JOINT STRIKE FIGHTER

Building a Distributed Product Description for the Joint Strike Fighter

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JSF SBA Strategy for EMD

- **Fall 2001: Down-select to one Weapon System Contractor, enter Engineering & Manufacturing Development (EMD)**

- **During EMD, JSF will further SBA realization by having WSC build a JSF Distributed Product Description (DPD)**

  "a distributed collection of the most current, authoritative JSF information available, provided to users via web technology such that it appears as a single, logically unified product representation"

- **DPD-based JSF representations will operate in:**
  - **Government-managed Strike Warfare Collaborative Environment (SWCE)**
  - **WSC-managed Engineering and Manufacturing Collaborative Environment (EMCE)**

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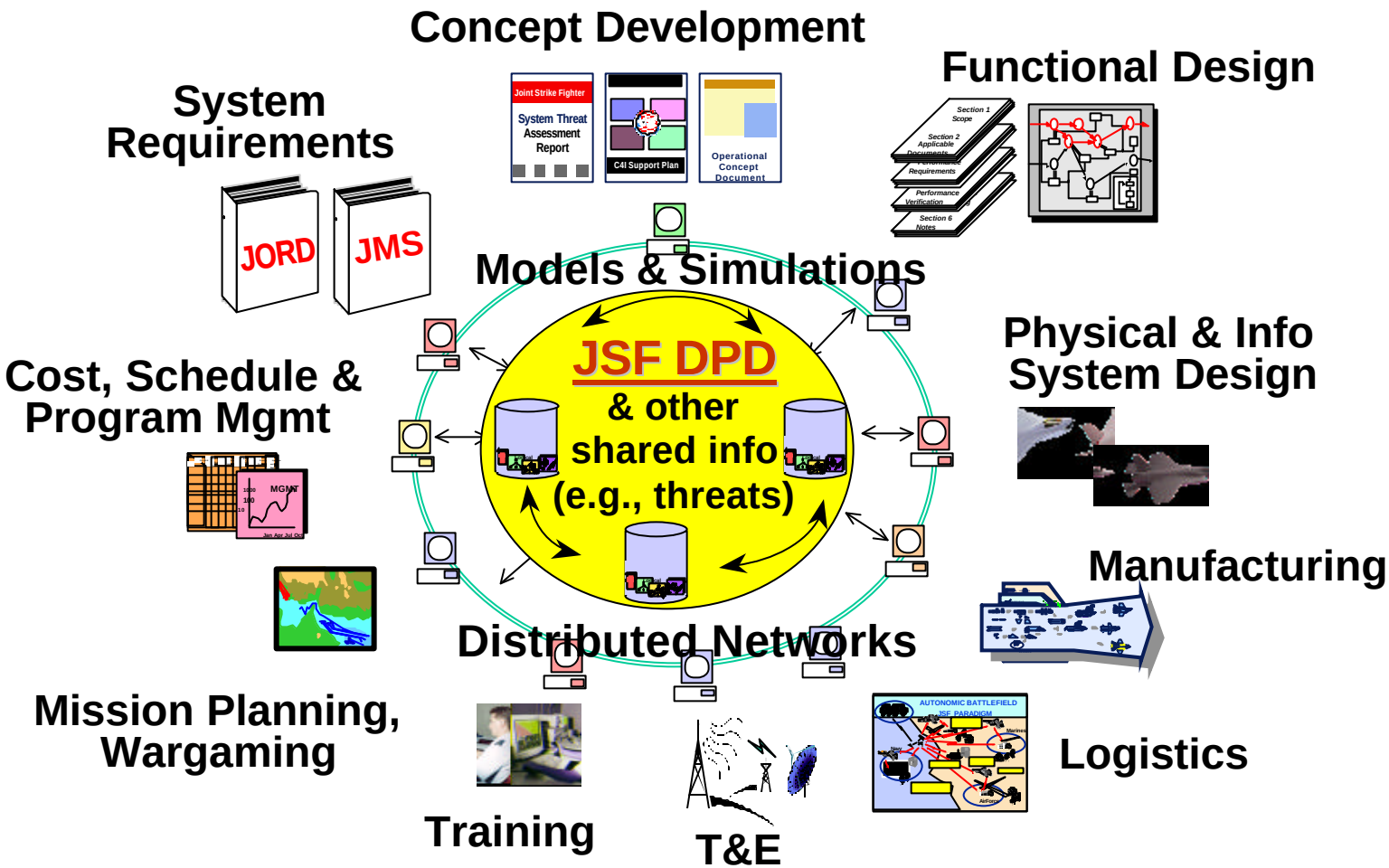
Hub of the IPPD Process



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DPD Goals

- **Increase information coherency, reducing the number and extent of potential misunderstandings across the JSF government/industry team**
- **Provide timely inputs to JSFPO personnel and MS&A tools, resulting in shorter decision cycle times**
- **Improve traceability (validation) of JSF representations**
- **Reduce manual data translations to yield lower translation costs and increased productivity**
- **Make information more readily retrievable throughout the JSF life cycle, saving resources and facilitating better informed decisions/actions**

