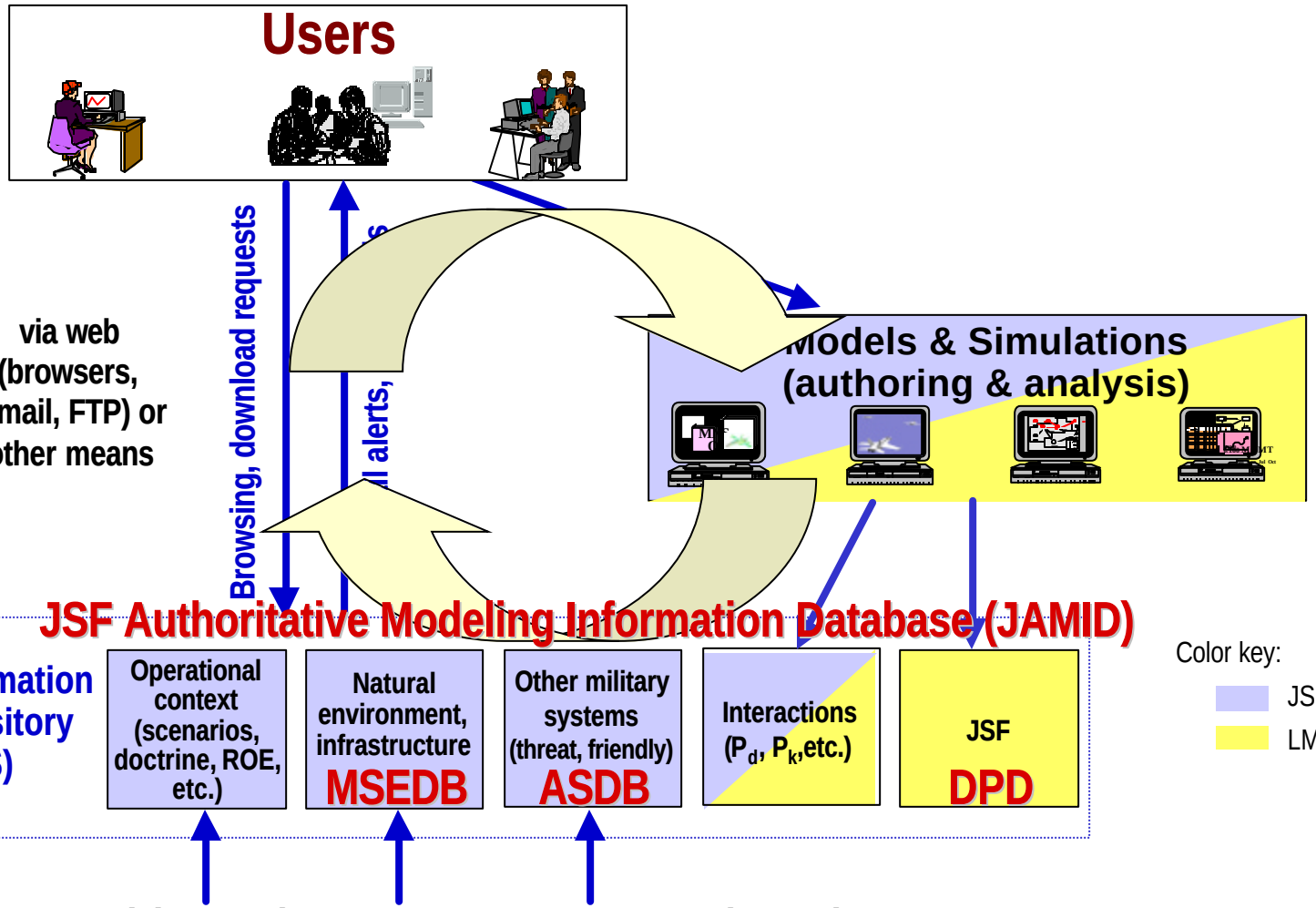


Implications

- **Much "authoritative data" will be internally generated**
  - and hence most subject to outside skepticism
- **LM and JSFPO must have a shared understanding of the analysis process and what organizations/tools will be regarded as the authoritative source**
  - requiring revisions to normal procedures

Information Flow

(Logical Depiction)



Operational Context DB Scope
(Enterprise-wide standards for analysis; in priority order)

