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System Safety in Systems Engineering Process

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NDIA 8th Annual Systems Engineering Conference

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Overview

- The Big Question
  - System Safety
  - Systems Engineering
- Classic System Safety Model
- OSD(AT&L) Life Cycle Management Framework
- Systems Engineering V-model
- "Integrated" System Safety Model
- Summary

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The Big Question

- **Have you ever wondered:**
  - **Why is it that it's *Systems* Engineering,**
  - **But it's *System* Safety?**
  - **What happened to the "s"?**
  - **Have you asked yourself this same question?**
  - **And, it's been used inconsistently at this conference!!**
- **Let's explore this for a few minutes**

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What is System Safety?

- **Engineering of Safe Systems or Safety of Systems**
- **Systems Safety – the discipline**
- **System Safety – the application of the discipline of systems safety to a specific system or a system of systems**
- **and…**

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What is Systems Engineering?

- Engineering of Systems
- Systems Engineering – the discipline
- System Engineering – the application of the discipline of systems engineering to a specific system or a system of systems
- One Air Force Program Office used the terminology Director of "System Engineering" because according to the Director, they were working on only one system (contextually-based)
- But what it points to…

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System Safety versus Systems Engineering

- Lack of effective integration of Systems Safety within Systems Engineering (or System Safety within System Engineering at the project level)
- Real issue is System Safety Requirements and ensuring System Safety is effectively integrated into product realization
- So…what do we do?
- First, we might use a standard definition of system
- But keep that question in mind while we discuss some other ideas

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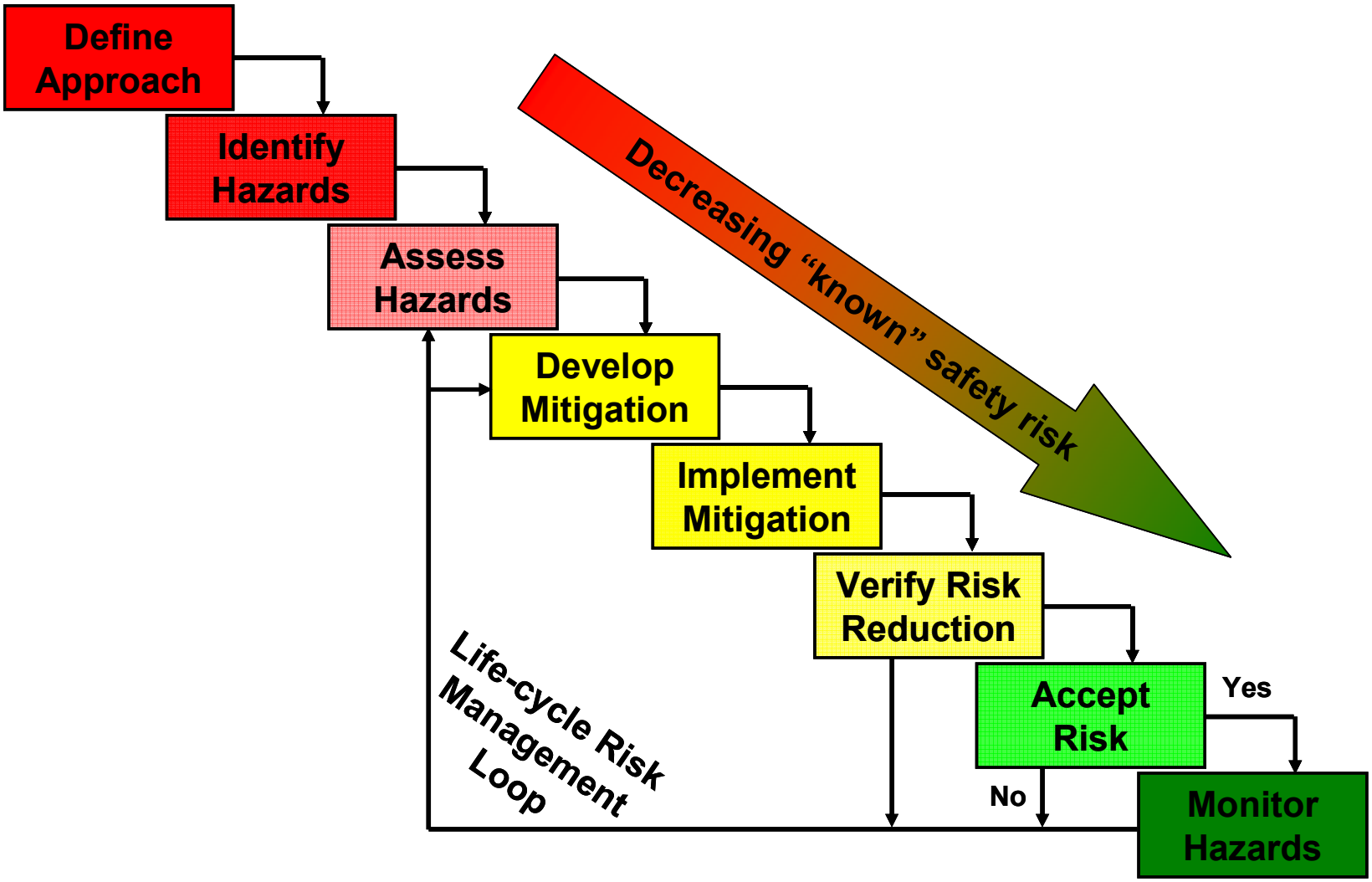
Classic System Safety Model

(MIL-STD-882D)