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DPD Scope

- **Initial DPD, so can't try to satisfy all program info needs**
- **Will satisfy JSF information needs (not threats, friends, factory, etc.) of:**
  - **SWCE: 28 tools in mission effectiveness, cost, supportability, engineering and manufacturing domains**
  - **EMCE: TBD (defined at down-select)**
- **Information types:**
  - **Product data (e.g. structure, performance parameters)**
  - **Algorithms (including look-up tables)**
  - **Software source code if it's needed and the most primitive source (e.g., flight control or mission avionics functions)**
- **Complete life cycle: requirements, functional allocation, as designed, as built, as tested, as employed**

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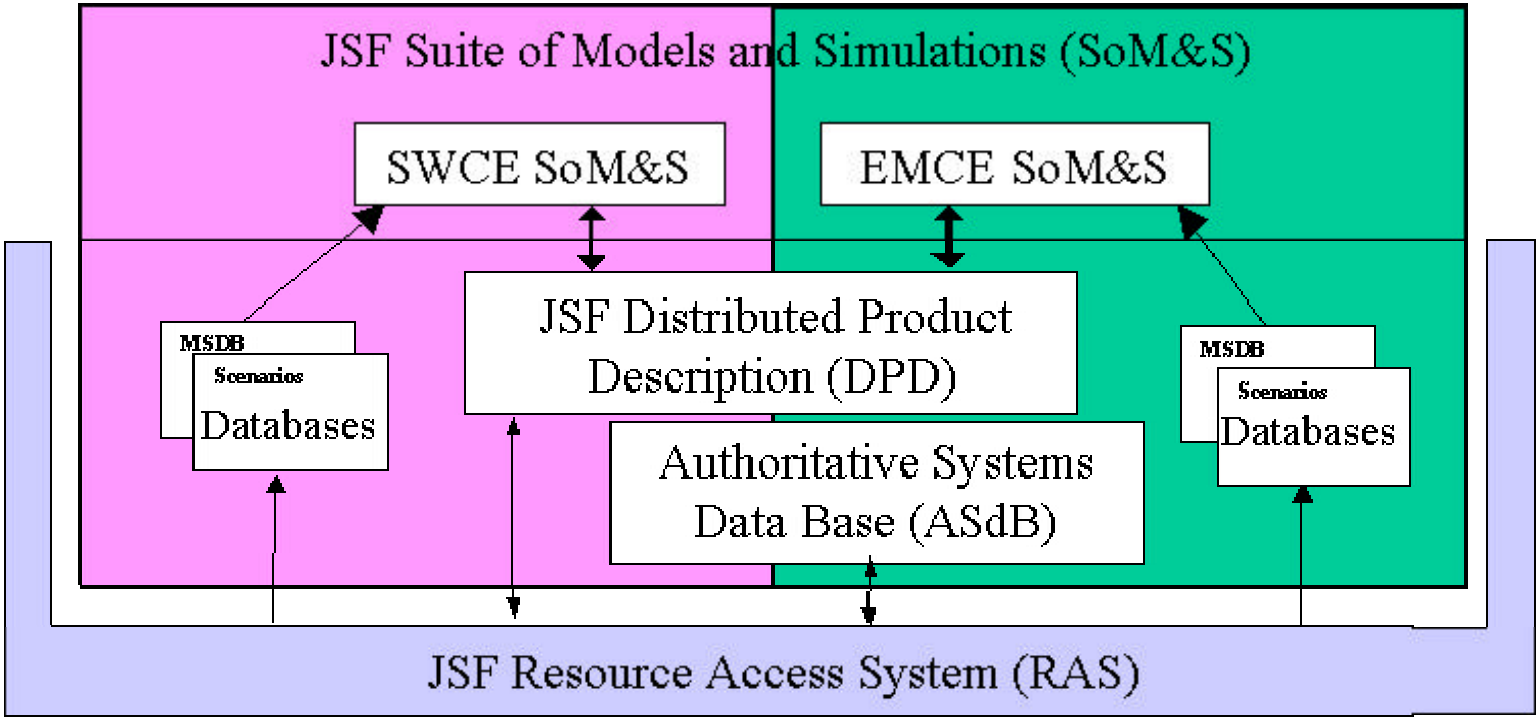
Components of the JSF M&S Toolset

Strike Warfare Collaborative Environment (SWCE) Toolset

Engineering & Manufacturing Collaborative Environment (EMCE) Toolset



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Development Requirements

- **Must be coherent in:**
  - **Semantics**
  - **Syntax**
  - **Levels of resolution (granularity)**
  - **Integrity among interdependent attributes**
- **Information duplication kept to an absolute minimum**
- **Appropriate uses for all information made clear**
  - **e.g., with metadata per DMSO VV&A RPG templates**
- **Information model and associated glossary to be developed by WSC**
  - **Gov't will provide access to subject matter experts for each SWCE tool**

