System Supportability and Life Cycle Product Support: A Systems Perspective

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Current Situation
What We Need to Do Better

Requirements

- Adapting to changing conditions
- Matching operational needs with solutions
- Overcoming biases of Services and others
- Moving to transform military

PPBES

- Laying analytical foundation for budget
- Aligning budgets with acquisition decisions

Personnel and Readiness

- Treating people as a resource

Acquisition

- Acquiring systems-of-systems
- Making system decisions in a joint, mission context
- Transitioning technology
- Assessing complexity of new work and ability to perform it
- Controlling schedule and cost
- Passing operational tests
- Ensuring a robust industrial base

Sustainment

- Controlling O&S costs
- Reducing logistics tails

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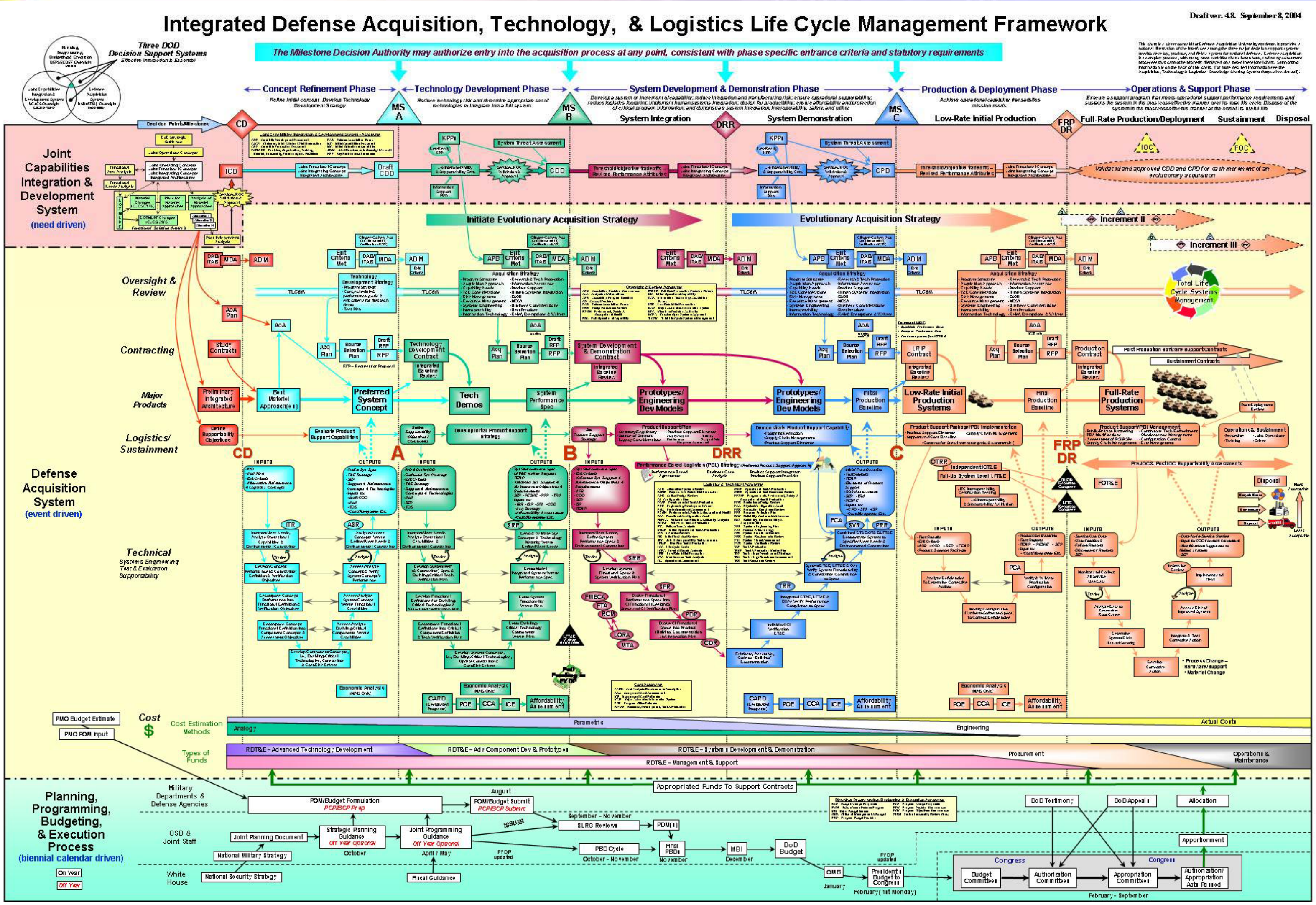
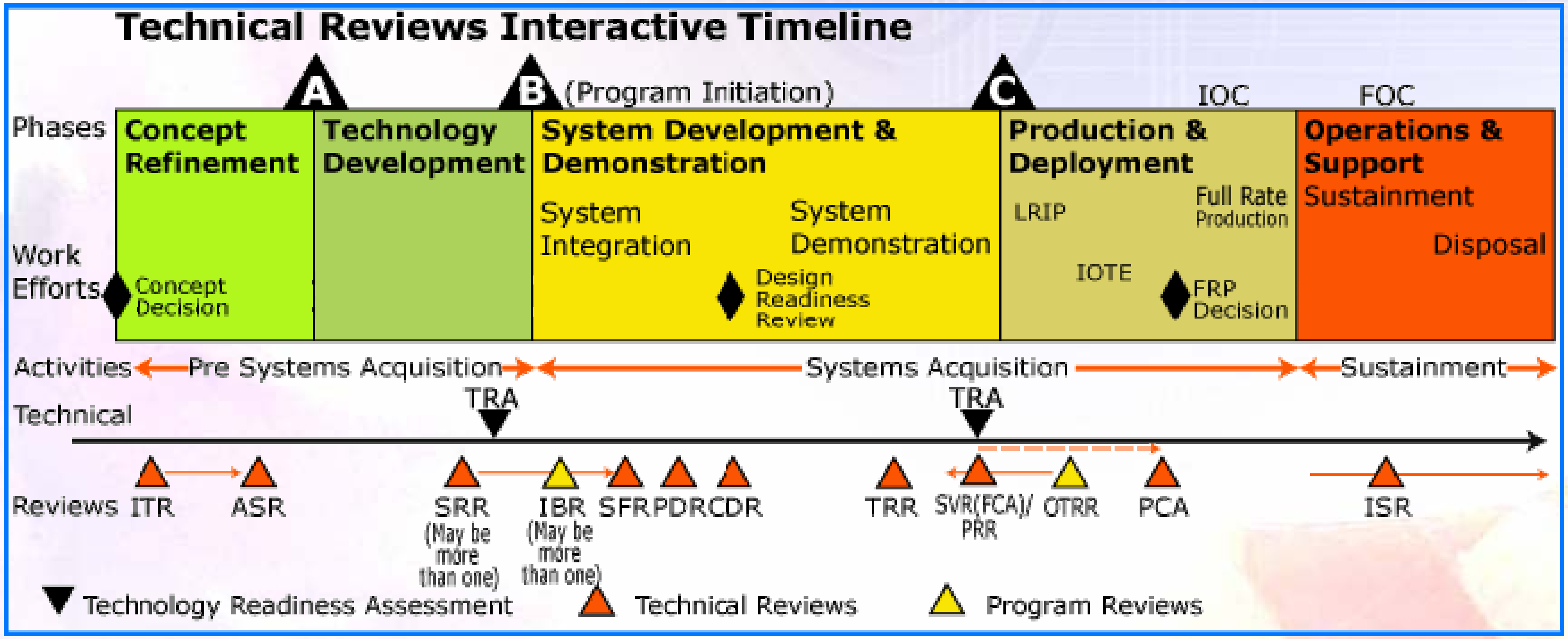
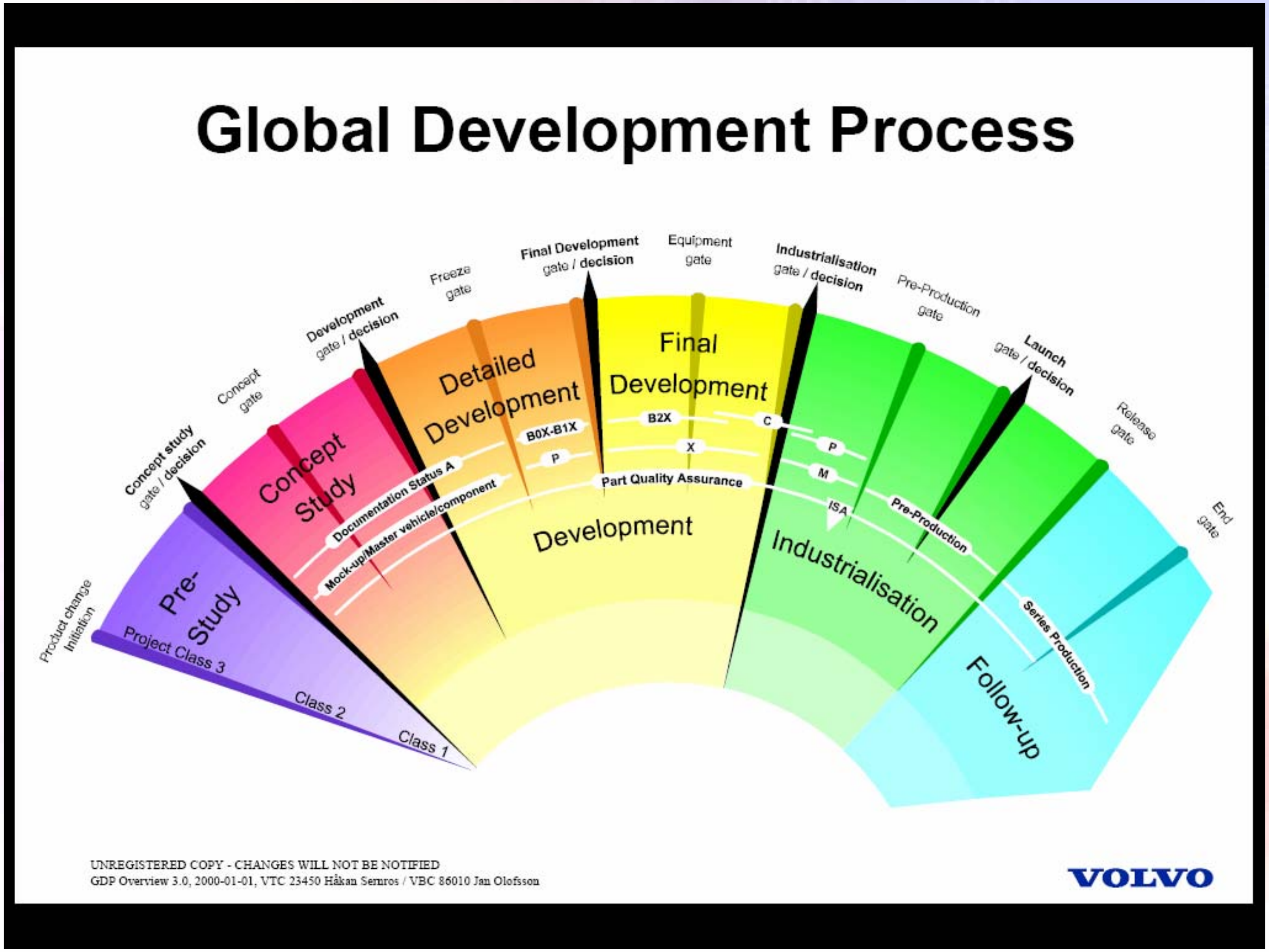
One Response