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Classic System Safety Model

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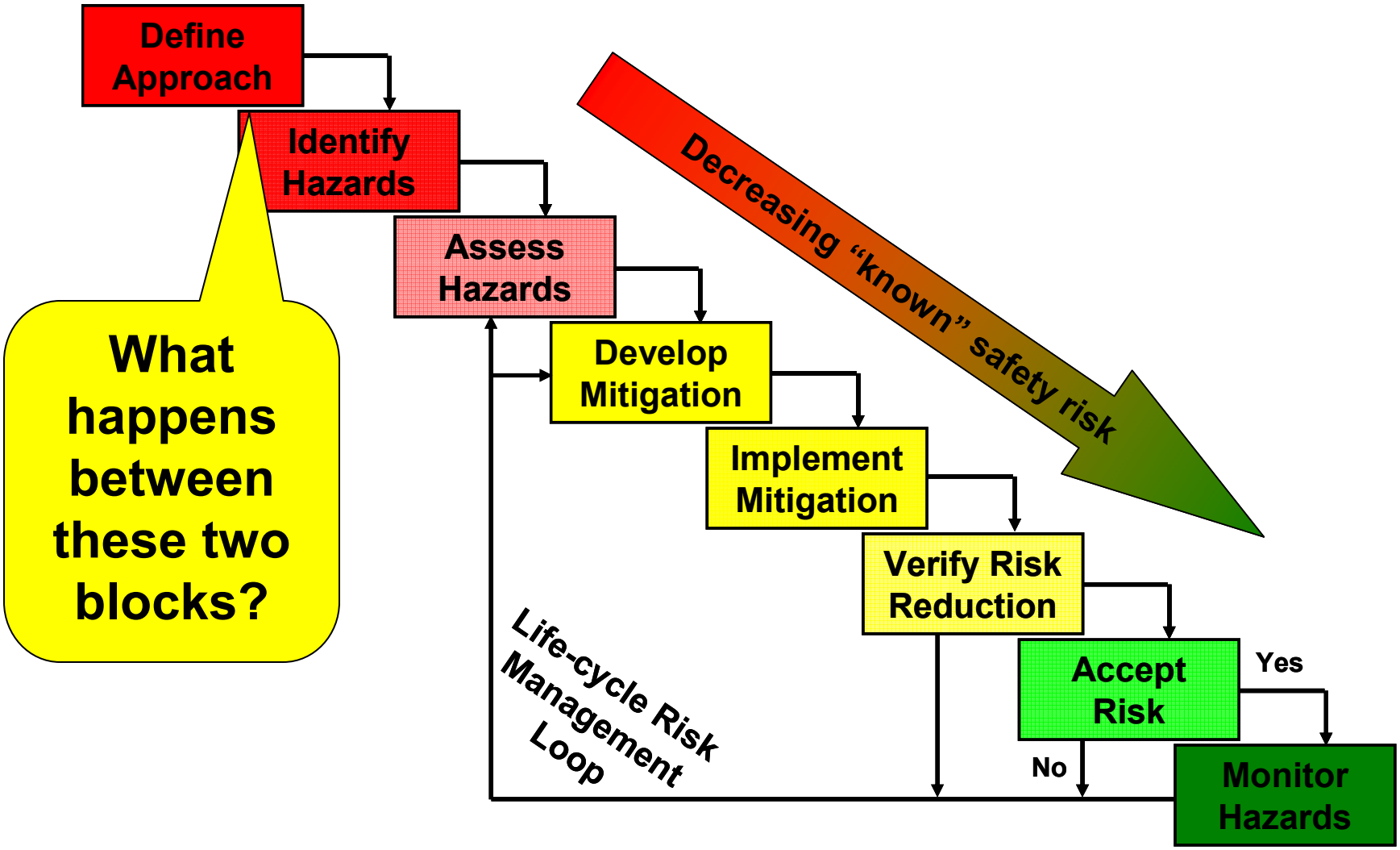

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DoD 5000.1 Acquisition Phases

- **Major System Acquisition Phases**
  - **Concept Refinement**
  - **Technology Development**
  - **System Development & Demonstration**
    - **System Integration**
    - **System Demonstration**
  - **Production & Deployment**
    - **Low-rate Initial Production**
  - **Operations & Support**
    - **Full-Rate Production and Deployment**
    - **Sustainment**
    - **Disposal (Recycle/Reuse, Reprocessing or Disposal)**

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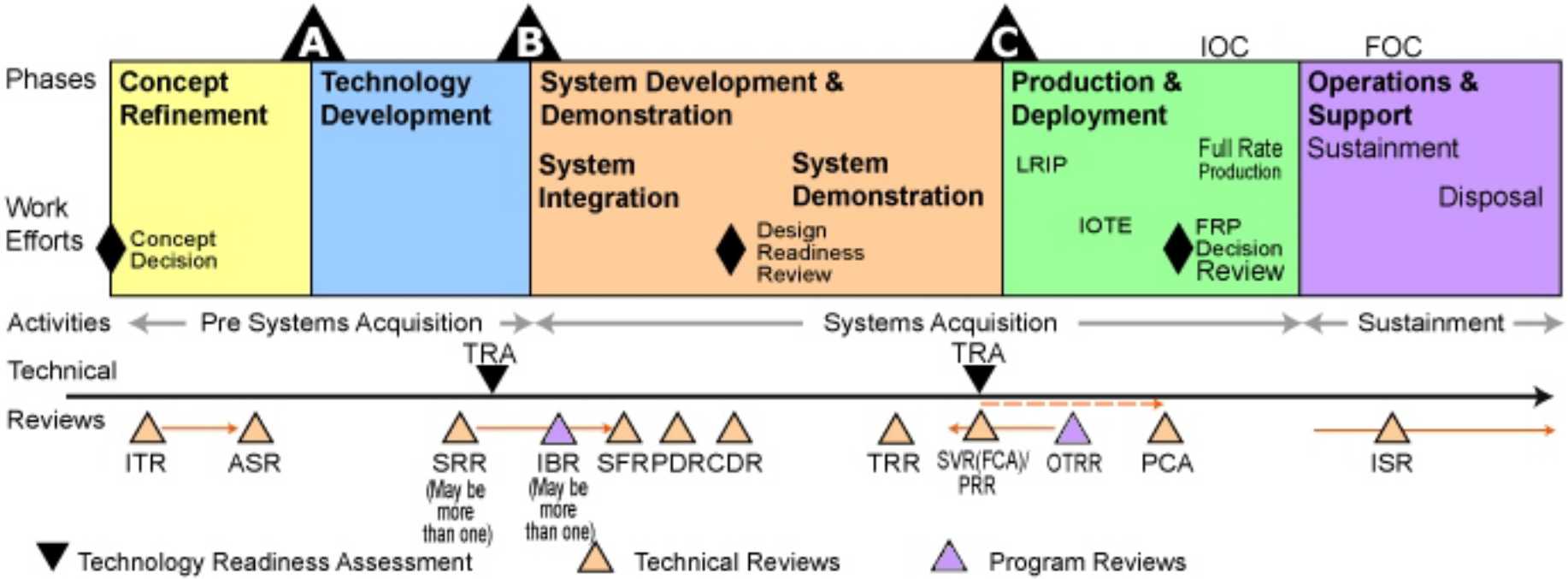
DoD 5000.1 Acquisition Phases