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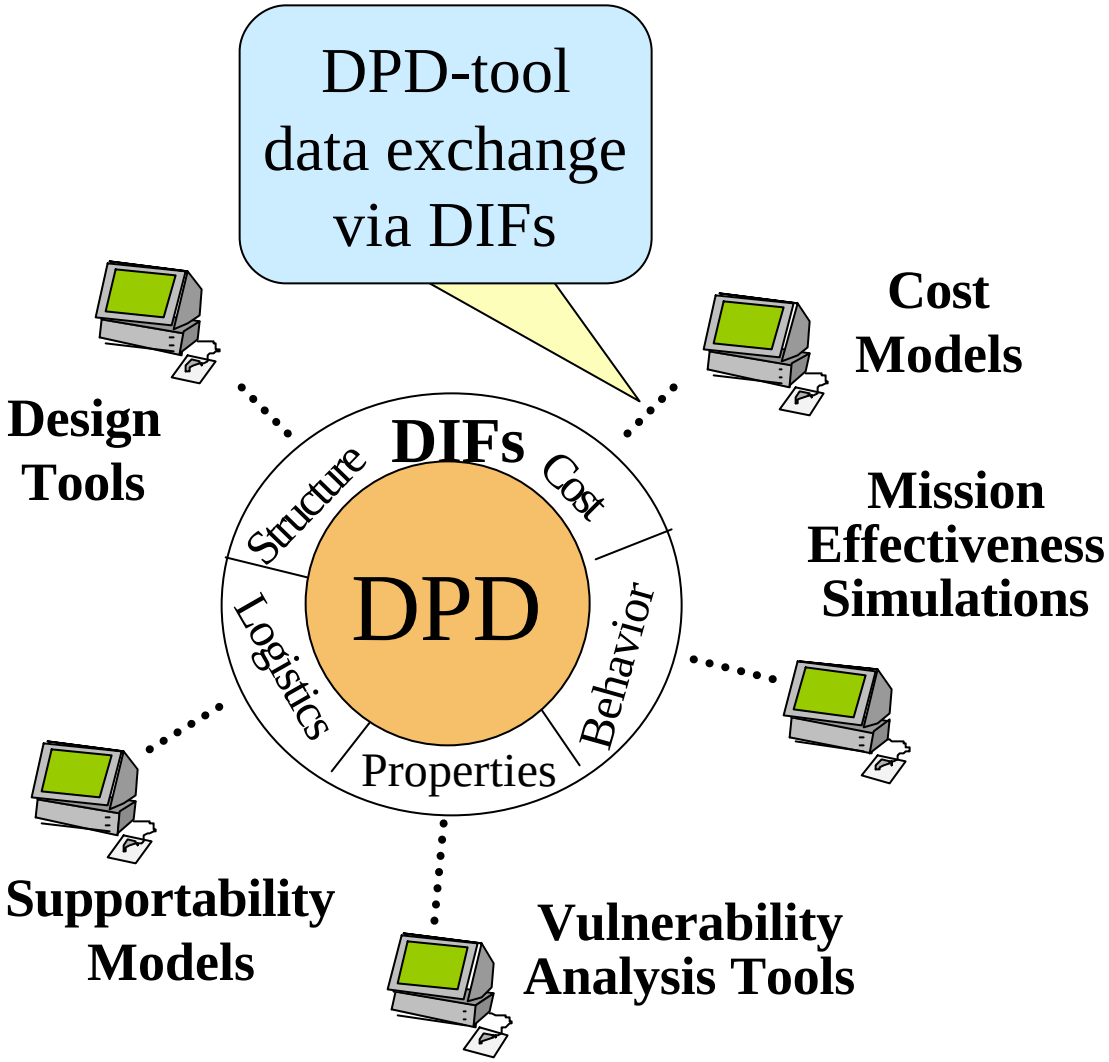
Data Interchange with DPD

- **WSC to define machine-readable data interchange formats (DIFs) for info exchange with DPD**
- **DIF is a common, intermediate format**
- **DIFs to follow current & emergent standards to max practical extent**



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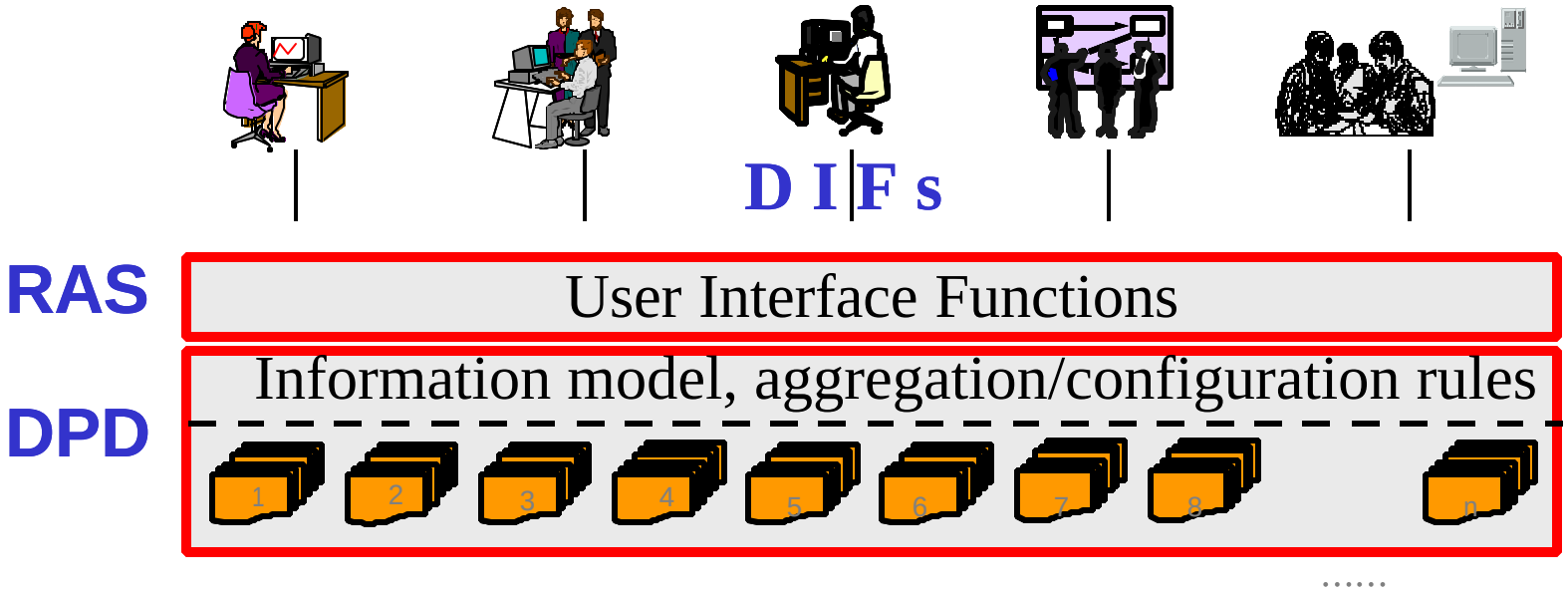
DPD Access via the Resource Access System (RAS)