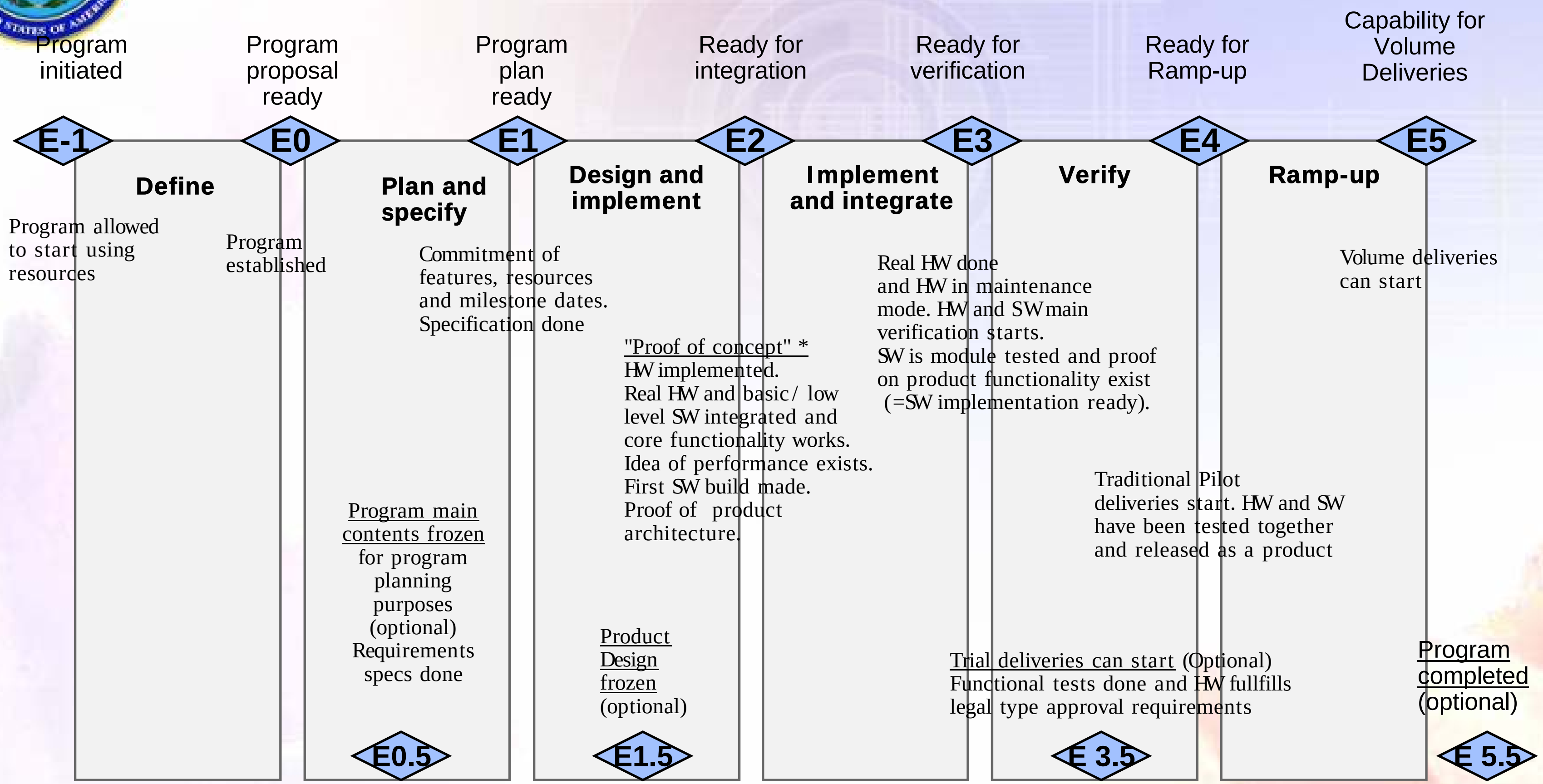
A Simpler View!



System Design Life Cycle Models:
An Automotive Example (VOLVO Car Corporation)



System Design Life Cycle Models:
A Telecom Example (NOKIA Networks)



Optional Milestones can be moved.
I.e. E1 and E1.5 dates can be the same.

* Core functionality can be I.e. control plane, signal goes through (typically not call yet). Exact contents of core functionality is need to be defined in E1

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System Design Life Cycle Models:
A Workstation Example (SUN Microsystems)

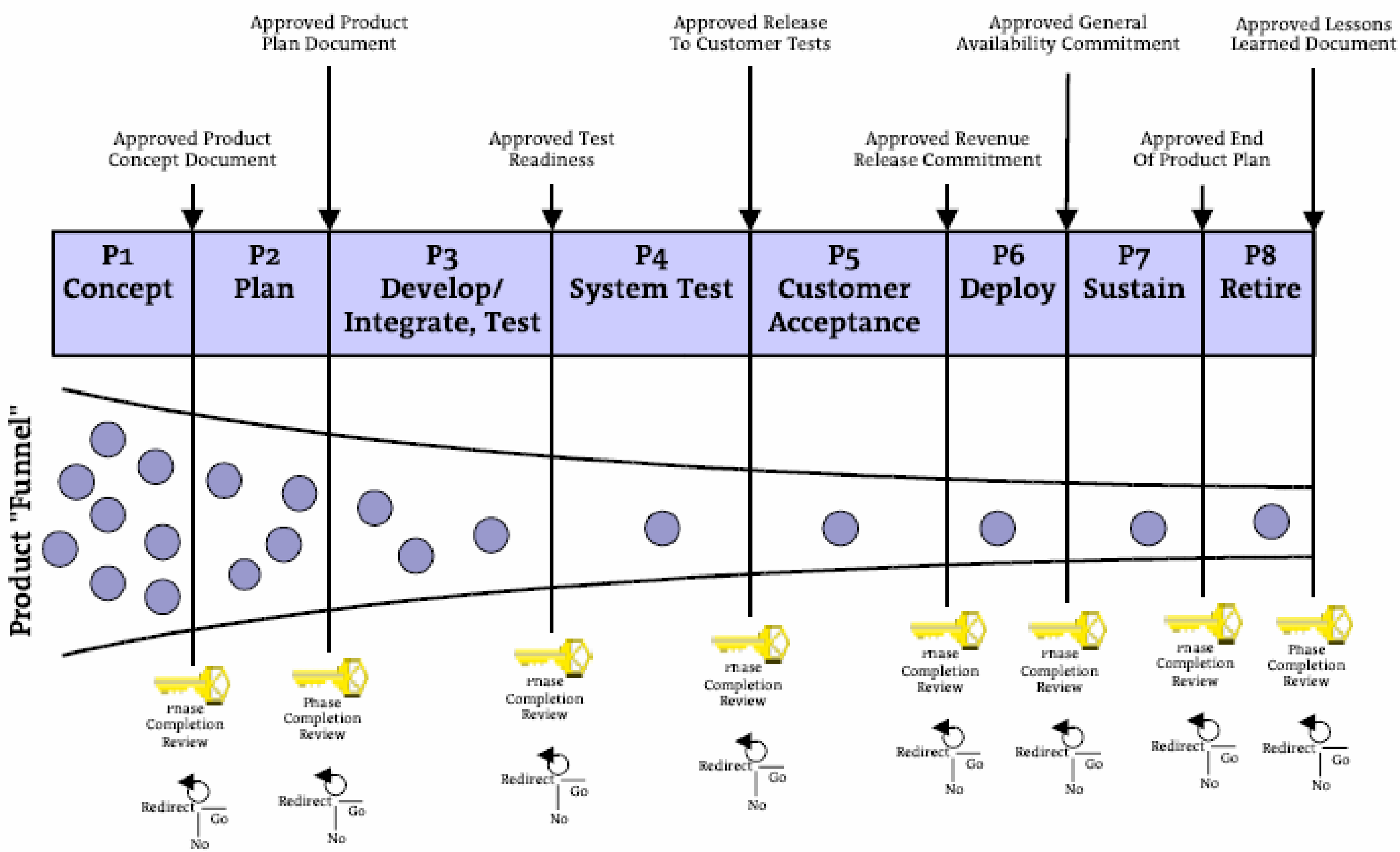
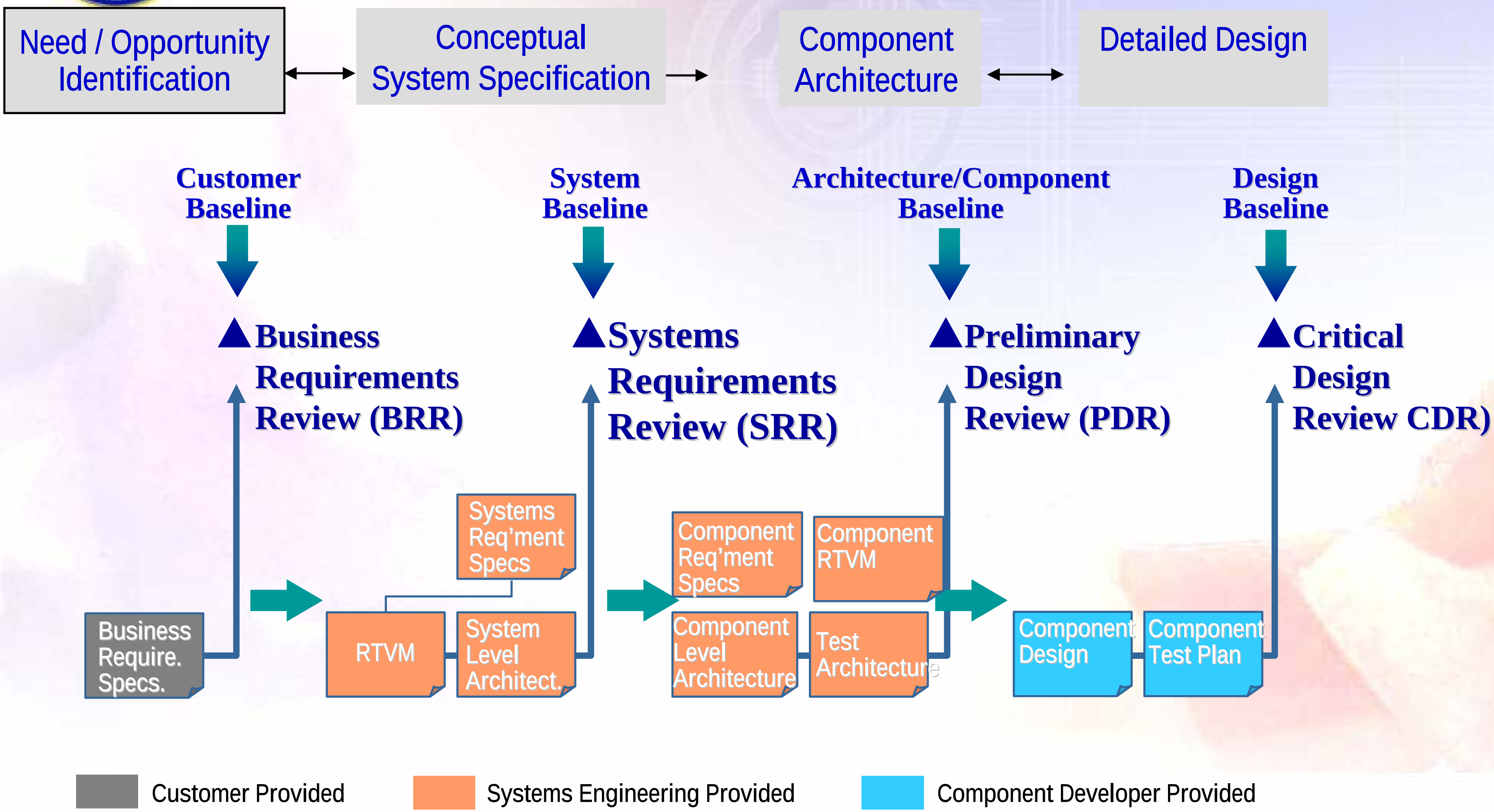


Illustration 1 - Sun PLC Process Overview

The IBM AMS Systems Engineering Process defines deliverables and a series of Reviews (I)