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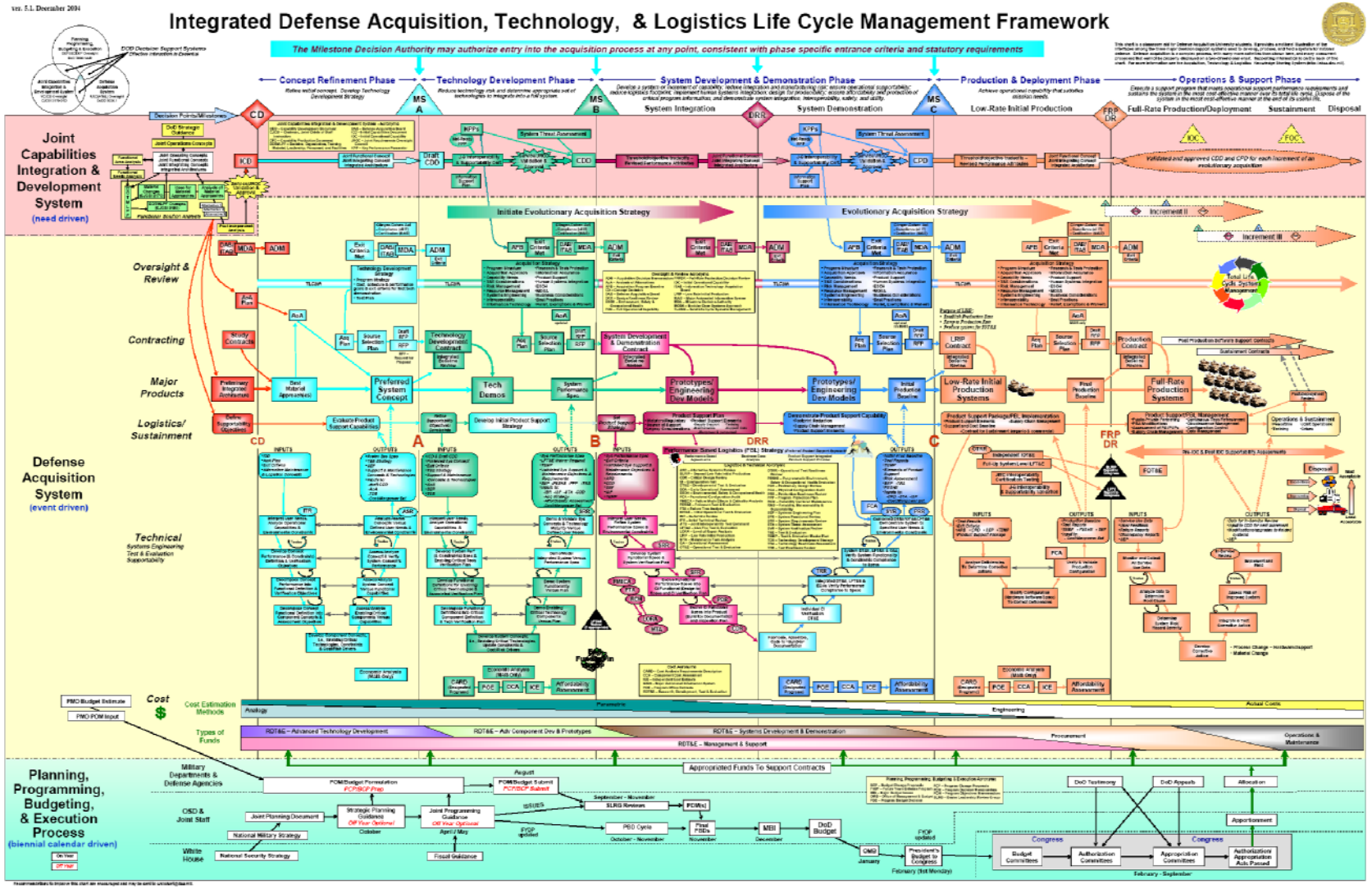
Integrated Systems Engineering "The Wall Chart"



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Phase Characteristics

- Phase-specific Technical Baseline
- Phase-specific “Requirements” Review including “Derived” Requirements
- Requirements Analysis
- Functional Decomposition
- Functional and Physical Allocations
- Subsystem and Component Specifications
- Component, Subsystem & System Integration
- Verification and Validation Activities