- **Scenarios**
  - Road to war
  - Blue TPFD
  - Orders of battle (UOB, EOB, etc.)
  - Geographic area
  - Infrastructure targets, location
- **Mission Groups**
- **Missions**
- **Vignettes** *(created by JSFPO)*
- **Use Cases** *(created by JSF IPTs)*
  - Initiating inputs, required actions, MOPs
- **Natural environment conditions**
  - Time of day, weather
- **Concept of Operations (CONOPS)**
- **Force doctrine**
- **Tactics**
- **Rules of engagement (ROE)**
- **Firing doctrine**
- **Infrastructure lay down** (other than targets)

Not in Operational Context DB:

- Study-specific archives
  - Input data sets
  - Raw execution outputs
  - Discretionary analyst decisions
    - e.g., Blue mission routes
- System C&P data
  - Context independent
  - Context dependent (e.g., P_k)
- Natural environment instance data (MSEDB)
- Infrastructure C&P (MSEDB)

Modeling Information Life Cycle

JAMID v N+1 (developmental)

JAMID Version N (baseline)

JSF

Interactions (P_d, P_k, etc.)

Other military systems (threat, friendly)

Natural environment, infrastructure

Operational context

Study-specific archives

Translation services (mapping, semantics/syntax)

JAMID Repository (RAS)

JSF changes holding tank

Individual JSF design changes

Update cycle A
Trigger: New JSF baseline (batch update of JSF & all other instance data)

JSF control boards

Program Offices

Blue system C&P information

Intel Centers

Threat C&P information

NIMA, DTRA, NRO, etc.

Natural environment & infrastructure C&P information

JSFPO, JFCOM, DoD, etc.

Operational context information

Smoothed / analyzed results

Relevant information
(data in tool-specific form)

Analyst action

Design change MOMs

Raw M&S results

Study-specific input datasets & software code

Analysis tools
(e.g., models, simulations)

Update Cycle B
Trigger: SWCE/EMCE change decisions

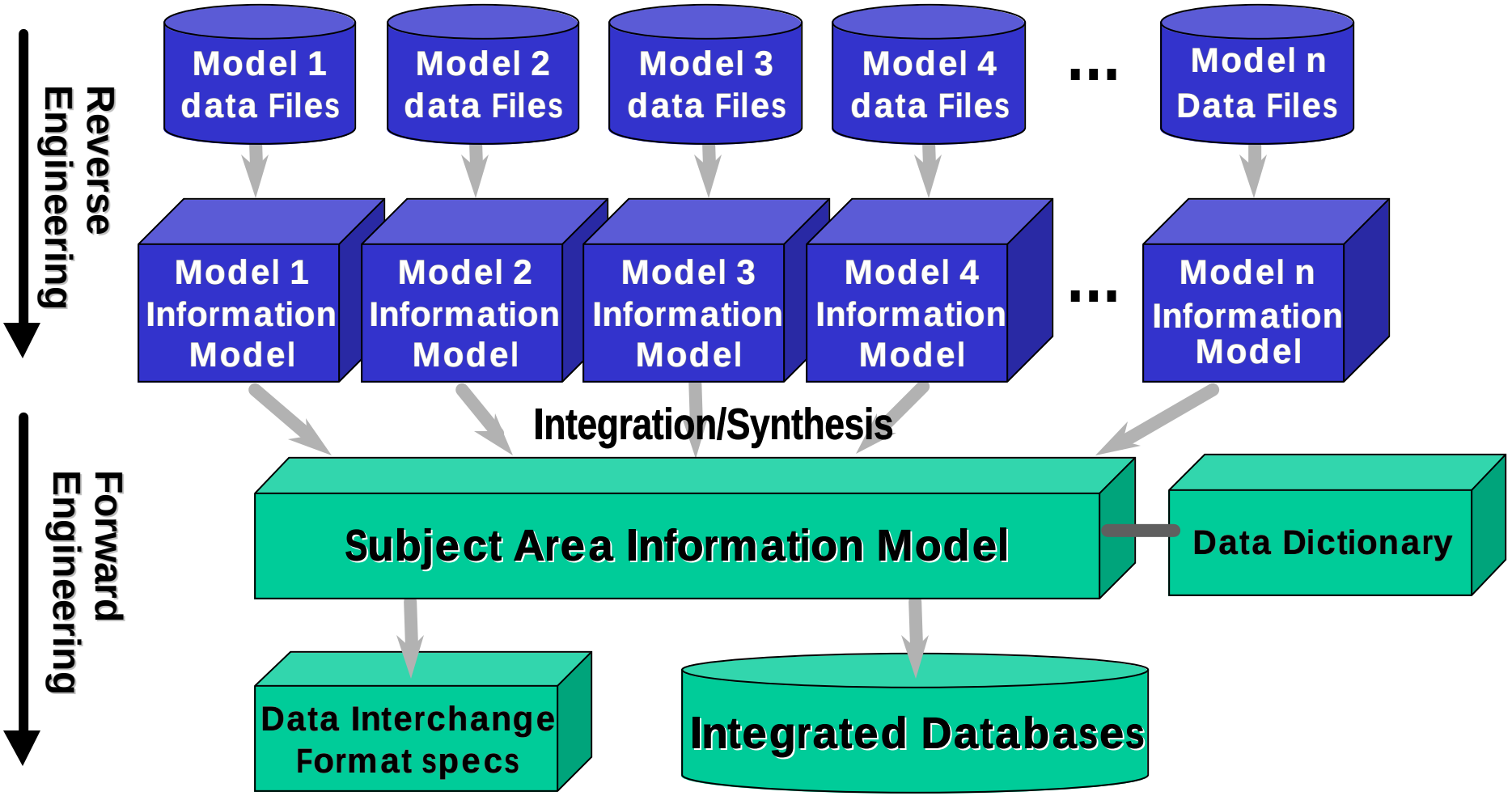
Structure & scope updates due to tool changes