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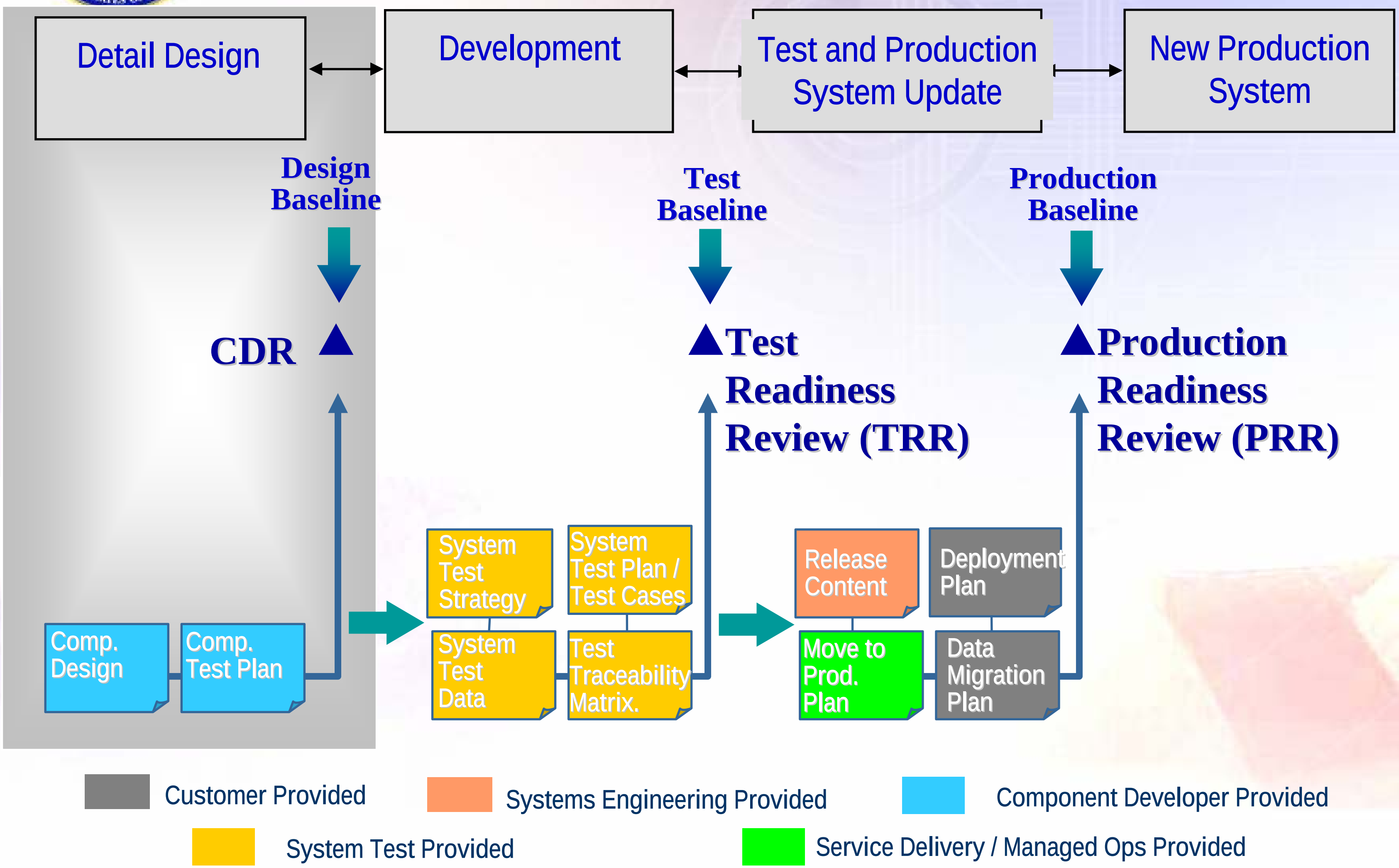

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Simple Translation…

- Systems Engineering is "problem solving and solution delivery." A key pre-requisite to good "problem solving" is good "problem definition." Now this has other pre-requisites!
- Some key best practices:
  - Early phases:
    - Translating customer needs (business and technical) into key acceptance criteria - 5 to 7 critical customer requirements agreed to in measurable/testable form.
    - Identifying requirements and then managing them (and tracing them) through the subsequent development, integration, testing, deployment, and support phases.
  - Middle phases:
    - Translating the requirements into an "architecture" that becomes a "linkage" between what the customers want and what the developers will build… the concept of an architect as the linkage between the homeowner and the builder.
  - Latter phases:
    - Developing a test architecture, test plans and procedures that are traceable to the requirements for maximum focus and efficiency

Sounds very simple! A lot of organizations have developed processes that attempt to capture the above intent. But very few are able to execute it…

Successful implementation of SE needs…

- **The process must be "productized" for efficient implementation**
  - Globally consistent templates and processes,
  - Uniform and consistent metrics and lexicon (part of the SE culture)
- **Focus must be on the "necessary" and critical subset of the overall methodology and theory (Flexibility and Adaptability)**
  - Tailoring for time-to-market considerations
  - Tailoring for schedule and resource considerations
  - Risk tolerance must be explicitly considered in the tailoring process
- **Implementation must be organizationally supported and nurtured**
  - Linkage to strategic organizational goals is key
- **A well managed competency development program and a "community of practice**

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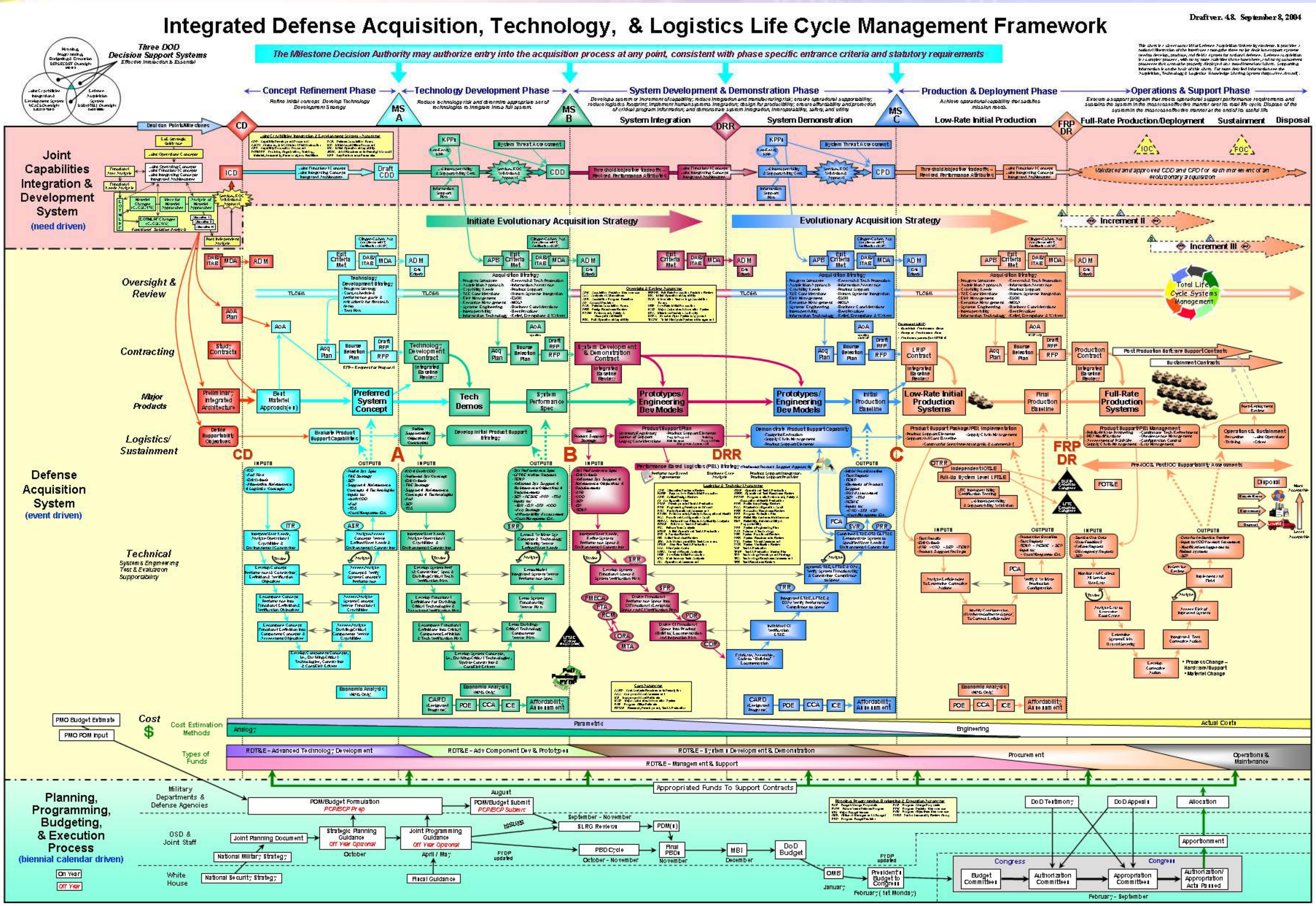

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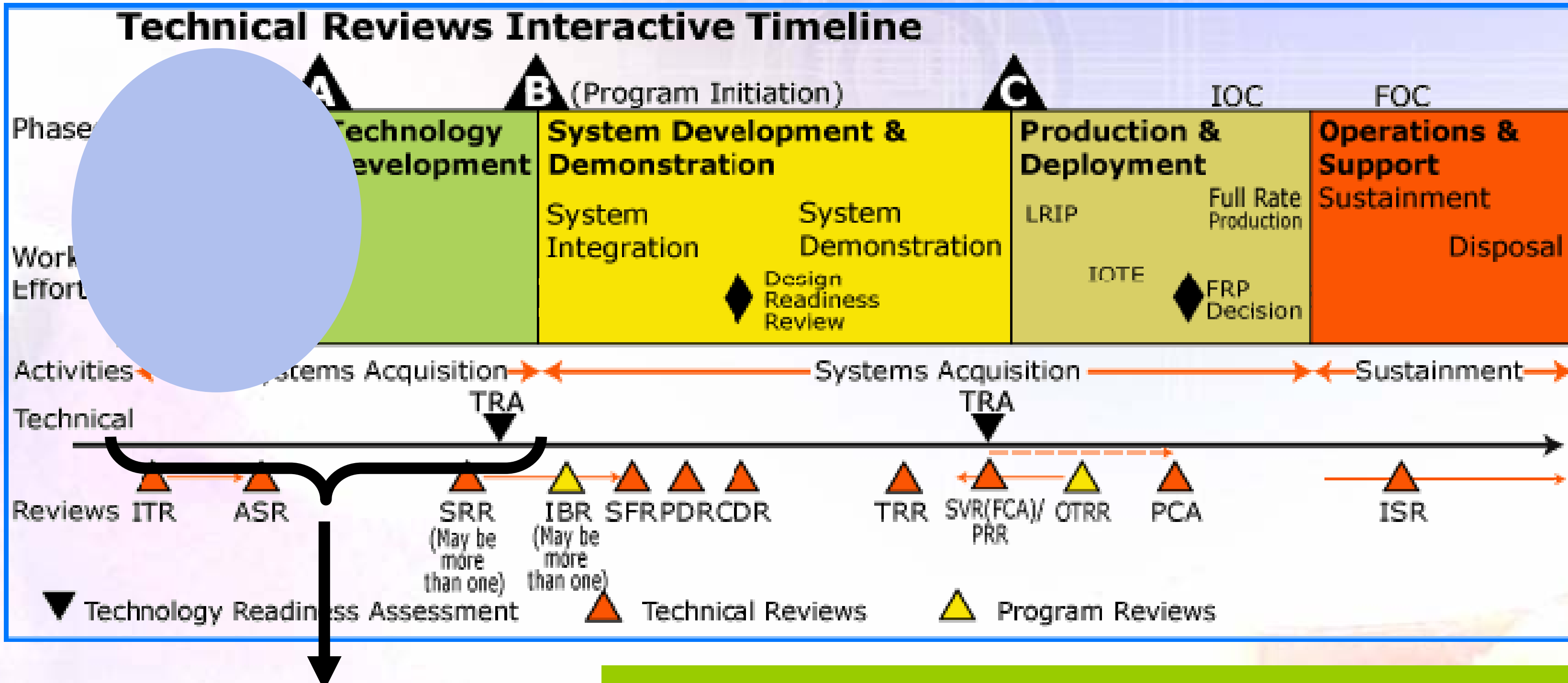
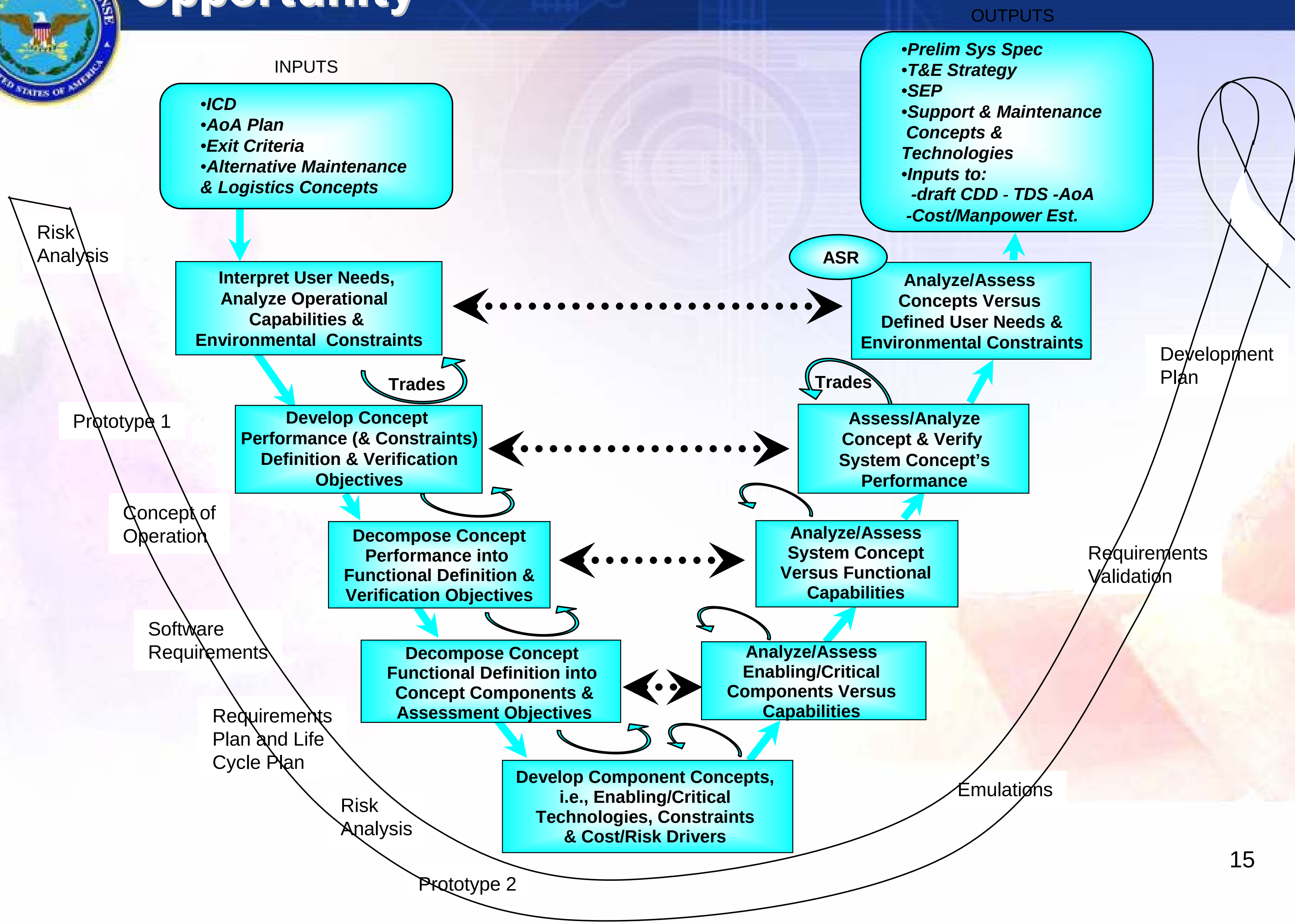