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DPD "Delivery"

- **Expected early in EMD**
- **Delivery defined as:**
  - **Making the DPD electronically accessible to authorized government personnel;**
  - **Demonstrating that the DPD satisfies requirements (e.g., scope, data model, coherency, glossary, metadata);**
  - **Providing appropriate documentation, including the data model and instructions for using the DPD;**
  - **Training JSFPO-designated personnel in use of the DPD and the Resource Access System; and**
  - **Demonstrating end-to-end use of DPD to communicate an evolution in the JSF design and consequent assessments using a portion of the SWCE M&S suite**

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Now it starts getting complicated…

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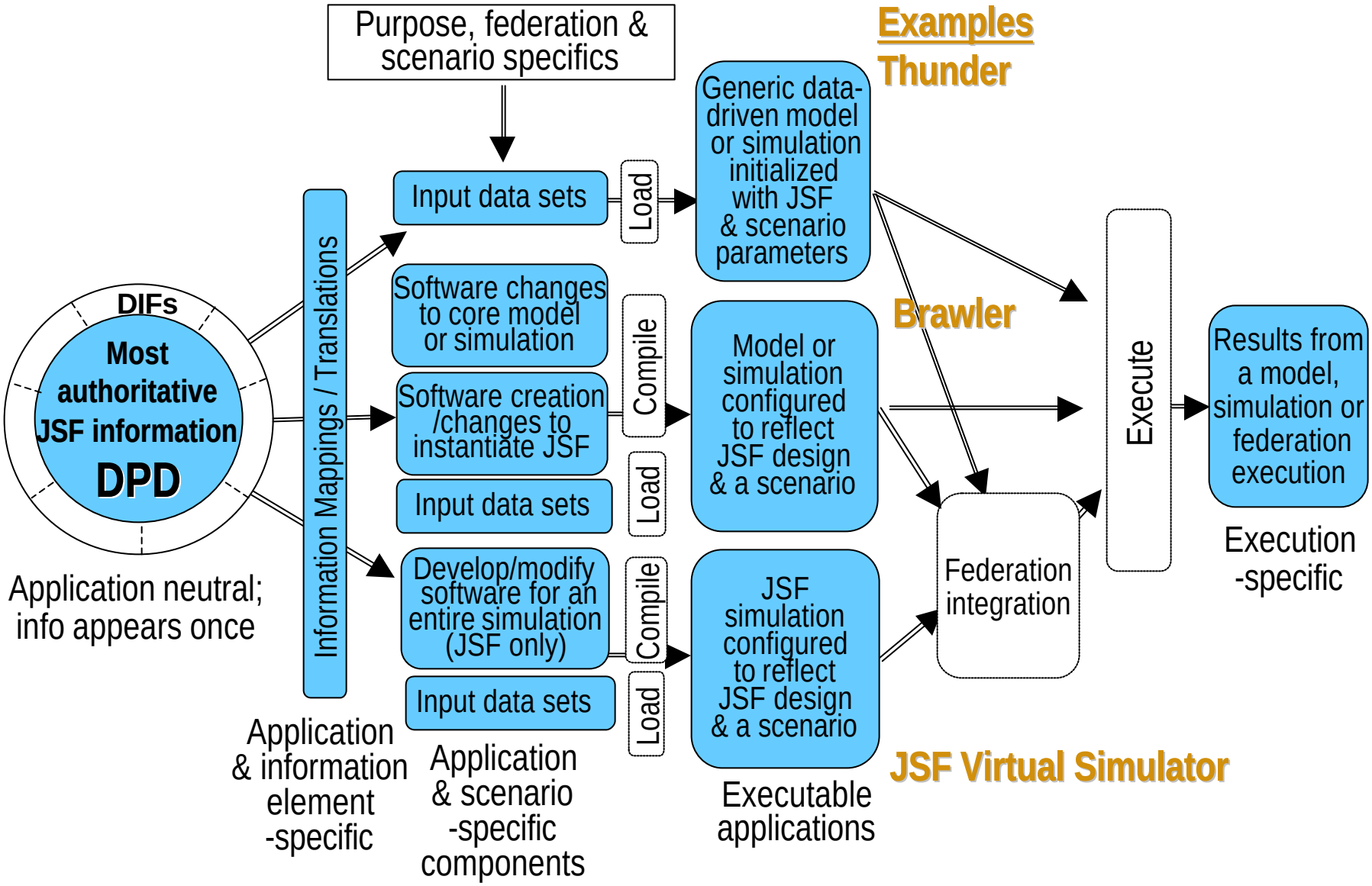
Providing JSF Representations