JAMID Information Model changes

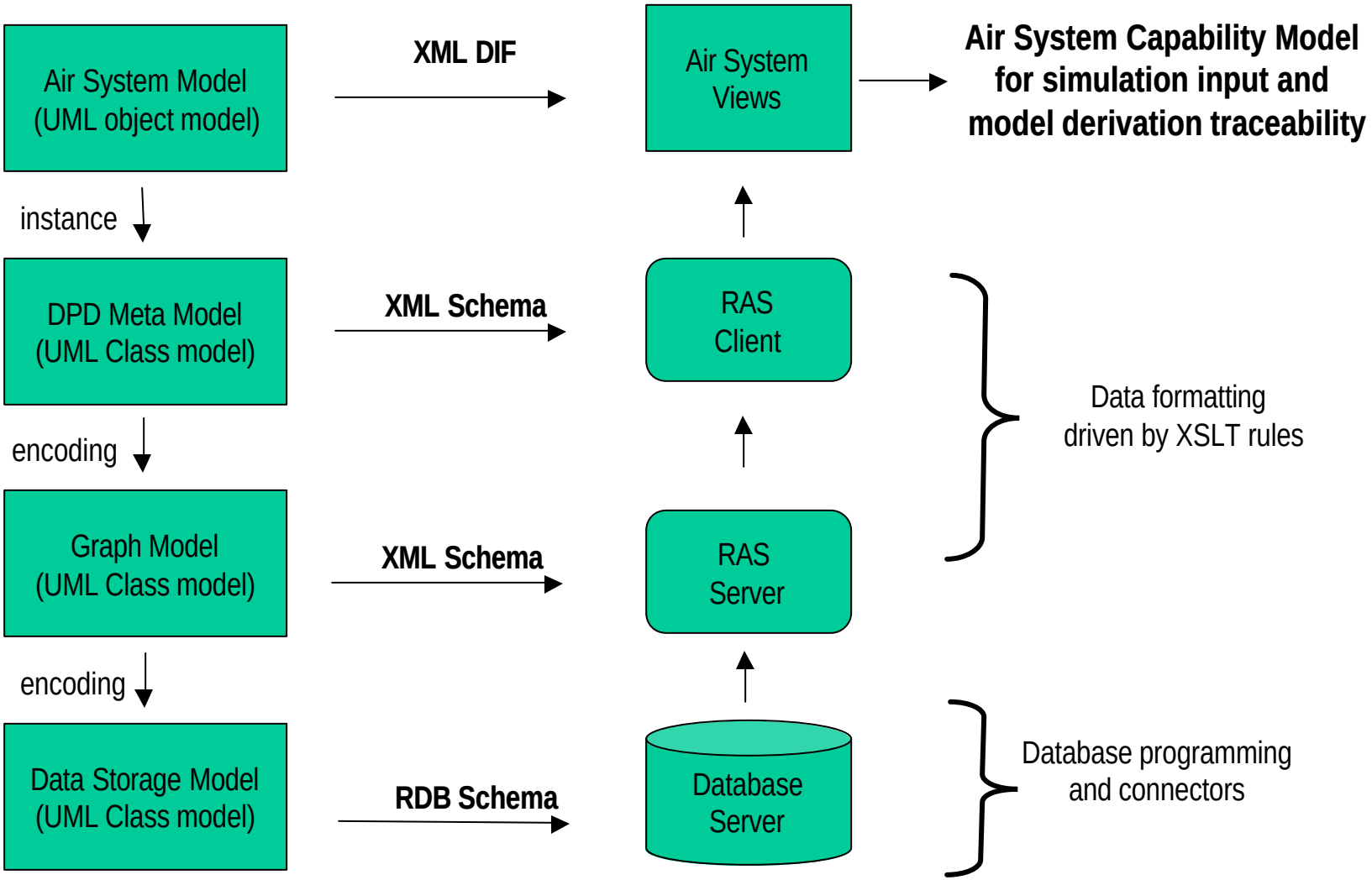
Information Modeling Challenges

M&S Tool Data Engineering Process

(DMSO's Reverse Engineering for Data Integration and Sharing (REDIS) process, simplified)



DPD Architecture Is Represented in UML as a Collection of Layered Models



JAMID Development Strategy

- **Integrated development**
  - Consistent information models for DPD, ASDB, etc.
  - Consistent user interface, procedures, training, etc.
  - Common distribution infrastructure (RAS, LM VPN)
  - Coordinated CM, update procedures, metadata, etc.
- **Spiral development**
  - A series of builds, prioritized per program needs
    - Information to support an increasing number of representations, in increasing numbers of tools, interfaced to an increasing number of organizations
  - Brawler datasets will be first cycle
- **Various classification levels, as appropriate**

Summary

- **Breaking new ground to achieve major improvements**
- **Big change to how we do business**
- **Incremental delivery of capability, incremental changes for users**
- **Requires careful planning and management**
- **The jury's out on whether we'll succeed**
  - but we're taking bets

Back-Ups

MIS AT Members

- **Action Team Leader: JSFPO MS&A military officer or government civilian** ***[Maj Steve Bishop, USAF]***
- **JSFPO Team Technical Lead** ***[Jim Hollenbach, Simulation Strategies]***
- **Lockheed Martin Team Technical Lead** ***[Dr. Henson Graves, LM DPD Architect]***
- **LM DPD/RAS Project Manager** ***[Russ Campbell, LM]***
- **ASDB Project Manager** ***[Steve Hix, Paradigm Technologies]***
- **JSF weapons information representative** ***[Curtis Erickson, AAC/ENMI - Orion Technologies]***
- **Natural/civil environment representative** ***[Floyd Adagio, Orion Networking]***
- **JSF Threat Working Group representative** ***[Tim Armstrong, Veridian]***
- **Operational context representative** ***[Roman Marzak, Veridian Engineering]***