System Readiness Levels, instead of Technology Readiness Levels

TRL scale is a measure of maturity of an individual technology, with a view towards operational use in a system context. A more comprehensive set of concerns become relevant when this assessment is abstracted from an individual technology to a system context, which may involve interplay between multiple technologies. Such concerns include system-level integration and test, human factors (with an emphasis on information and data), and sustainability/**supportability**.

Concept Refinement Phase – The Initial Opportunity



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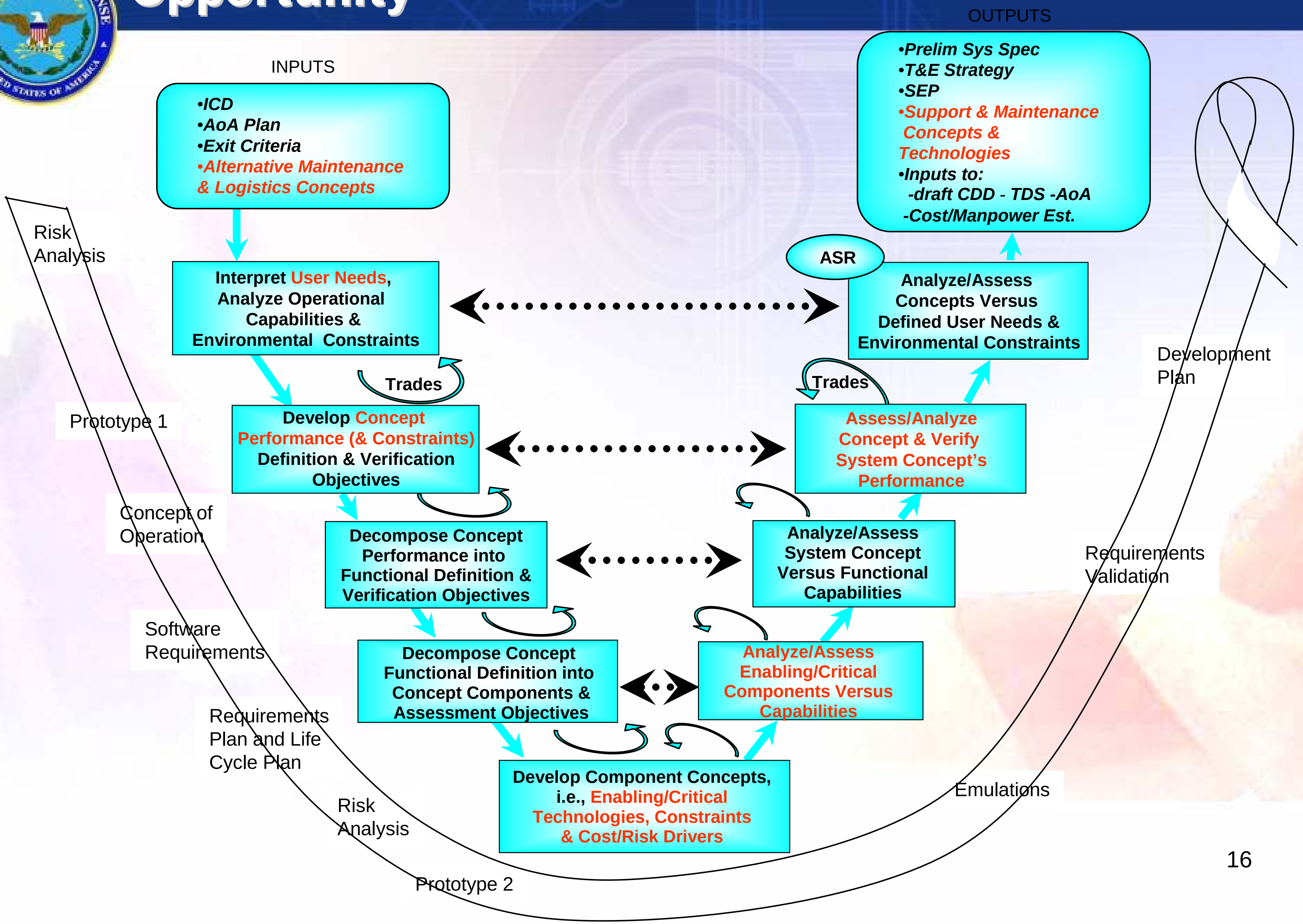

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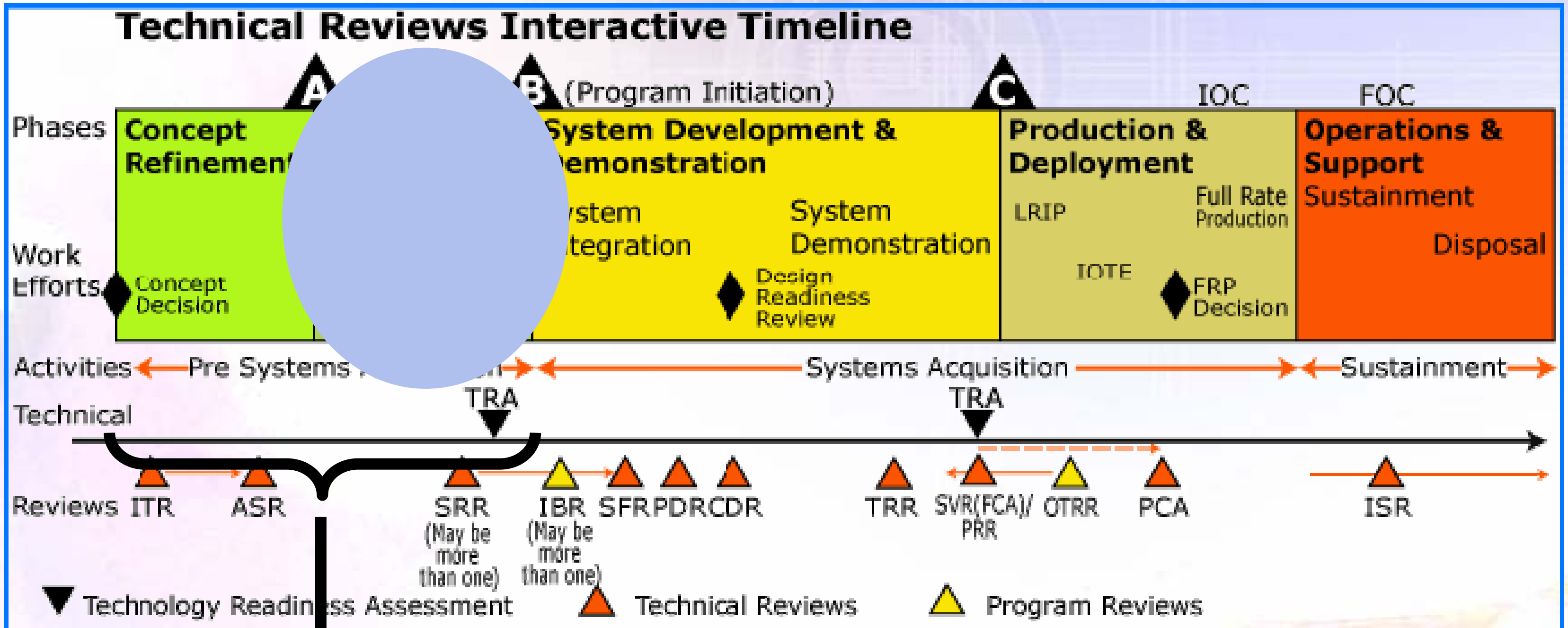

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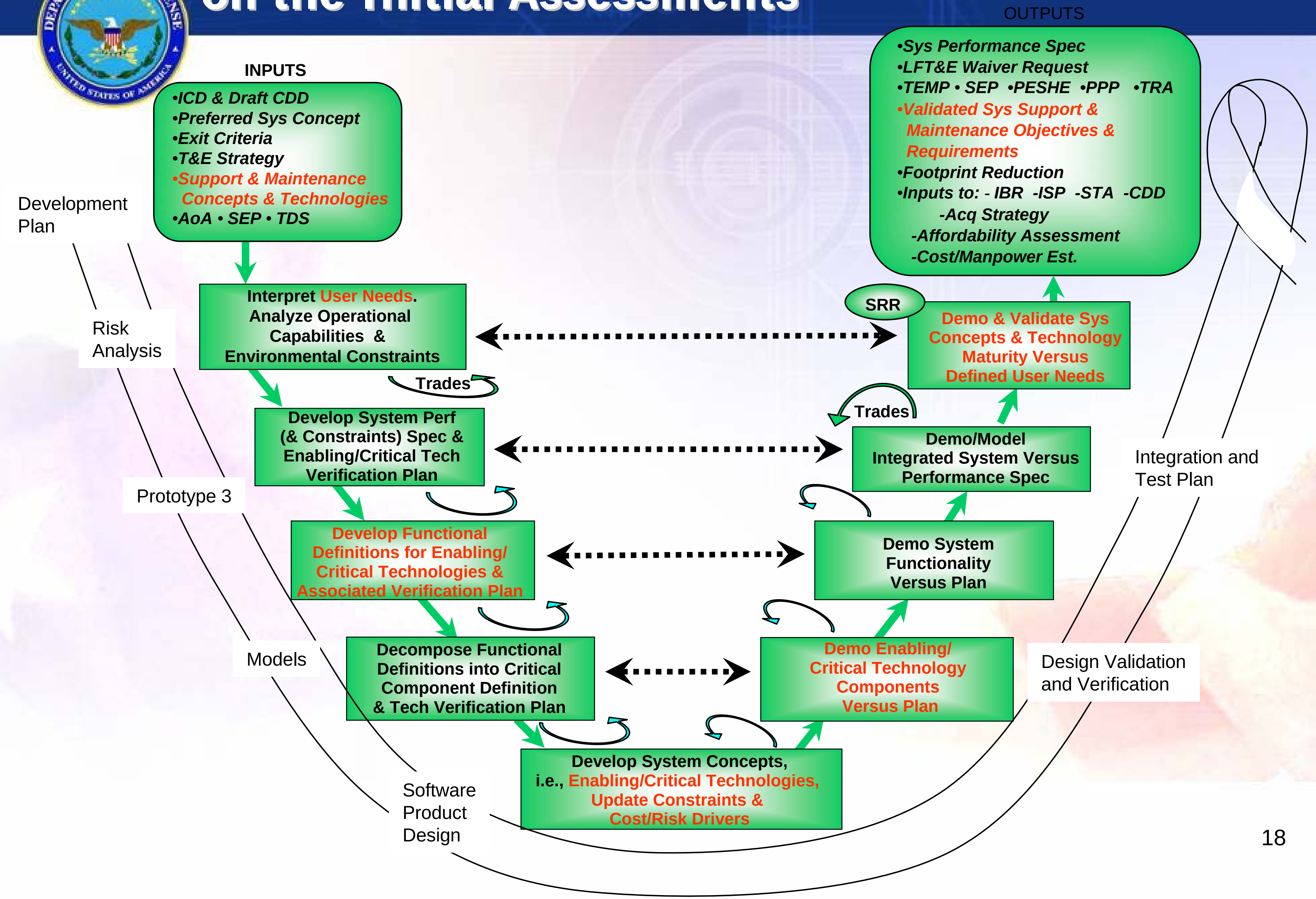
Technology Development Phase – Capitalize on the Initial Assessments