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Digital System Models
(a.k.a. Product Models)

- A DSM is a software component to represent a system within a particular software application
- One of several reusable artifacts that are created in the JSF representation development process (previous slide)
- JSF wants to enable reuse of all these artifacts, with users to only reach as far left as necessary to meet their needs
- WSC will build, share DSMs for all SWCE tools he uses
- WSC will establish, share translation rules (and software)
- Gov't will build several DSMs with DPD info
- Gov't will configure SWCE tools with parameters from DPD
- All JSF model, simulation, DSM and translation software will undergo V&V, with complete visibility between gov't & WSC

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DSMs Not Packaged in JSF DPD

- **Based on insights thus far, JSF has not included DSMs & other application-specific artifacts within its DPD because:**
  - **Inclusion violates goal of minimizing data duplication in DPD**
  - **Narrow vice broad use**
  - **Don't need an application-neutral DIF to interchange them, a key DPD concept**
  - **If DSMs were included, logic would compel including all other application-specific artifacts in the DPD**
  - **They have different purposes, interchange mechanisms, configuration management methods and business cases**
- **Disagrees with earlier concepts, but including the other application-specific components would disagree too**
- **Managing authoritative information separately from downstream products seems the cleanest approach**

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Process Models

- **Exclusion of process models from the JSF DPD is largely due to the practical constraints inherent in this initial DPD implementation**
  - **resources, schedule, risk**
- **However, complexity of the processes involved in an acquisition enterprise may argue for a similar parsing**
  - **workflow management, scheduling, systems engineering, manufacturing, test and evaluation, budgeting, VV&A, etc.**
  - **configuration managed by different orgnaizations**
    - **IPT, company PM, company corporate, government PM, Service, DoD, etc.**

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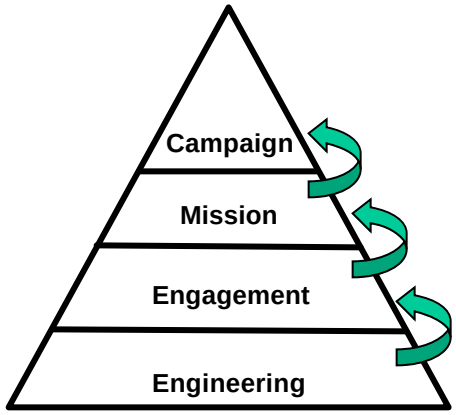
Aggregated Information

- **Some aggregated info is solely JSF design dependent**
  - **e.g., radar cross section, sensor antenna patterns**
  - **derived mathematically**
- **Much of the aggregated information needed by higher level simulations is compound – a characteristic of the JSF in the context of other systems, the natural environment and/or scenarios**
  - **e.g., probabilities of kill, survival**
  - **derived by running other simulations**
    - government as well as WSC
    - some contention regarding sequence
  - **perishable with threat changes**



- **Aggregated info will be maintained in the DPD, posing configuration management challenges**

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Conclusion

- **JSF DPD project is breaking new ground, will yield program benefits and valuable lessons**
- **Reuse opportunities should be considered as a continuum and pursued wherever they're cost-effective**
- **How reusable resources are packaged and managed is important**
- **It's too early to be dogmatic about DPD definitions and architectures**
  - **SBA Road Map authors noted *"The definition and CONOPS of DPDs will evolve as…users experiment with the concept"***