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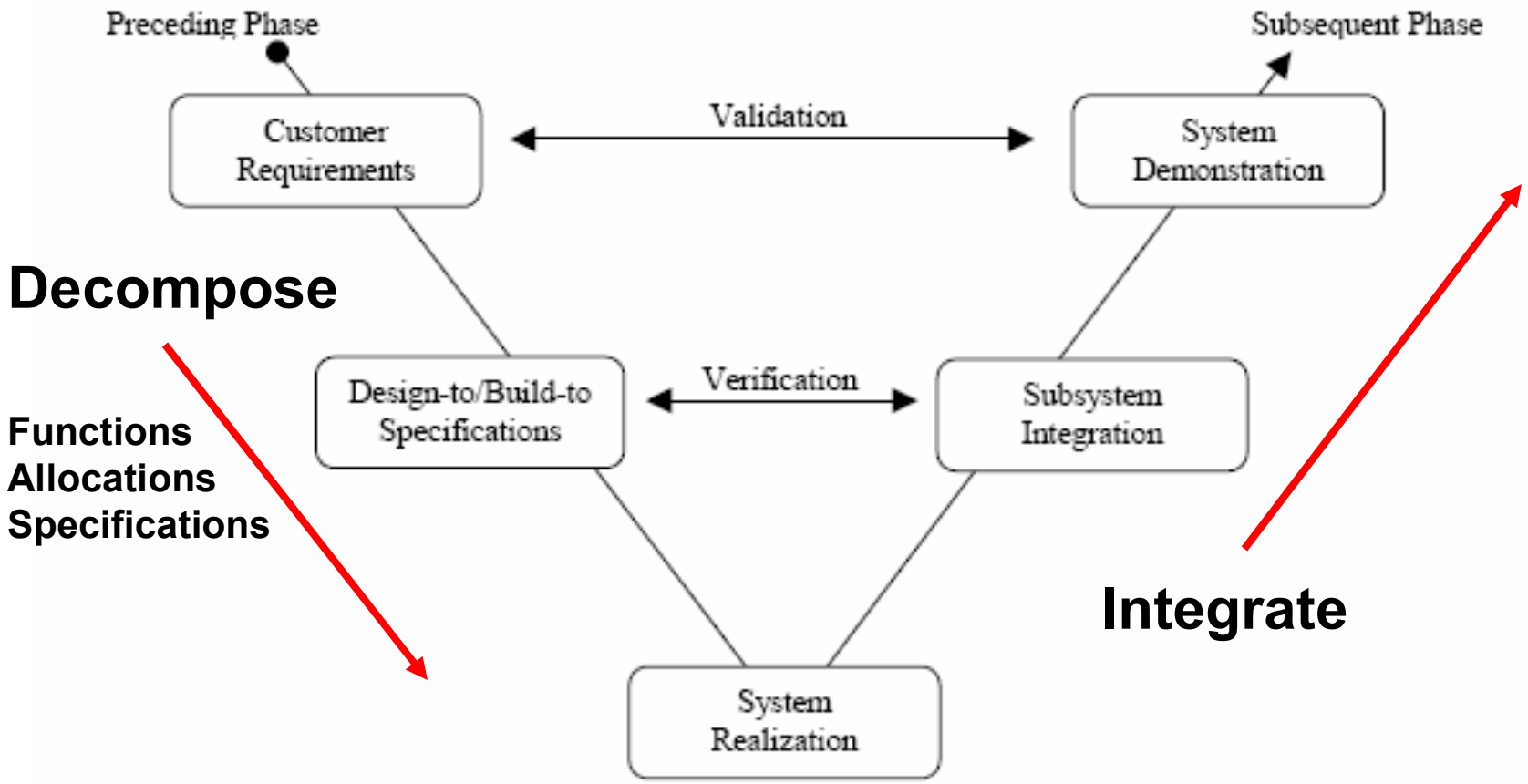
Systems Engineering V-model
(generalized)



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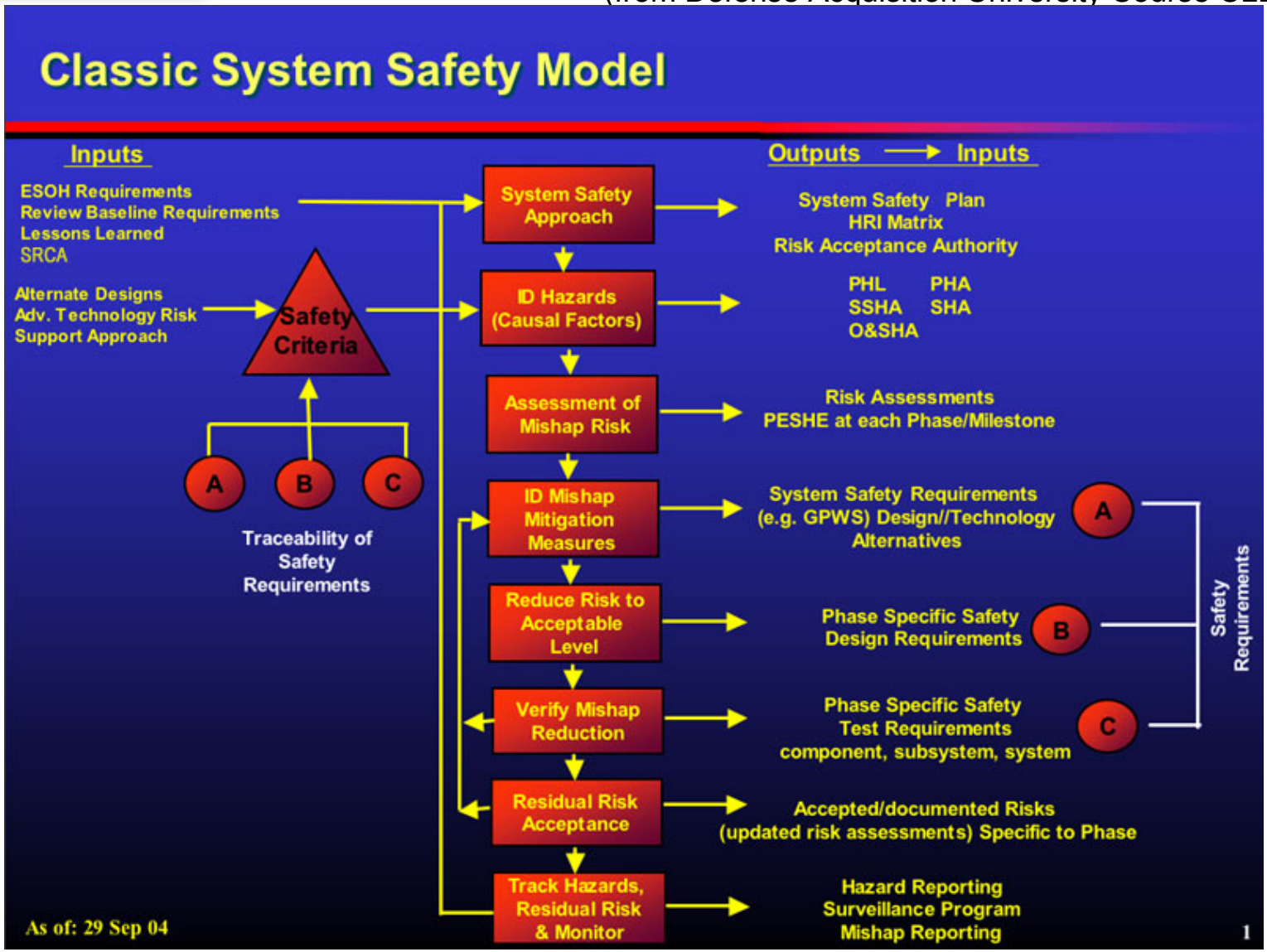
"Integrated" System Safety Model