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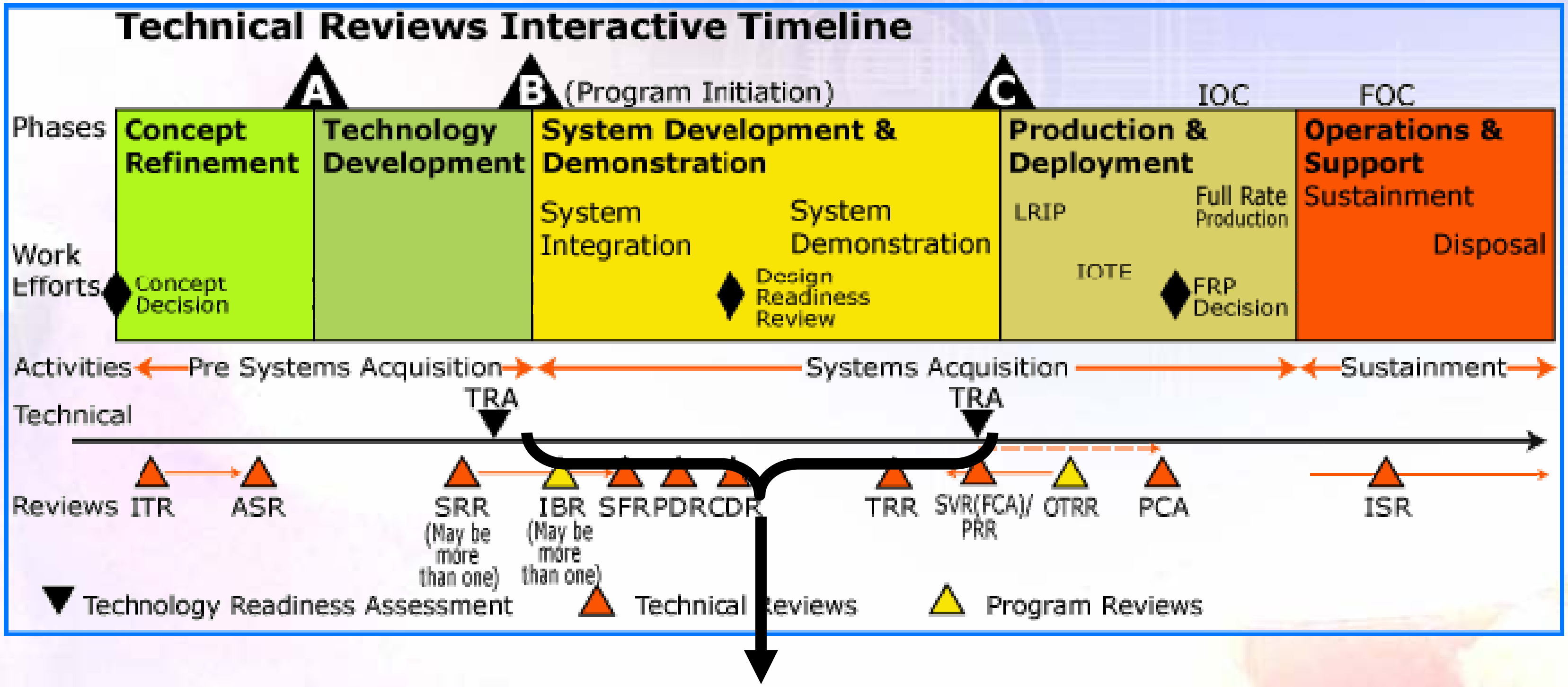
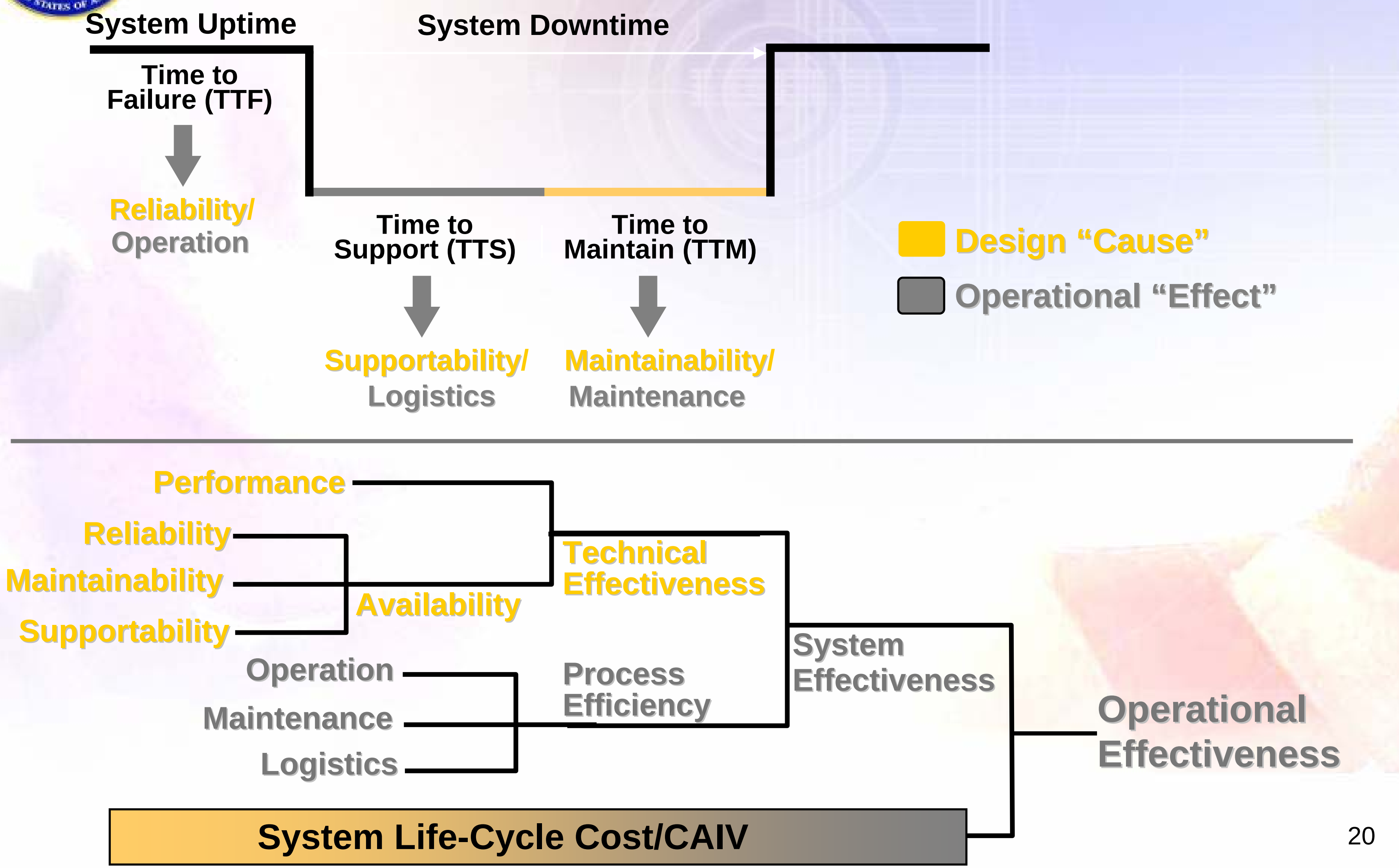


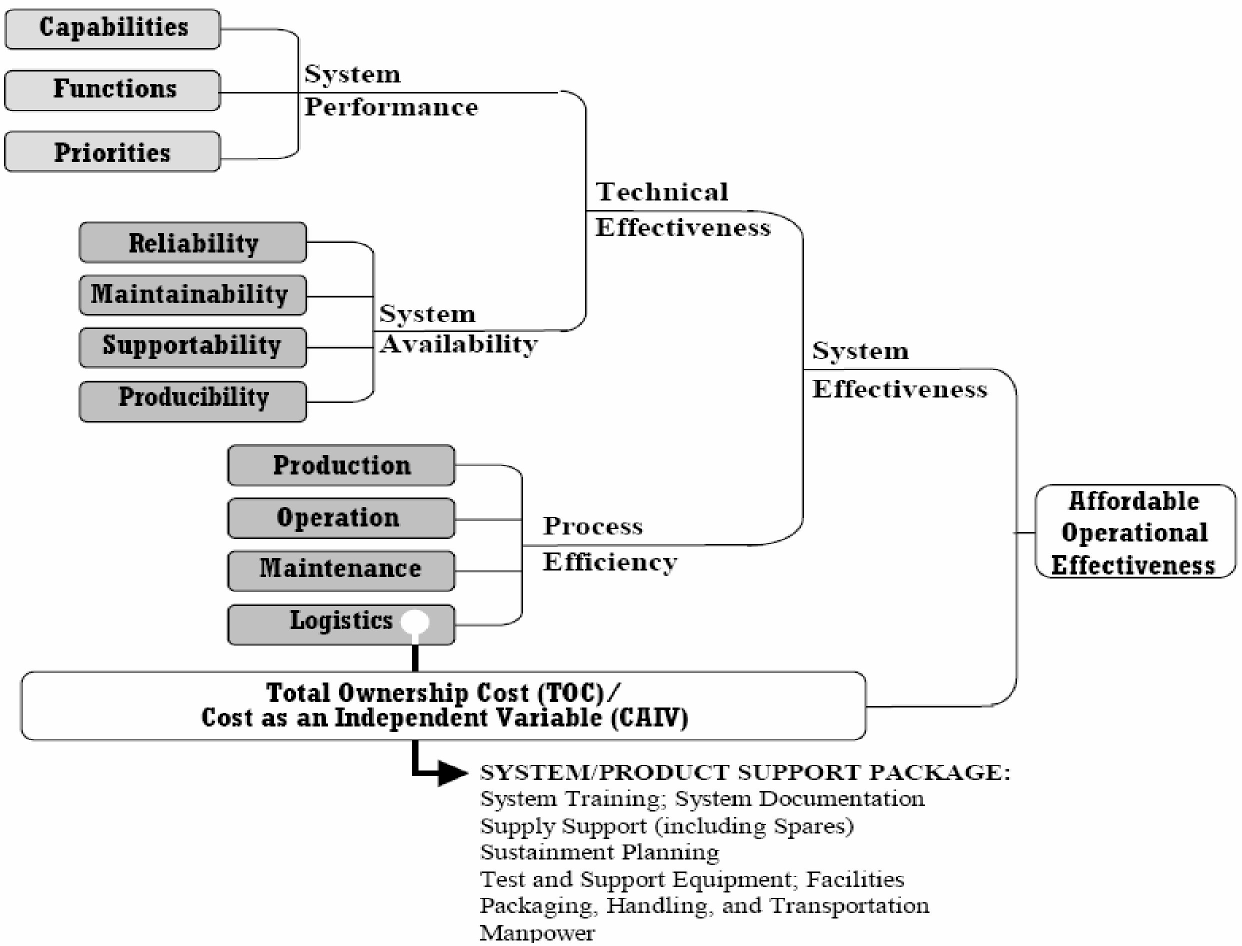
System Design for Operational Effectiveness, instead of just System Design

This was the emphasis in the Supportability Guide. This concept is also inherent in the Defense Acquisition Guide (DAG)

Design for System Operational Effectiveness



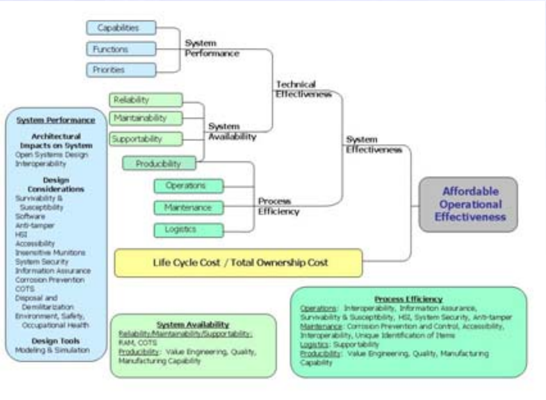
SDOE Components and Relationships



As articulated in the Supportability Guide...