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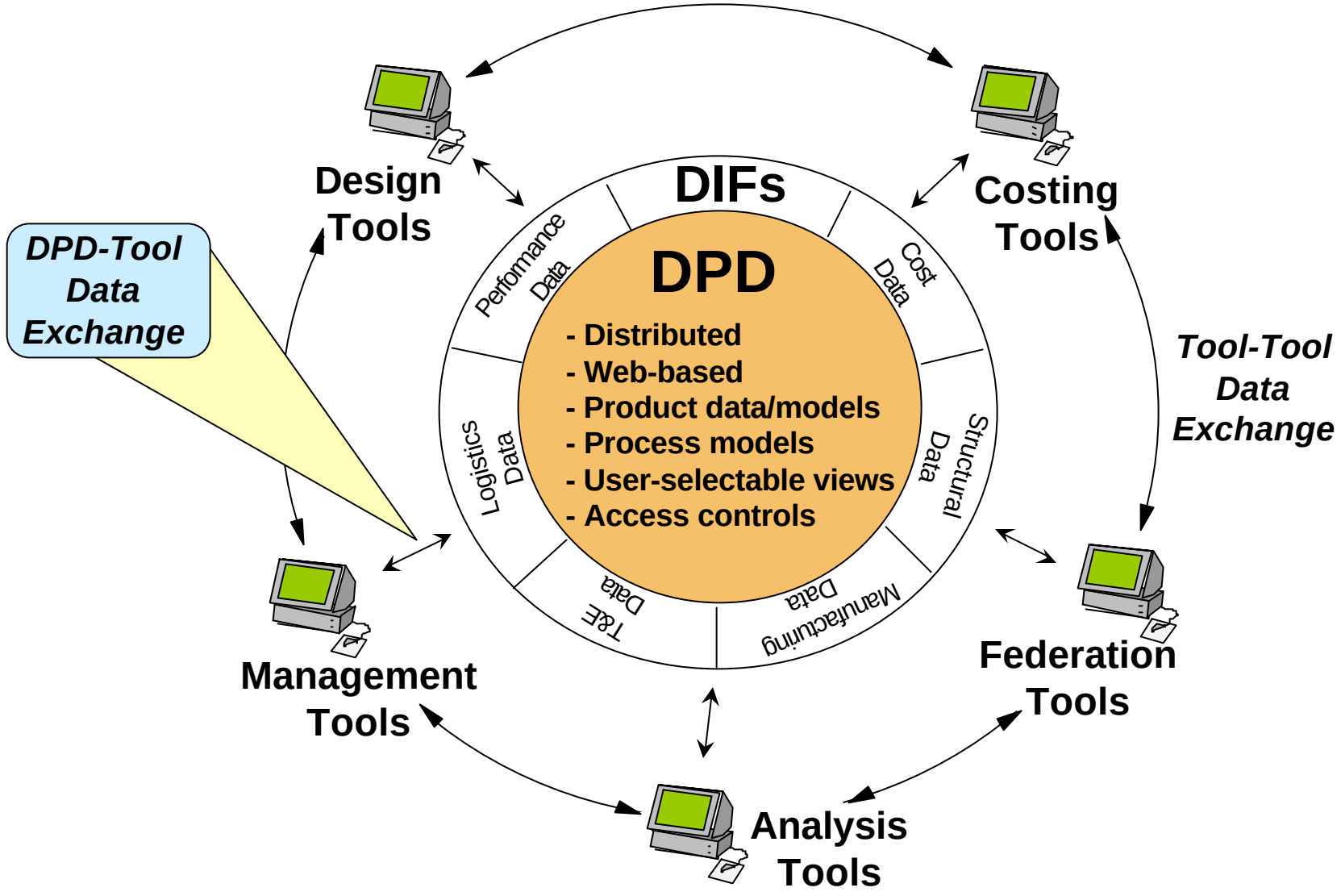
The Next Generation Strike Fighter