(from Defense Acquisition University Course CLE009)



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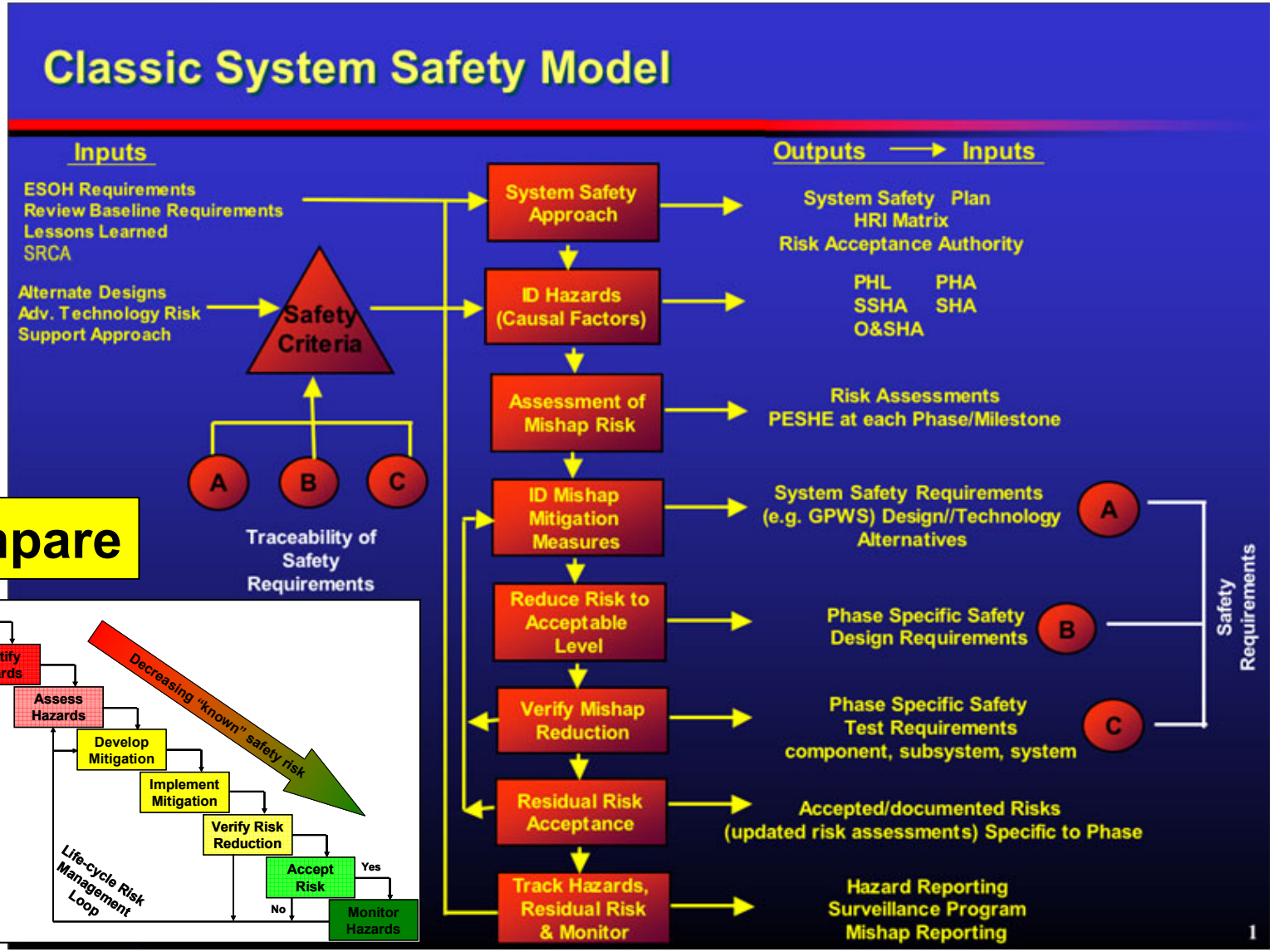
"Integrated" System Safety Model