SE Decisions: Important Design Considerations
Defense Acquisition Guidebook; Chapter 4, Section 4.4

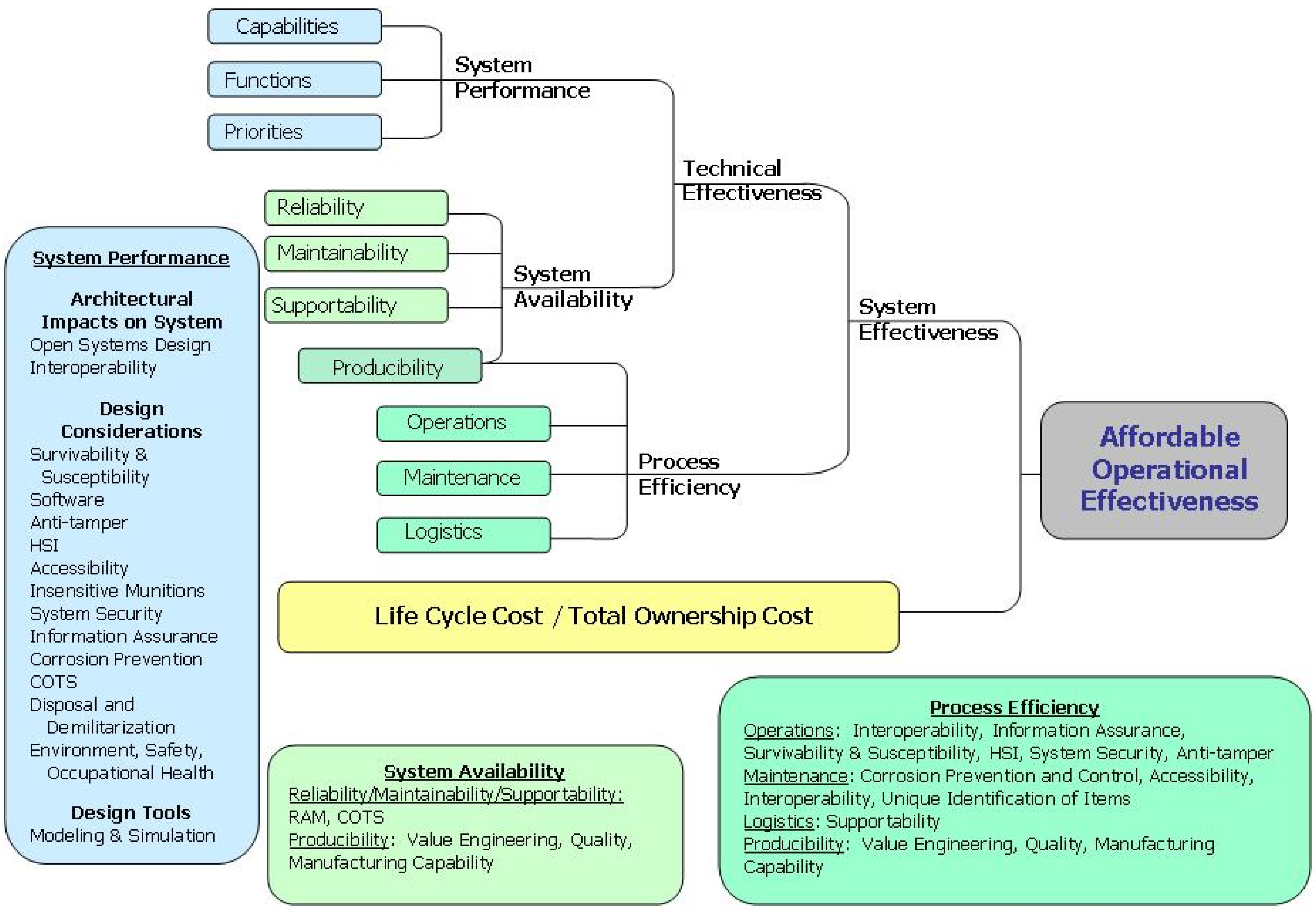
- SE must manage all requirements as an integrated set of design constraints
  - KPPs
  - Statutory
  - Regulatory
  - Derived performance requirements
    - Constraints
    - Usage, duty cycle, mission profiles



- Decomposition and allocation must address entire set at each level of recursion
- Integrated set of requirements and associated stakeholders are a primary driver for program staffing (non-trivial and a major source of program risk)

As articulated in the Defense Acquisition Guide...

Important Design Considerations "The Fishbone"



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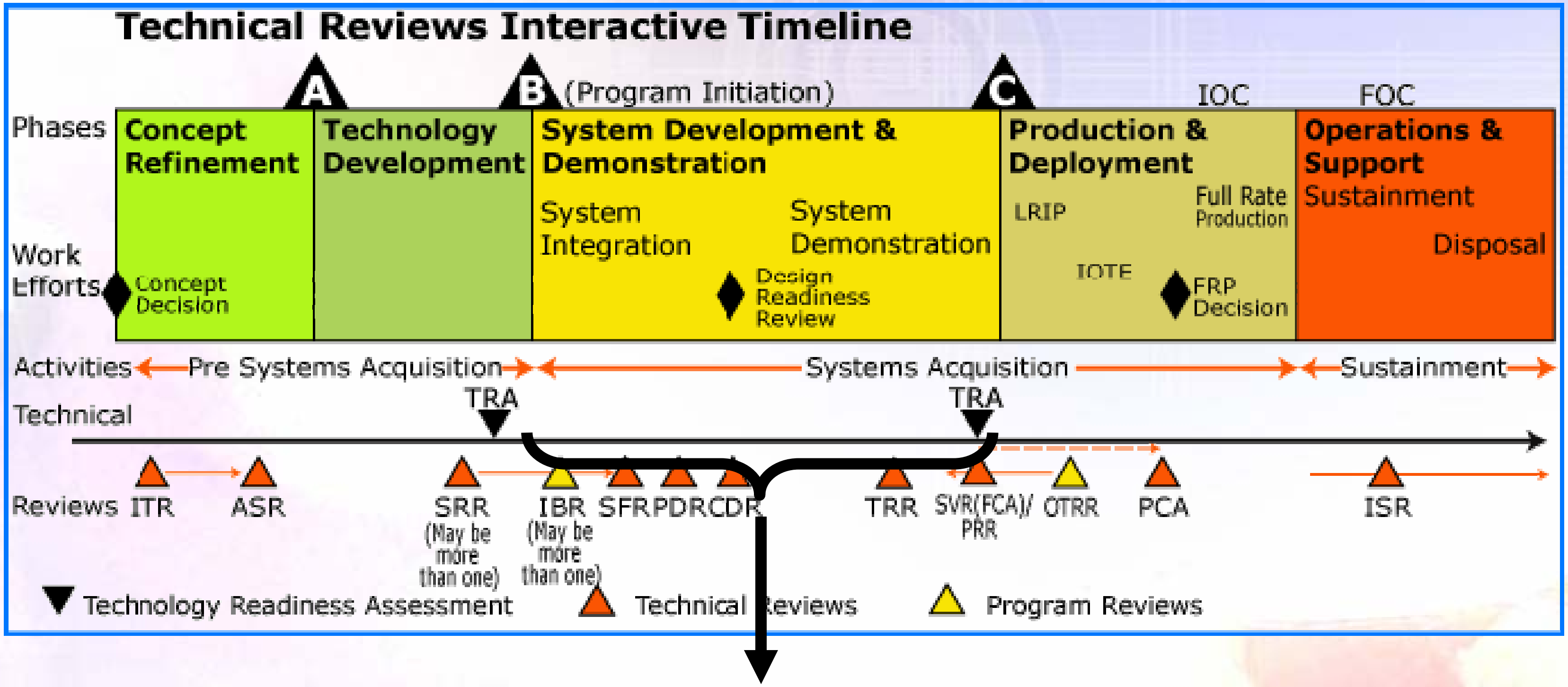

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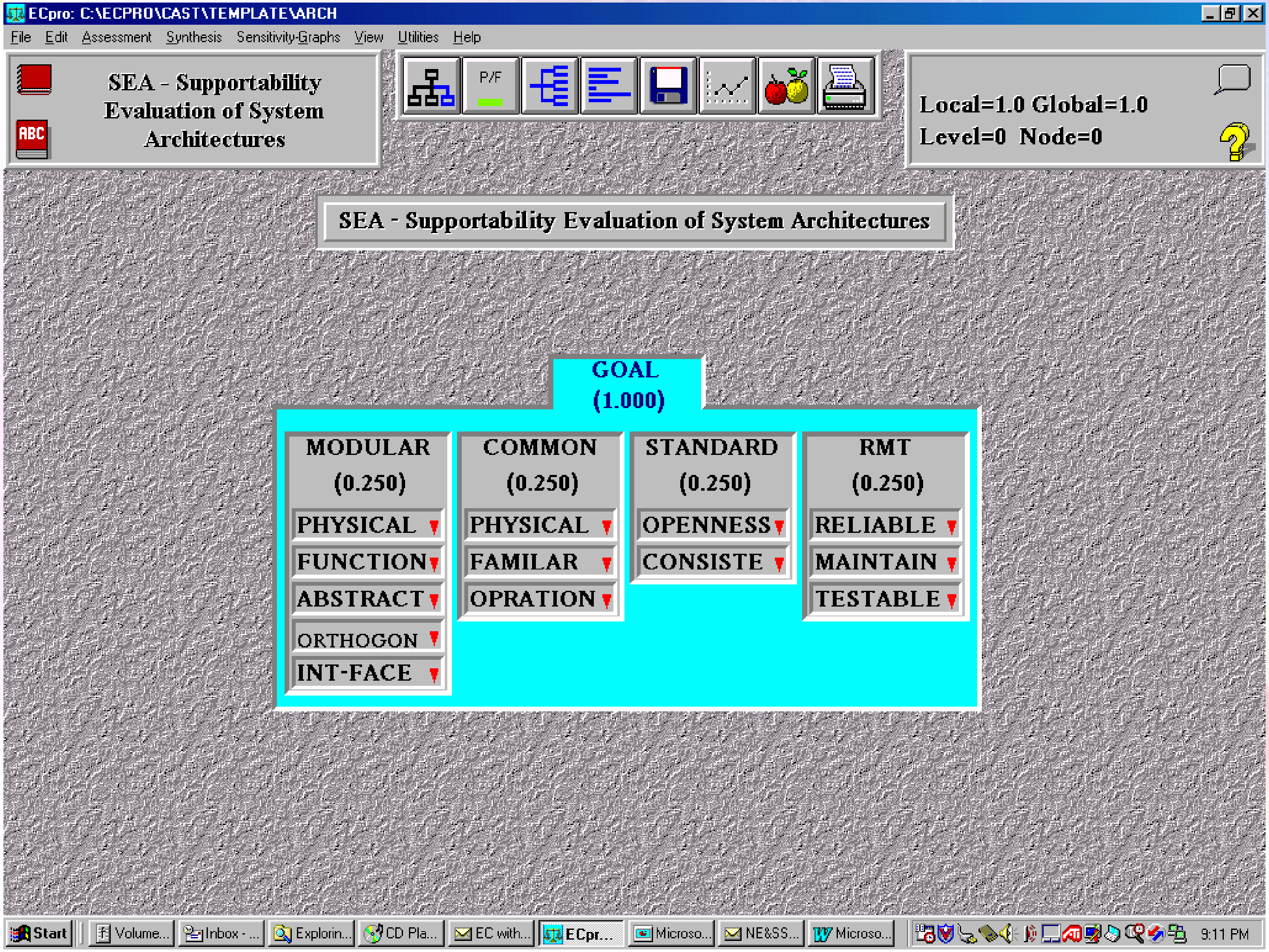
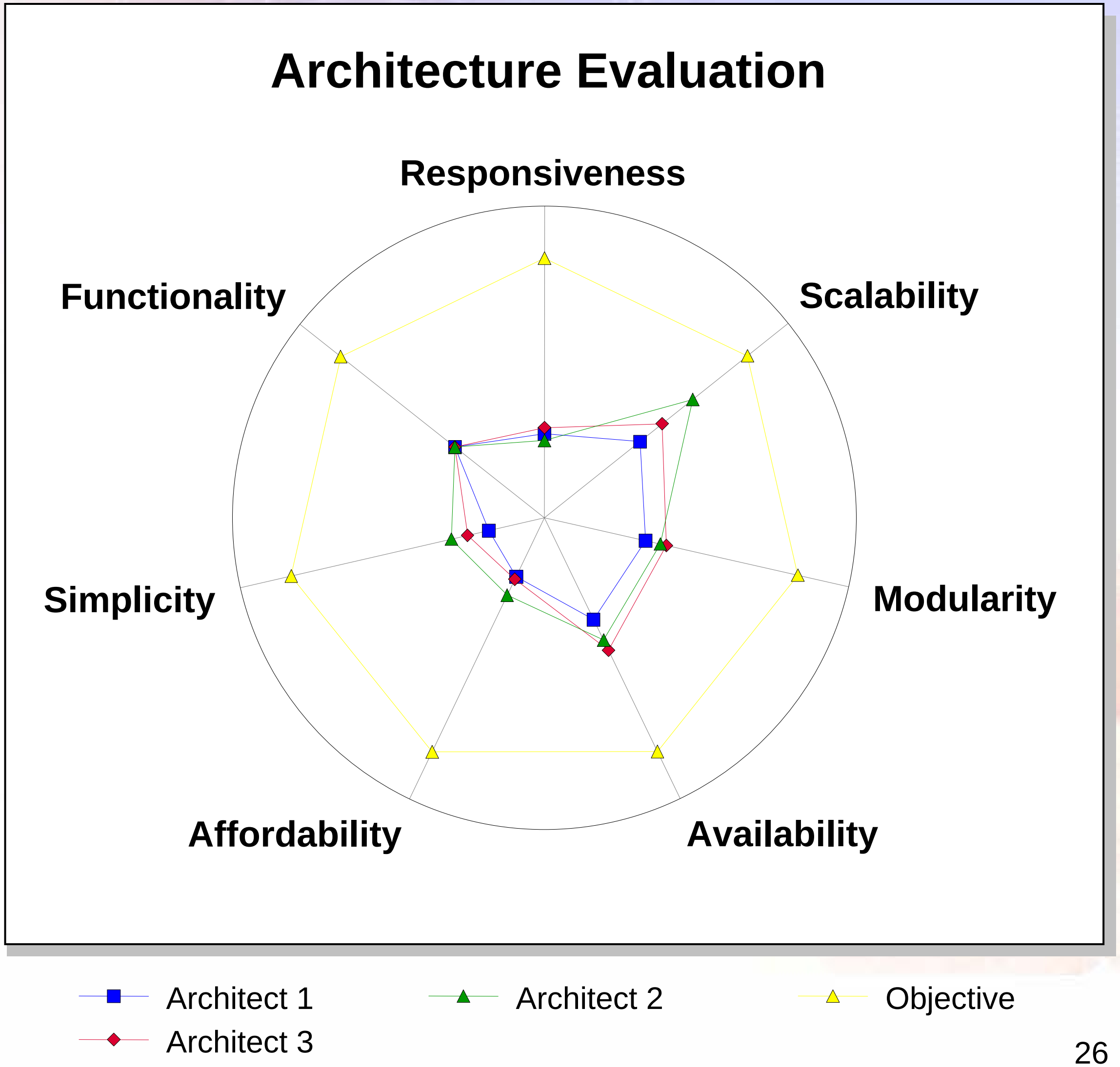
Let us consider System Architectures to illustrate the concept…