Distributed Product Descriptions and Data Interchange Formats



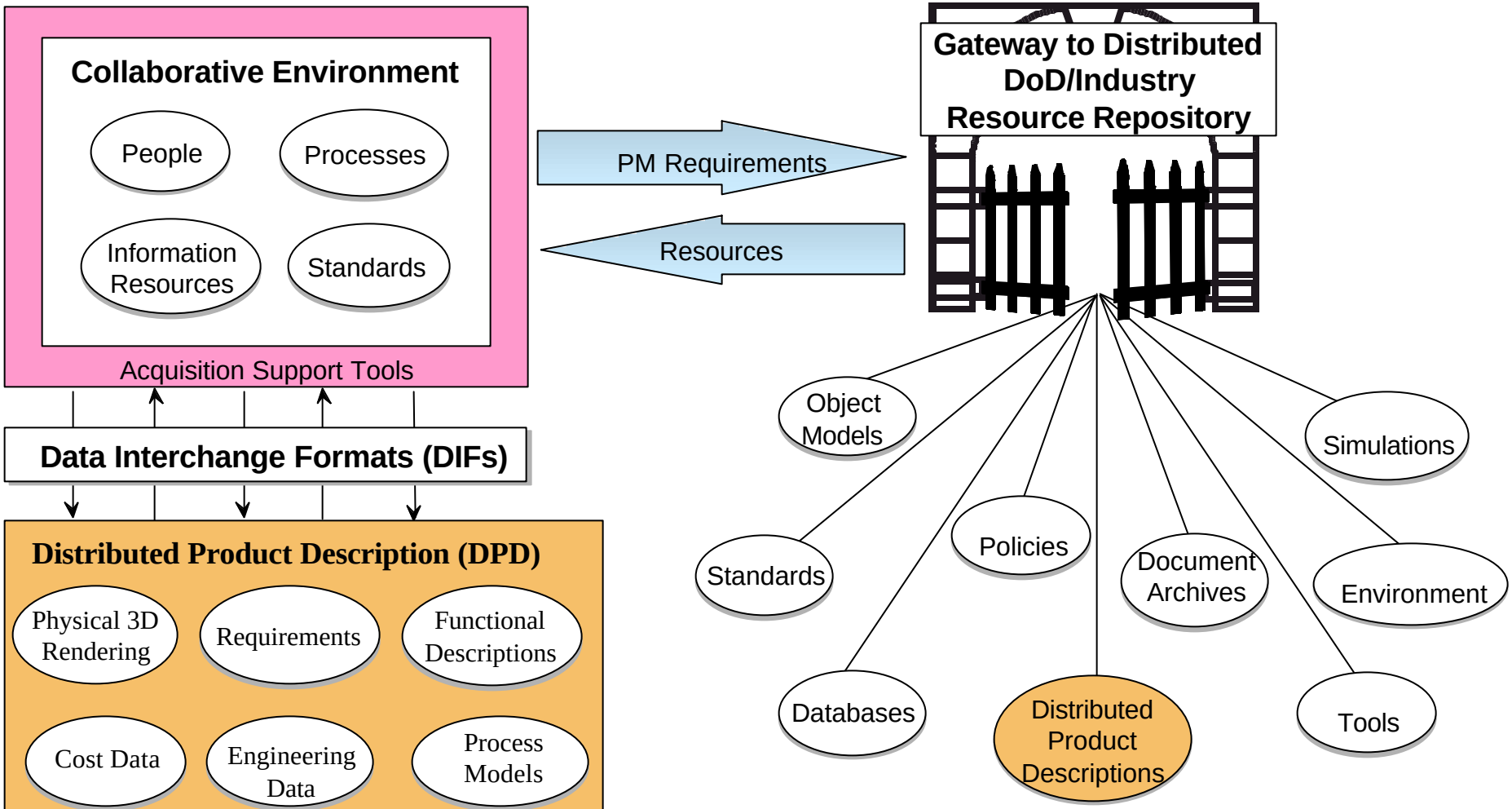
DPD Components
per SBA Road Map

Product Data. "… information that describes the current state of a product specification at some point...requirements data, engineering data, cost data, manufacturing data, logistics data, and whatever other types of data are required to fully define the product…

Product Models. "Authoritative representations of product behavior and performance. Each product model identified in a DPD can reference an actual software implementation of the product (data and methods) that has been developed to operate in a specific static analysis tool or dynamic virtual environment. …a single DPD for a radar system might reference several different product models, each of which is intended for use in different simulation systems… Alternatively, product behavior may also be represented via appropriate algorithms, which have not been implemented in software. Each product model is based on a common functional and operational description (included in the DPD) that provides the basis for [V&V]. The results of V&V testing and…accreditation…are additional categories of product data…"

Process Models. "A depiction of the processes and activities relevant to operating an enterprise. For instance…design processes…manufacturing processes…test and evaluation …operational support…VV&A…standard business practices."

Top-Level View of SBA Systems Architecture

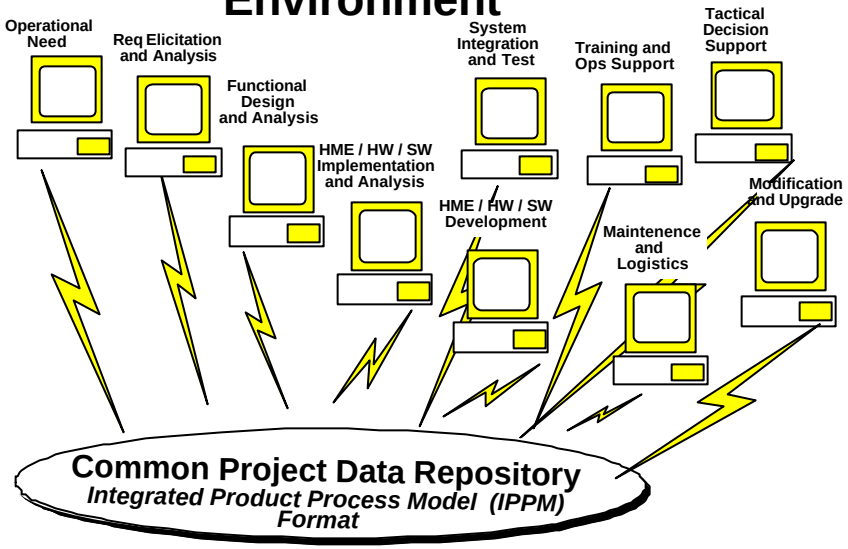


Both the DIRR and DPDs
– are interconnected using web technology
– have a configuration control process
– use encrypters/firewalls for access control

Simulation Based Acquisition

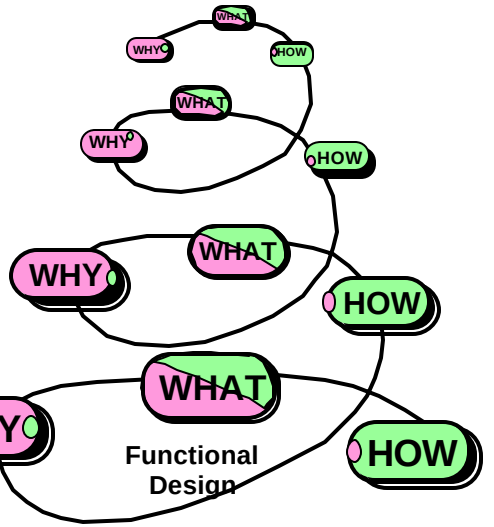
(from NDIA SBA Industry Steering Group tutorial)

1 Integrated Engineering Environment



- **Integrated Design Data Schema**
- **Dist System Info Repository**
  - User Transparent Web Style Access
- **Collaborative Distributed Engineering**
  - Seamless Integration of Engineering Disciplines