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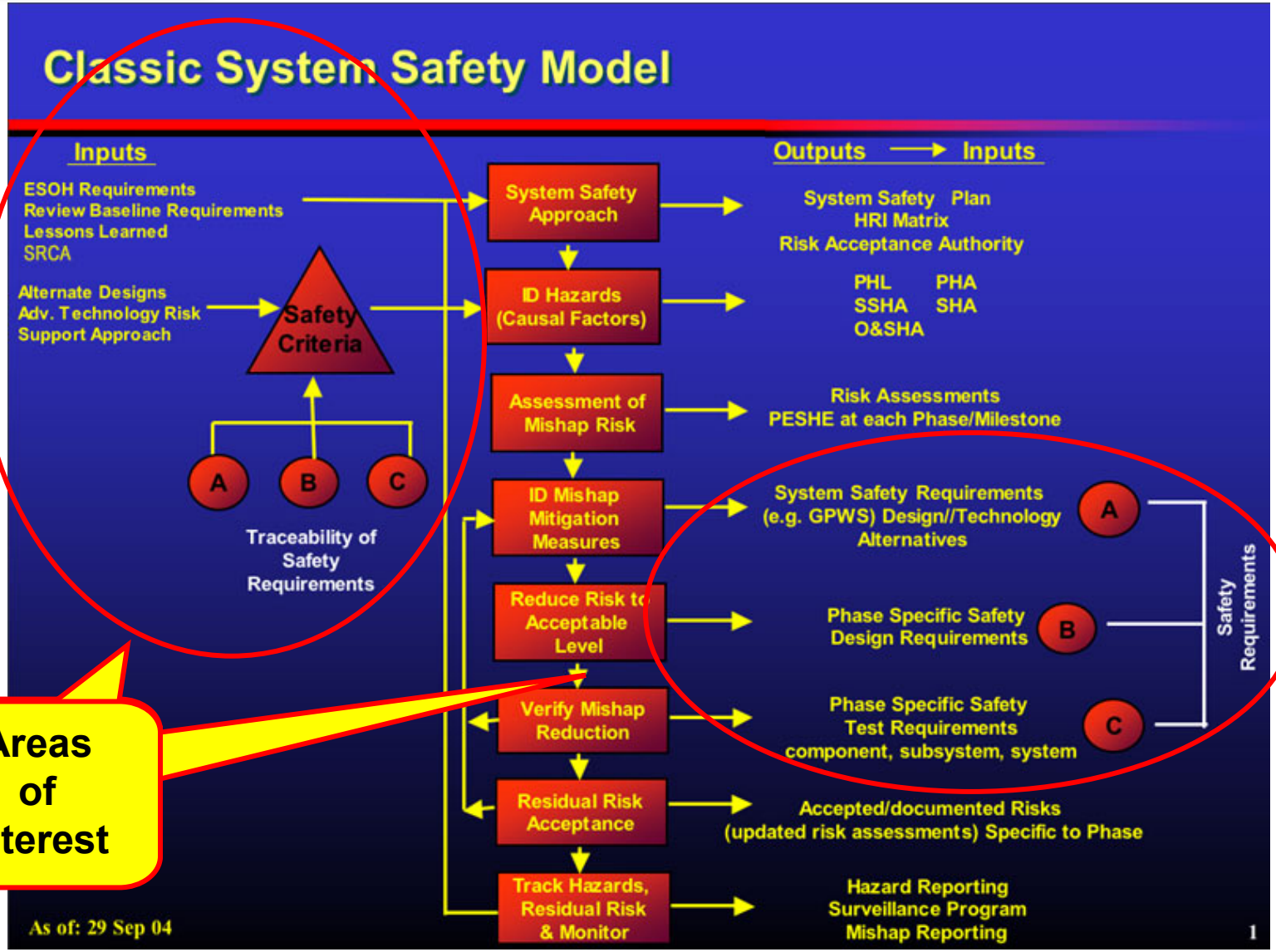
"Integrated" System Safety Model



Areas of Interest

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System Safety Requirements

- **Phase Specific**
- **Managed with Other System Engineering Artifacts**
  - **Requirements Traceability (requirements tool)**
  - **CONOPS, Conceptual Design & System Architecture**
  - **Verification and Validation Tests (e.g., TEMP)**
- **Part of Technical Baseline for Each Phase**
  - **Alternative System Review**
  - **System Functional Review**
  - **System Requirements Review**
  - **Preliminary Design Review**
  - **Critical Design Review**
  - **Test Readiness Review**

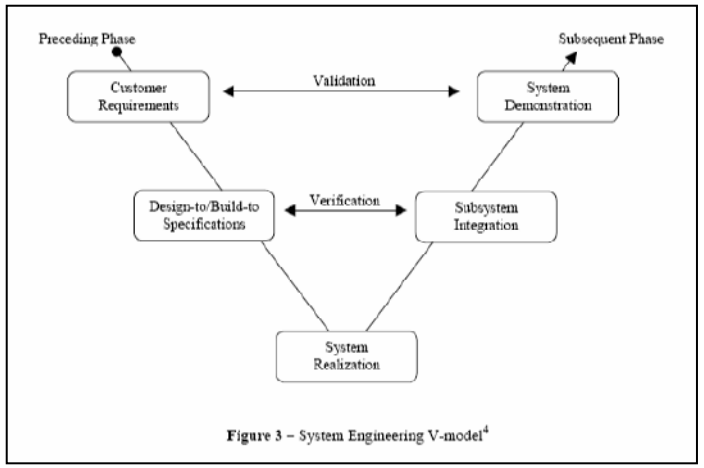

Figure 3 – System Engineering V-model[4]

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System Safety Requirements

- **Phase Specific**
- **Managed with Other System Engineering Artifacts**
  - **Requirements Traceability Matrix**
  - **CONOPS, Conceptual Design & System Architecture**
  - **Verification and Validation Tests (e.g., TEMP)**
- **Part of Technical Baseline for Each Phase**
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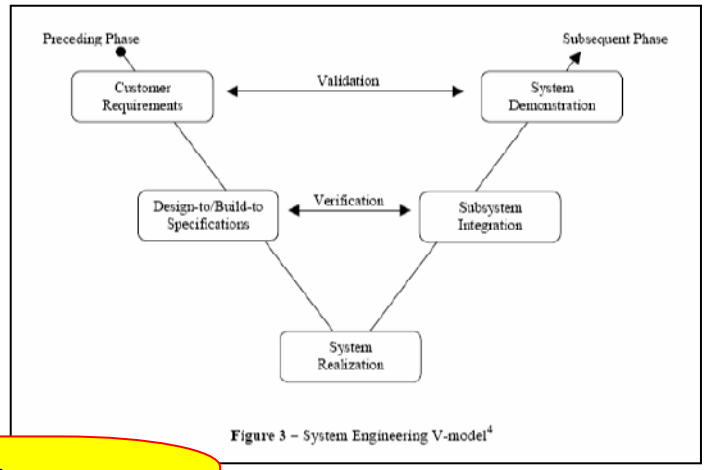

Figure 3 – System Engineering V-model[4]

Somewhere just before here is typical entry point!!