Evaluating Architectures from a Sustainment Perspective – Industry Sponsorship (COTS Focus)



Architecture Development:
Architecture Assessment and Evaluation – IT Context

- Architecture assessment conducted by three senior architects knowledgeable about the system
- Created a baseline for comparison with other alternatives
- Architectures are a strategic tool in today's environment for increased competitiveness and profitability
- Good requirement definition, understanding of stakeholder/customer expectations is key



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Architecture Development:
Architecture Assessment and Evaluation – Telecom

- Goal: Selecting the Best Base Station Architecture
  - 1. Functionality
  - 2. Flexibility
    - 2.1 Scalability
    - 2.2 Modularity
    - 2.3 Upgrades
    - 2.4 Compatibility and Consistency (Solution Harmony)
  - 3. Logisticability
    - 3.1 Ease of HW installation
    - 3.2 Ease of SW installation
    - 3.3 Serviceability and maintainability
    - 3.4 Learnability
    - 3.5 E-Business compatibility (move to 3.)
  - 4. Testability
    - 4.1 Built in testing
    - 4.2 Verification and acceptance testing
    - 4.3 Testing ease
  - 5. Commonality
    - 5.1 Hardware commonality
    - 5.2 Software commonality
    - 5.3 Operational commonality
    - 5.4 COTS and reuse
  - 6. Reliability and Availability
  - 7. Simplicity
    - 7.1 Interfaces
    - 7.3 Orthogonality (Solution Harmony)
  - 8. Affordability
    - 8.1 Costs
    - 8.2 Timeliness and Profitability
    - 8.3 Customizability
    - 8.5 Environmental Issues
  - 9. Future proofness issues
    - 9.1.1 Industry acceptance
    - 9.1.2 Business horizontalization
    - 9.1.3 Control over the product

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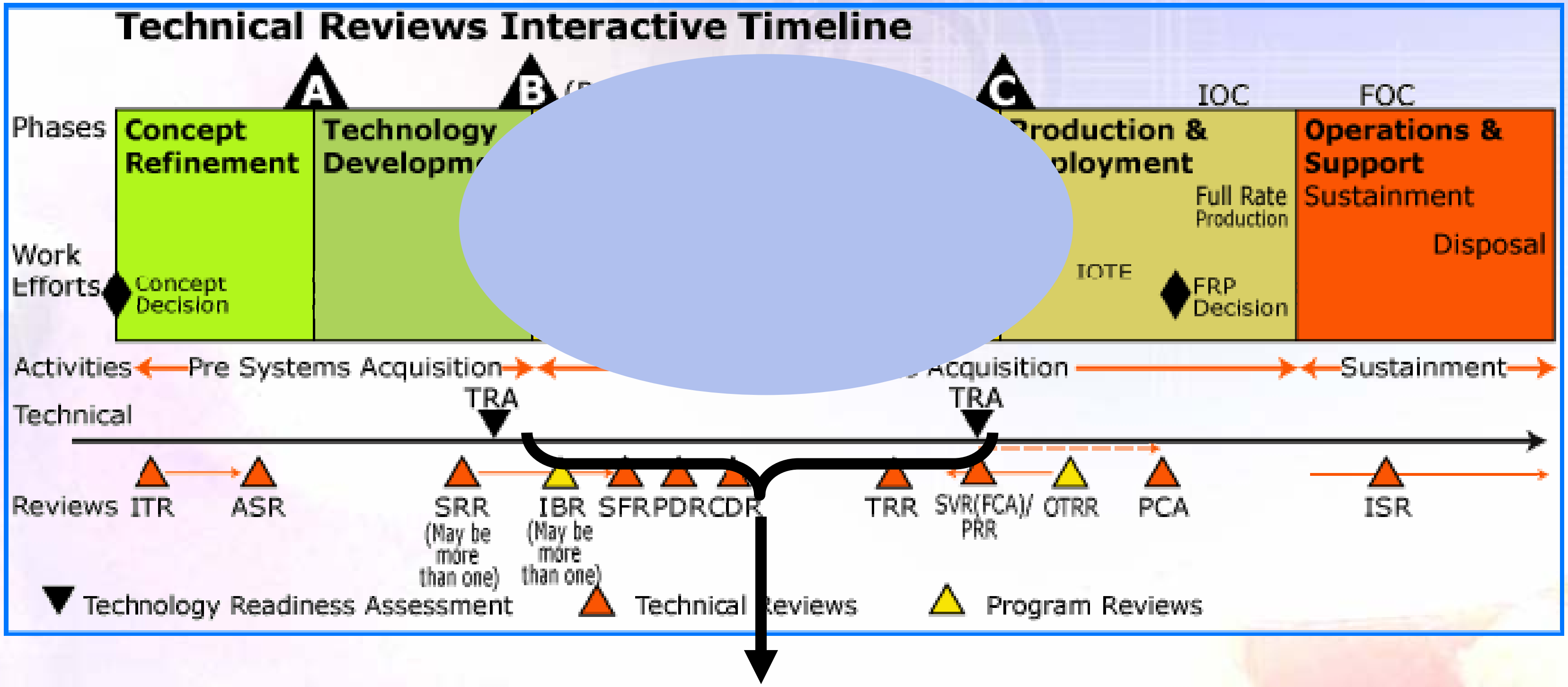

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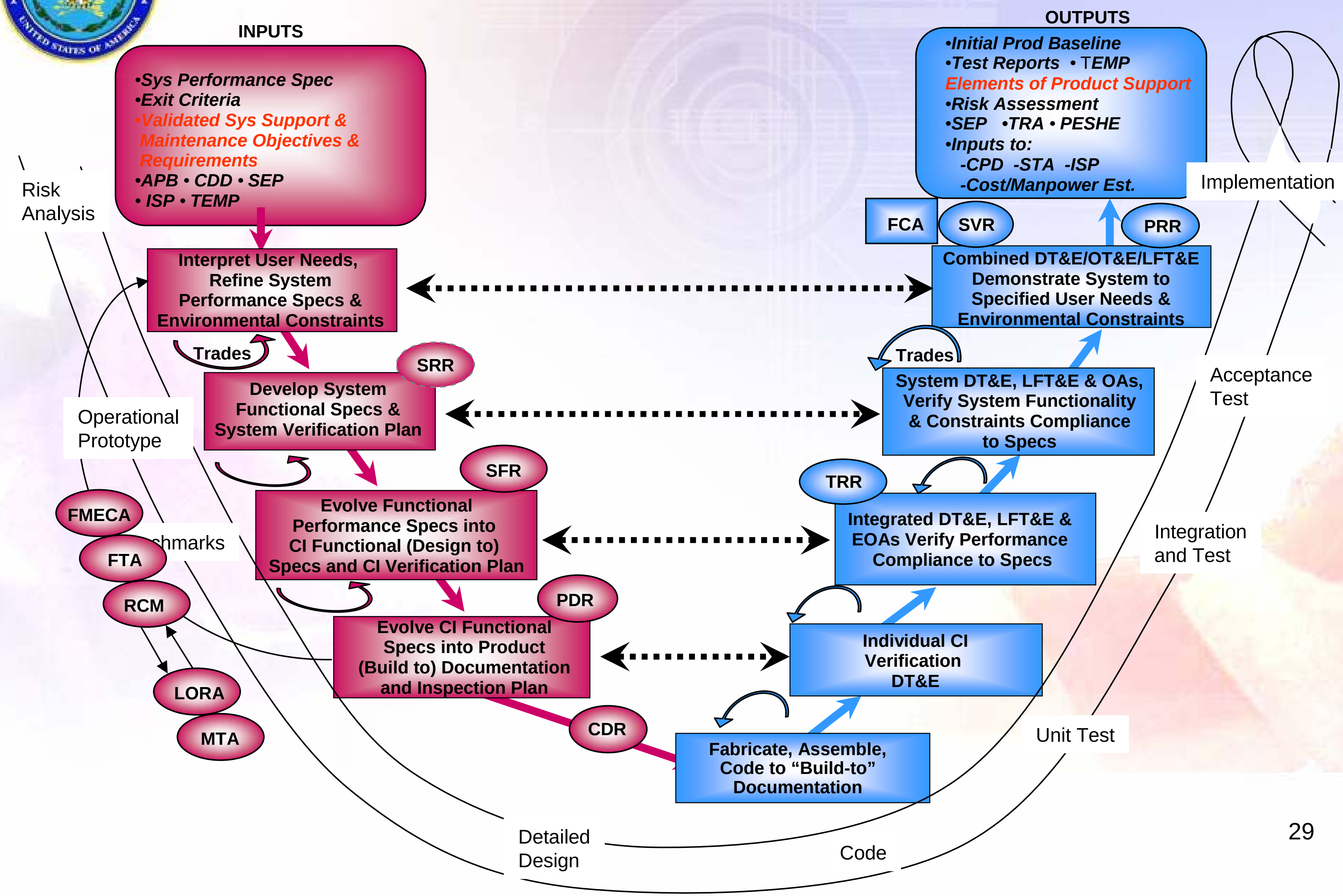
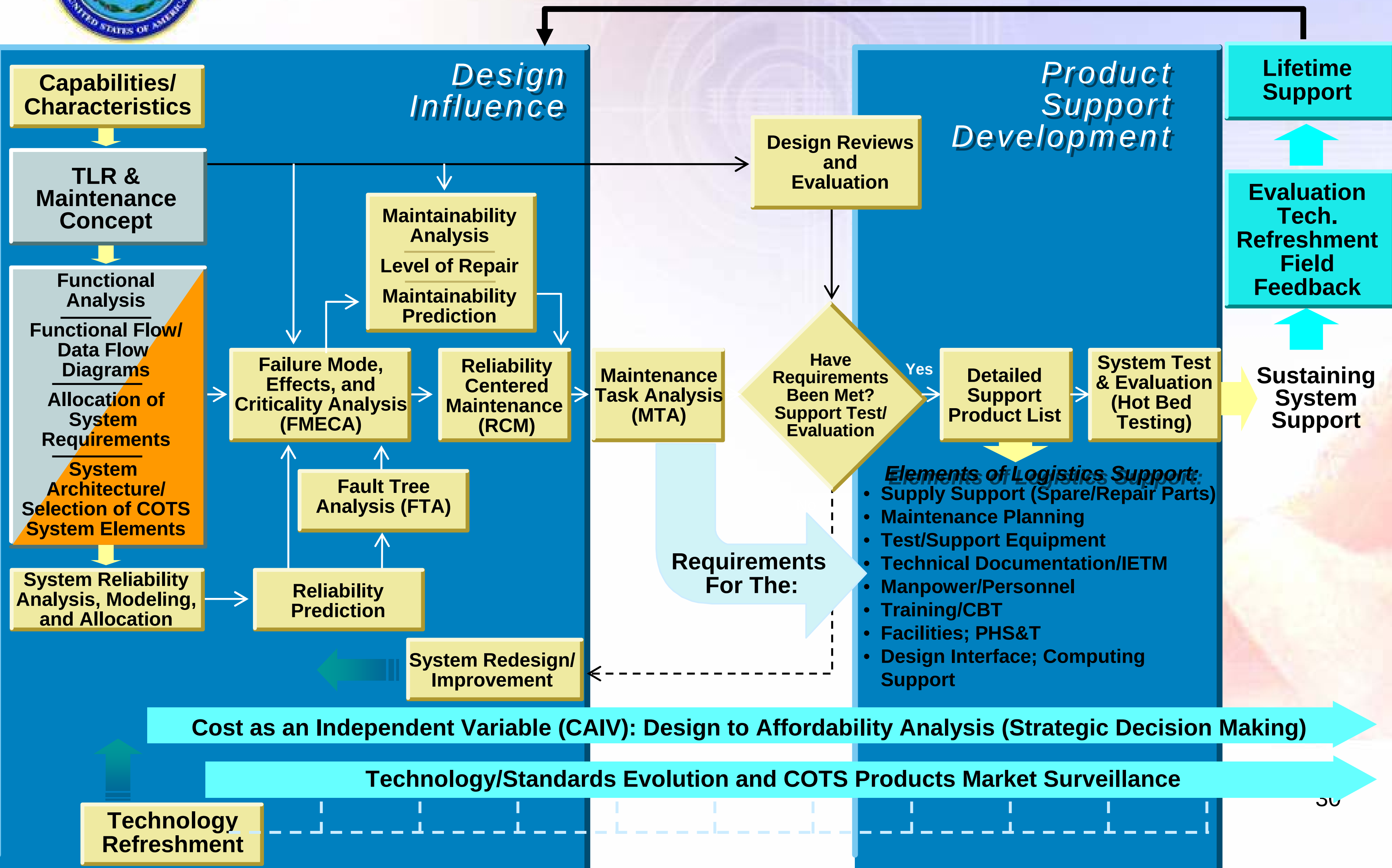
System Development and Demonstration Phase