- **DMSO representative** ***[Roy Scrudder, ARL UT]***
- **Other representatives as approved by the SBA Implementation Council**

Shared Responsibilities During SDD

The Government will:	The SDD contractor shall:
Establish and maintain a Strike Warfare Collaborative Environment in which the DPD-based JSF representations will operate, that spans the collaboration focus areas of mission effectiveness analysis, autonomic logistics analysis, engineering and manufacturing analysis and cost analysis	Establish and manage an Engineering and Manufacturing Collaborative Environment
Provide configuration-managed versions of a JSF SWCE Suite of Models and Simulations	Develop, populate, and manage the JSF DPD, which, as a minimum, shall provide, via a DIF, all the JSF information needed to represent the JSF in the SWCE and the EMCE SoM&S.
Develop, maintain, and manage the configuration of a library of SWCE boxed sets. Develop translations and Digital System Models (DSMs) not provided by the WSC.	Develop the software that may be necessary to convert DPD information into the form needed to initialize or configure an individual model or simulation for that portion of the SWCE SoM&S that the WSC uses. This shall include translations and JSF Digital System Models.
Provide an Authoritative Systems Database (ASDB) which is accessible through the JSF Resource Access System	Develop and maintain a web-based JSF Resource Access System

(JSF M&S Support Plan Table 1-1)

Dimensions of Information Coherency

Temporal coherence

- The extent to which the data being used for different tools and sites has the same time stamp

Organizational coherence

- The extent to which all JSF Enterprise organizations are using the same set of databases

Layer (tier, level, stratum) coherence

- The extent to which all the information at a given level of granularity (e.g., engagement level) is logically consistent