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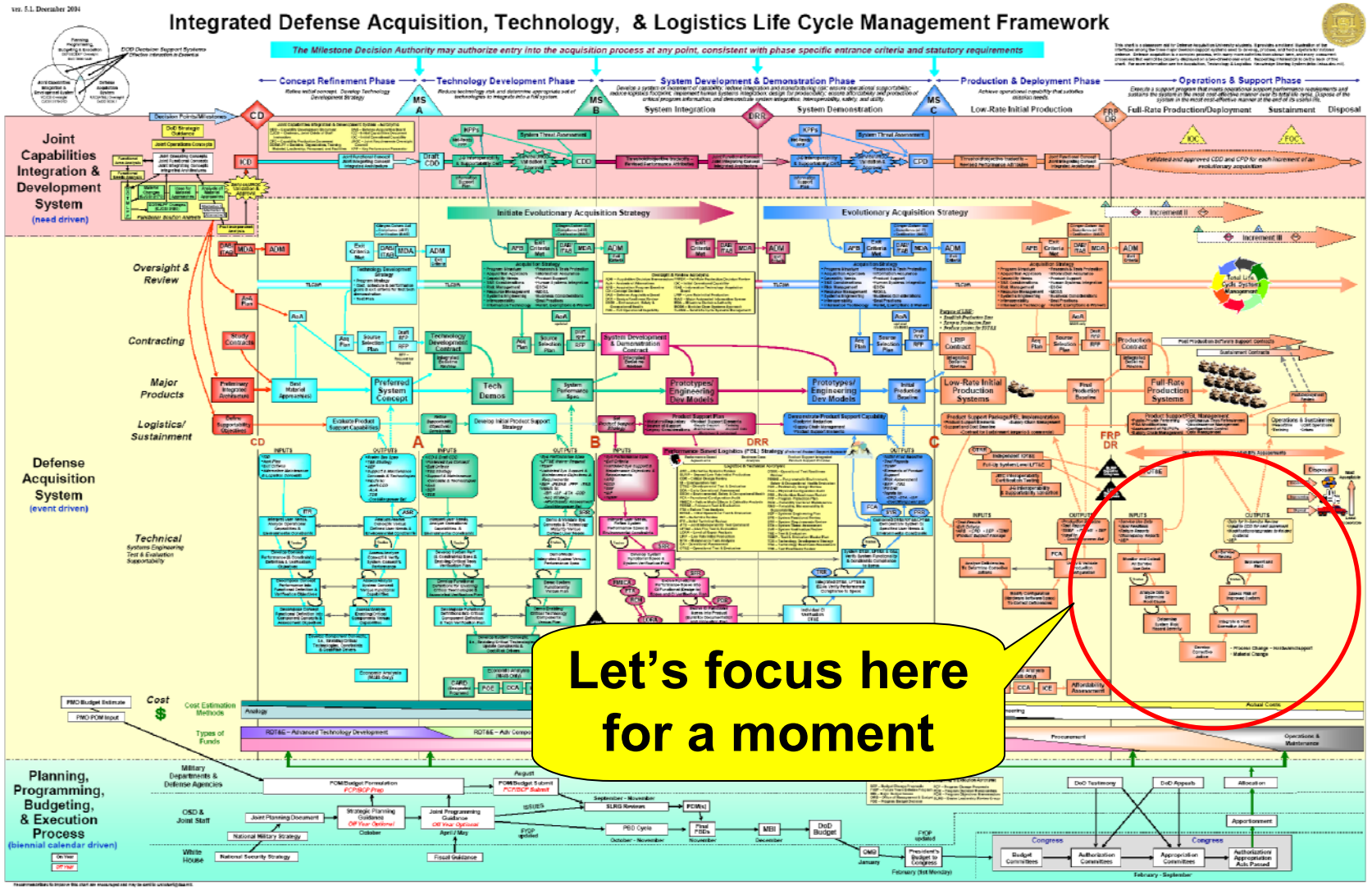
Integrated Systems Engineering "The Wall Chart"