Systems and Supportability Engineering Process



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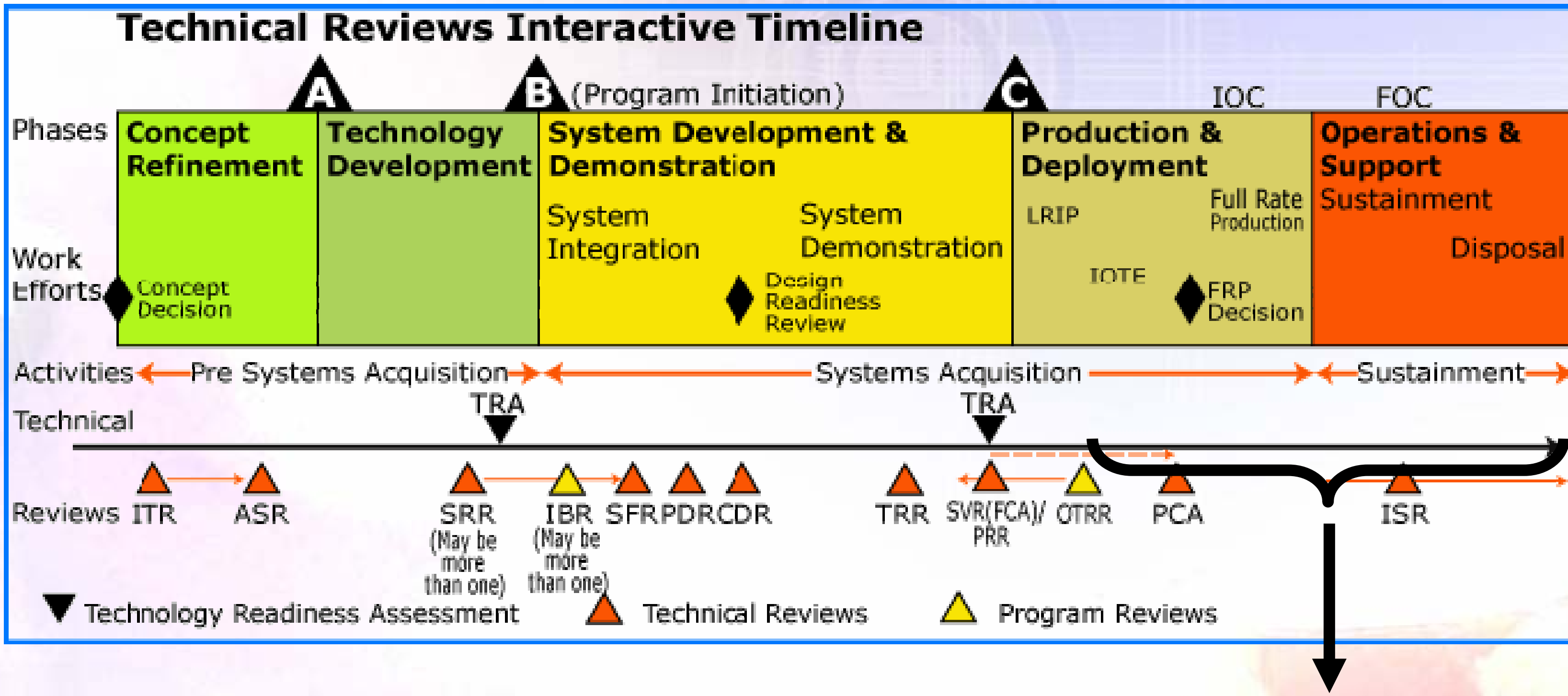
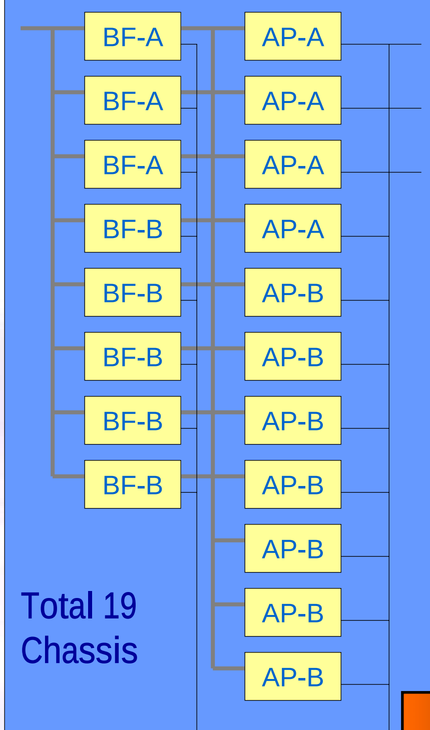


Performance Based Logistics, instead of just Material Readiness, Spares Optimization, and the like…

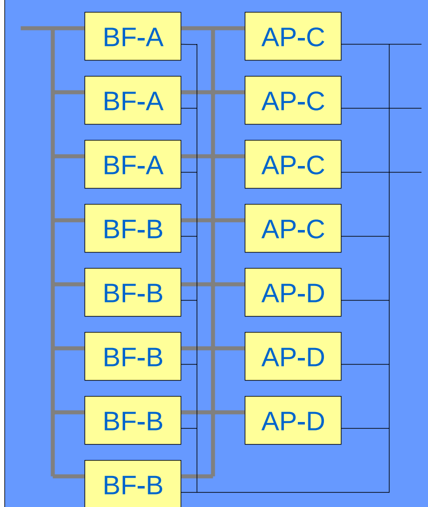
Current Trends in System Development:
COTS, Reusable and Common Platforms and Components

Reference Configuration



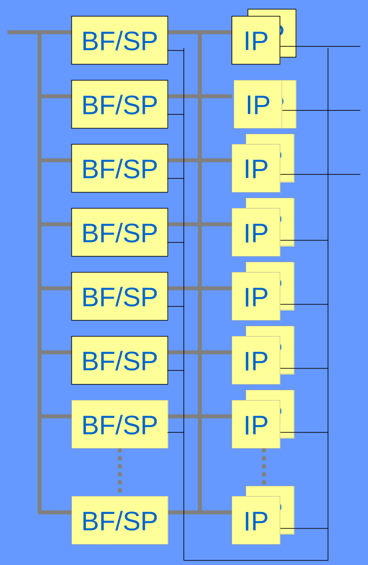
Total 19 Chassis

'98 Technology Update



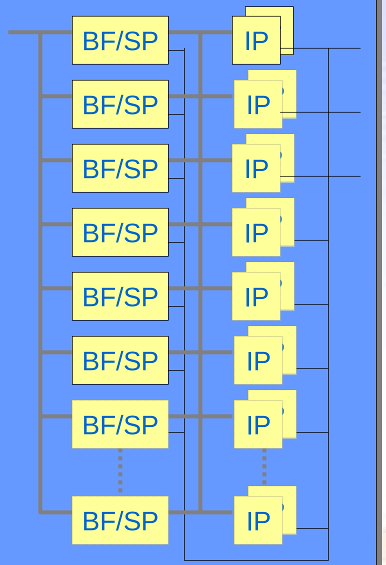
Total 15 Chassis

'00 Technology Update



Total 7 Chassis

Technology Refresh



Total 7 Chassis

Processing Summary
1995-Level Technology

8 Beamformers - 75 GOPS

11 Allocatable Processors - 65 GOPS

Total Throughput - **140 GOPS**

Processing Summary
1998-Level Technology

8 Beamformers - 75 GOPS

7 Allocatable Processors - 75 GOPS

Total Throughput - **150 GOPS**

Processing Summary
2000-Level Technology

6 BF/Signal Processors - 240 GOPS

2 Information Processors - 30 GOPS

Total Throughput - **270 GOPS**

Processing Summary
2003-Level Technology

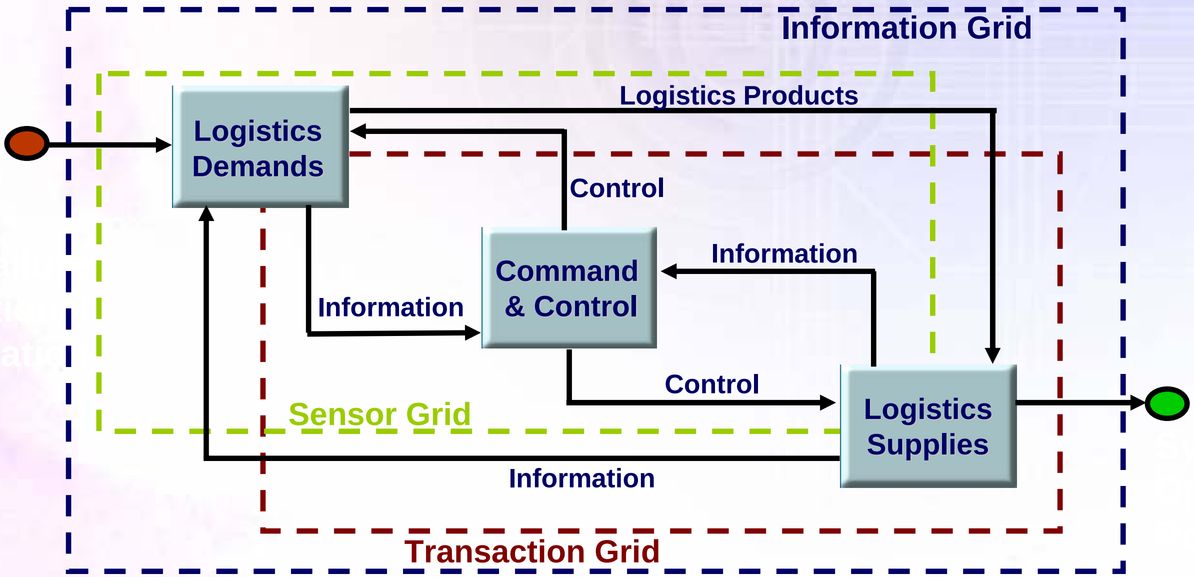
6 Beamformers - 380 GOPS

2 Information Processors - 50 GOPS

Total Throughput - **430 GOPS**

Current Trends in System Development:

Network Centric Warfare must be supported by Network Centric Logistics Planning



Sense demands and requirements at the Equipment Level . . .

Supply at the Fleet Level (Cross Platform) . . .

The Metrics...

- Operational Availability
- Operation Reliability
- Cost per Unit Usage
- Logistics Footprint
- Logistics Response Time

Multi-Asset, Multi-Echelon... Modeling and Simulation

An offer!!

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