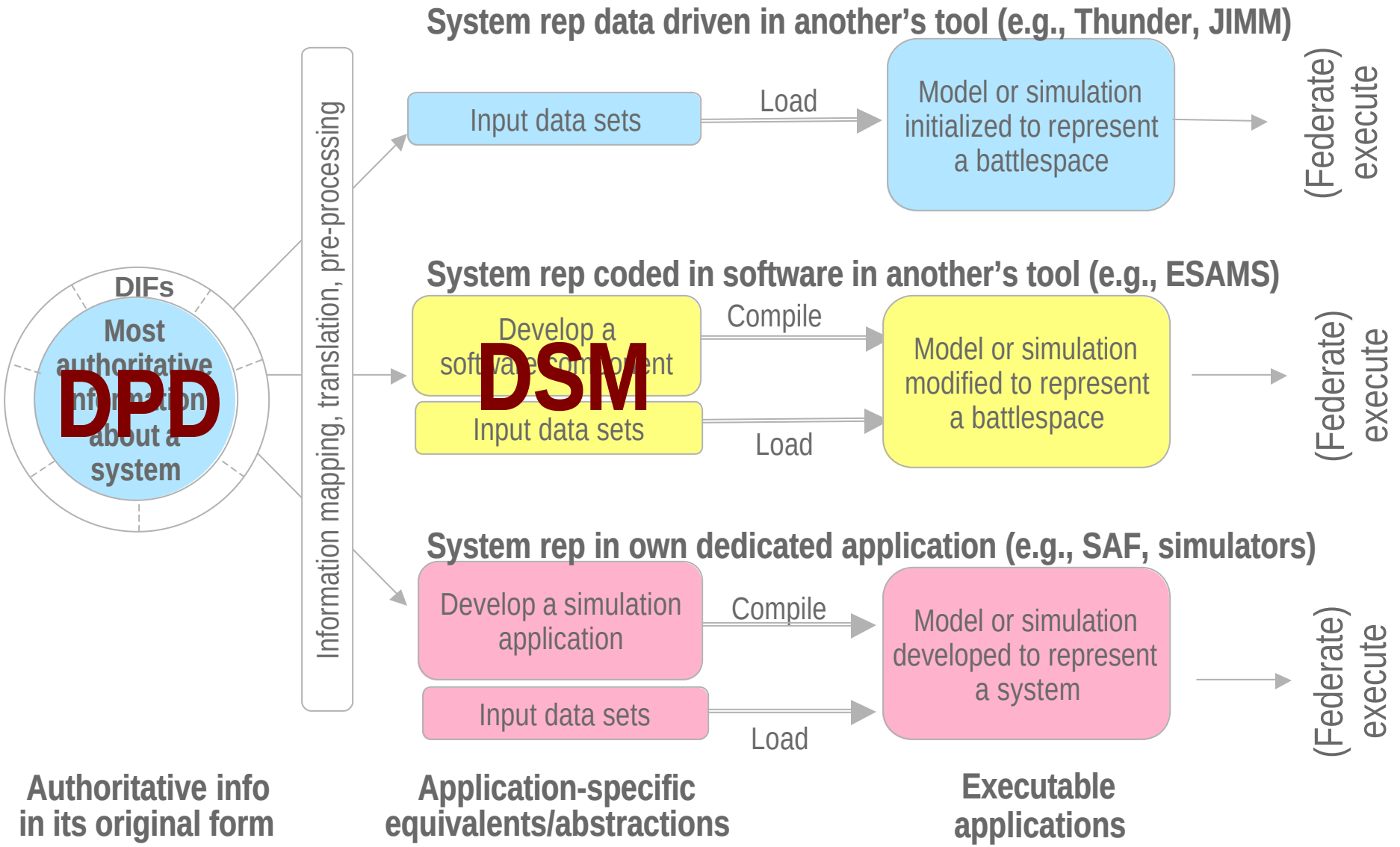
Granularity coherence

- The extent to which the information at different levels of abstraction is logically consistent

Context Dependency

- **"Context-independent" data**
  - Entity attributes that remain stable regardless of its environment
  - Examples: structure, weight, radar signal, cost
- **"Context-dependent" data**
  - Conditional attributes ("it depends")
  - Determined by:
    - How the system is employed
    - The characteristics of its natural environment
    - Interactions with other systems
  - Examples:
    - Speed, range, turn performance
    - Radar, IR and visual signatures
    - Engagement range, P_s, P_k, exchange ratio, targets killed

Current JSF Definitions
(initial attempt at DPD implementation)



Interactions with other Action Teams

- Identify representations of interest (User AT)
- Identify SWCE & EMCE tool information types (Tools AT)
- Identify authoritative sources for derived information (User AT)
- Define data quality documentation to support VV&A (V&V AT)
- Define metadata templates (User AT)
- Capture security, network and user interface needs (User AT)
- Plan JAMID/RAS user training and support (User AT)
- Establish user feedback for JAMID QA (User AT, V&V AT)
- Define threat data fill/update process (Threat Working Group)

Action Teams must work together