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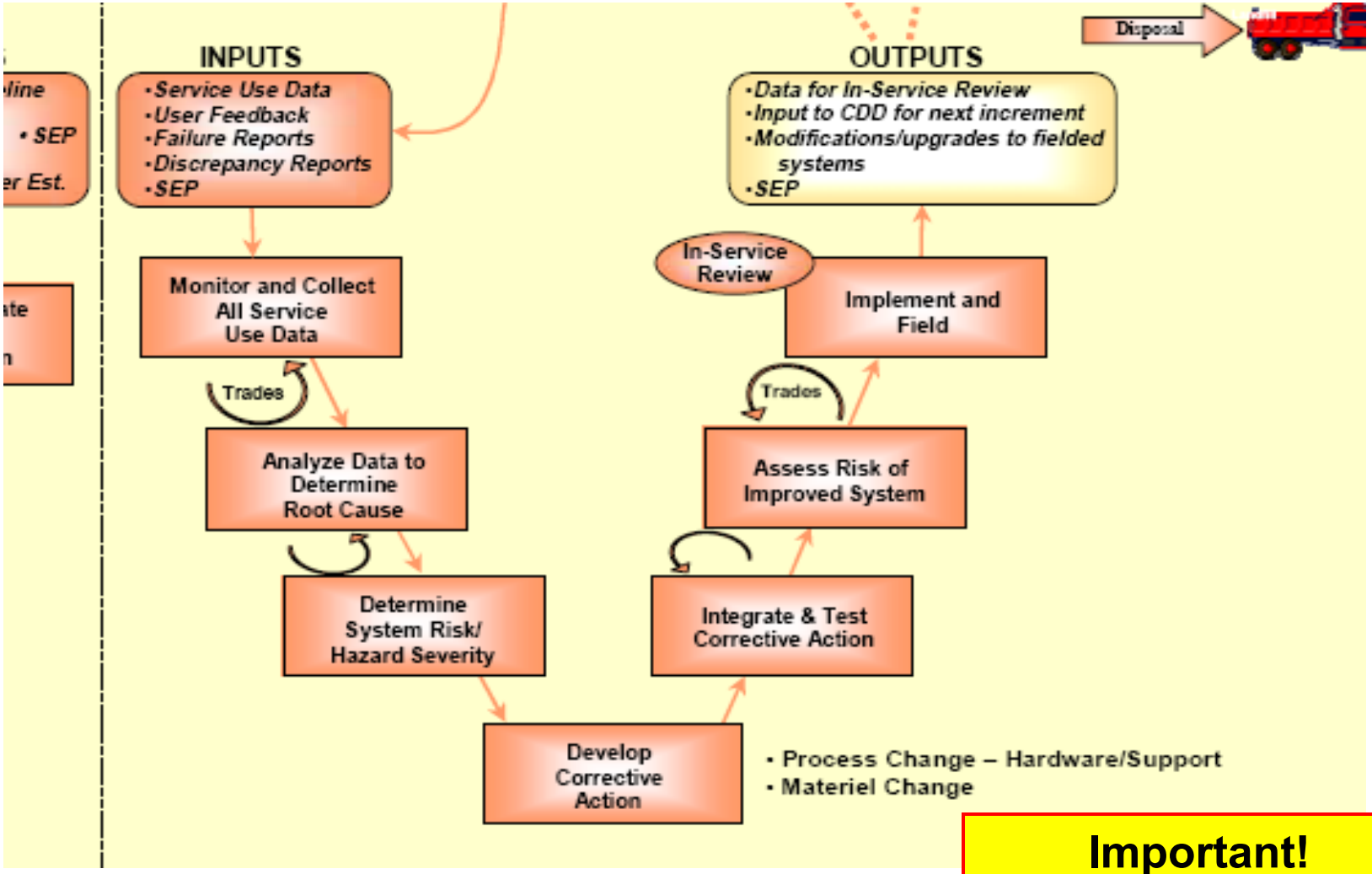
Life Cycle Framework In-service System Safety Requirements



Important!

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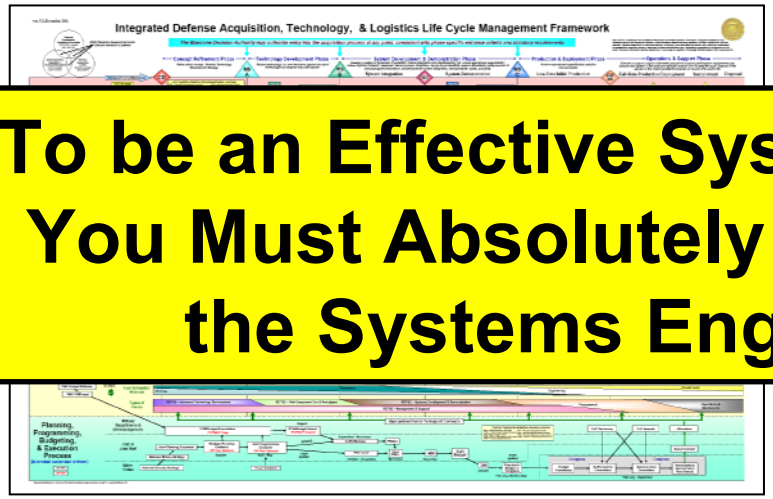
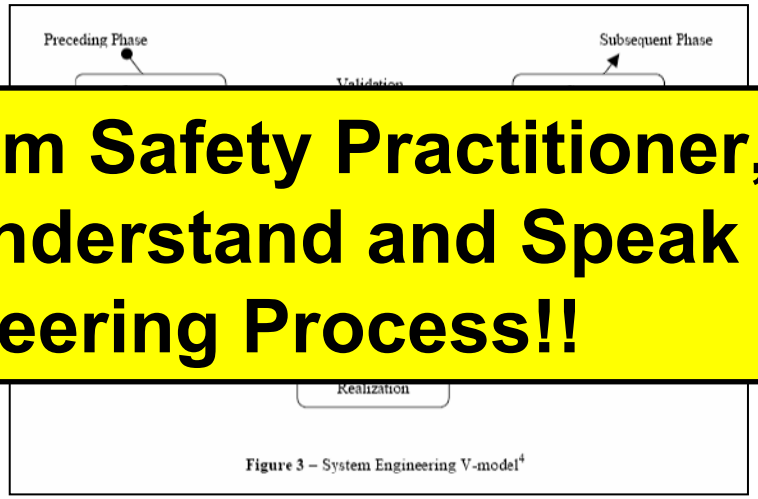
Conclusions

- **Requirements, Requirements, Requirements**
  - **The language of the systems & design engineers**
- **Integration of System Safety into System Engineering Framework is Critical**
- **Framework is the Key**
- **Conditions are Right (OSD is an Advocate)**
- **Must Understand and Spread the Word**





To be an Effective System Safety Practitioner, You Must Absolutely Understand and Speak the Systems Engineering Process!!