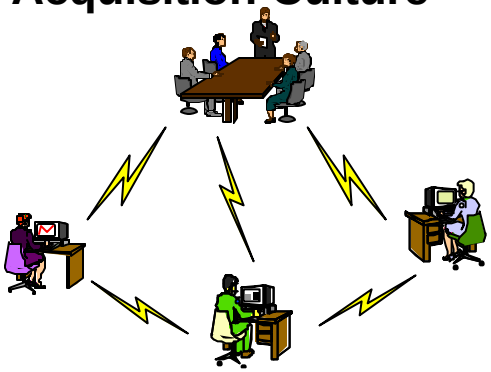
2 Iterative Acquisition Process



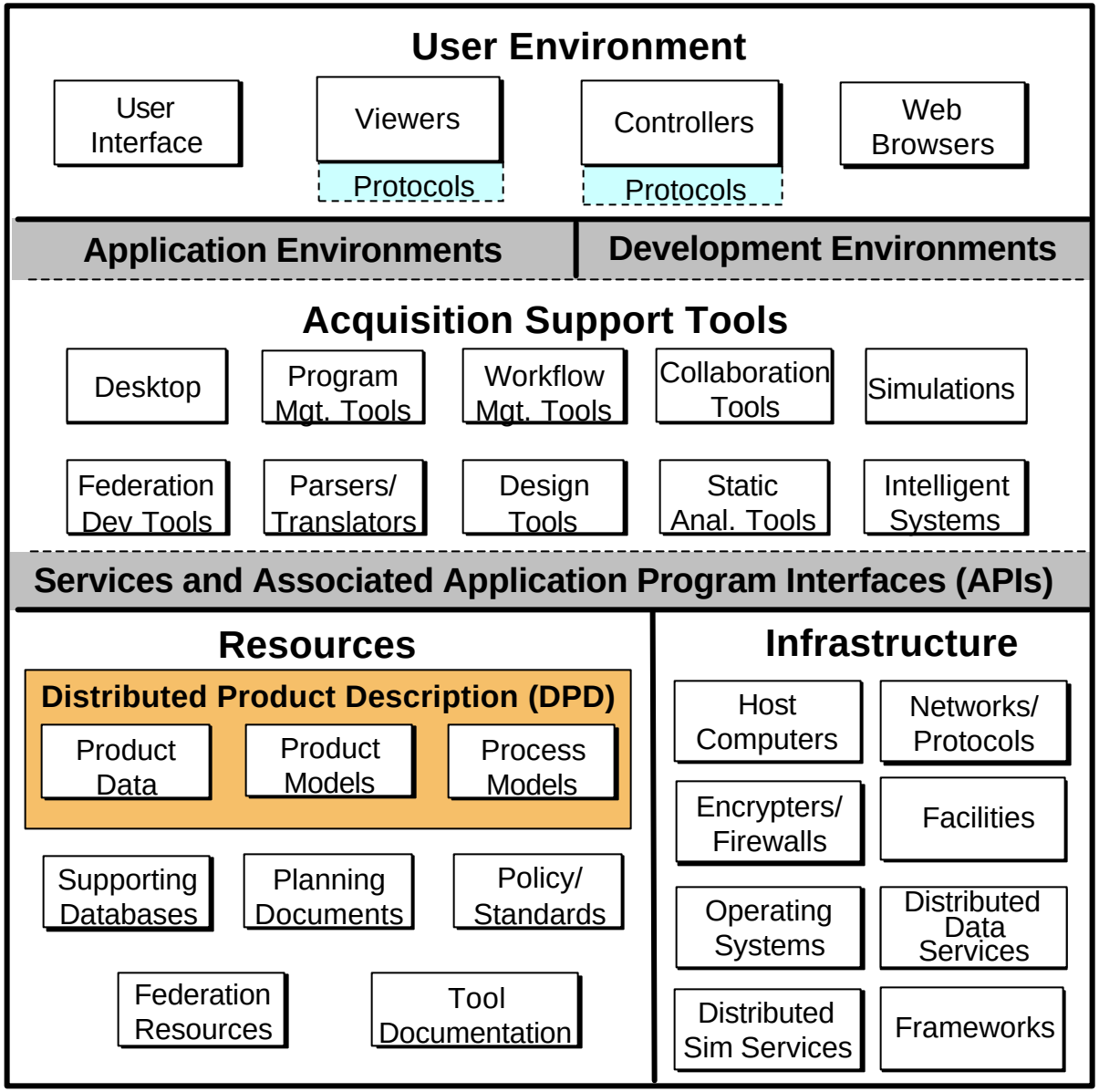
Government | Industry

- **Iterative Spiral Process**
  - Rapid Evaluation of Multiple Options
  - Electronic Exchange of System Models

3 Evolved Acquisition Culture



- **Integrated Process Teams**
  - HME and Info Systems
- **Changing Roles and Responsibilities**
  - Policy and Education
  - Standards and Guidlines

EFFICIENT AUTOMATION / MULTIPLE BASELINES
MULTI-DOMAIN / CONCURRENT SIMULATION CAPABILITIES

Collaborative Environment Reference Systems Architecture