Aligning System Development and Testing for Successful IOT&E

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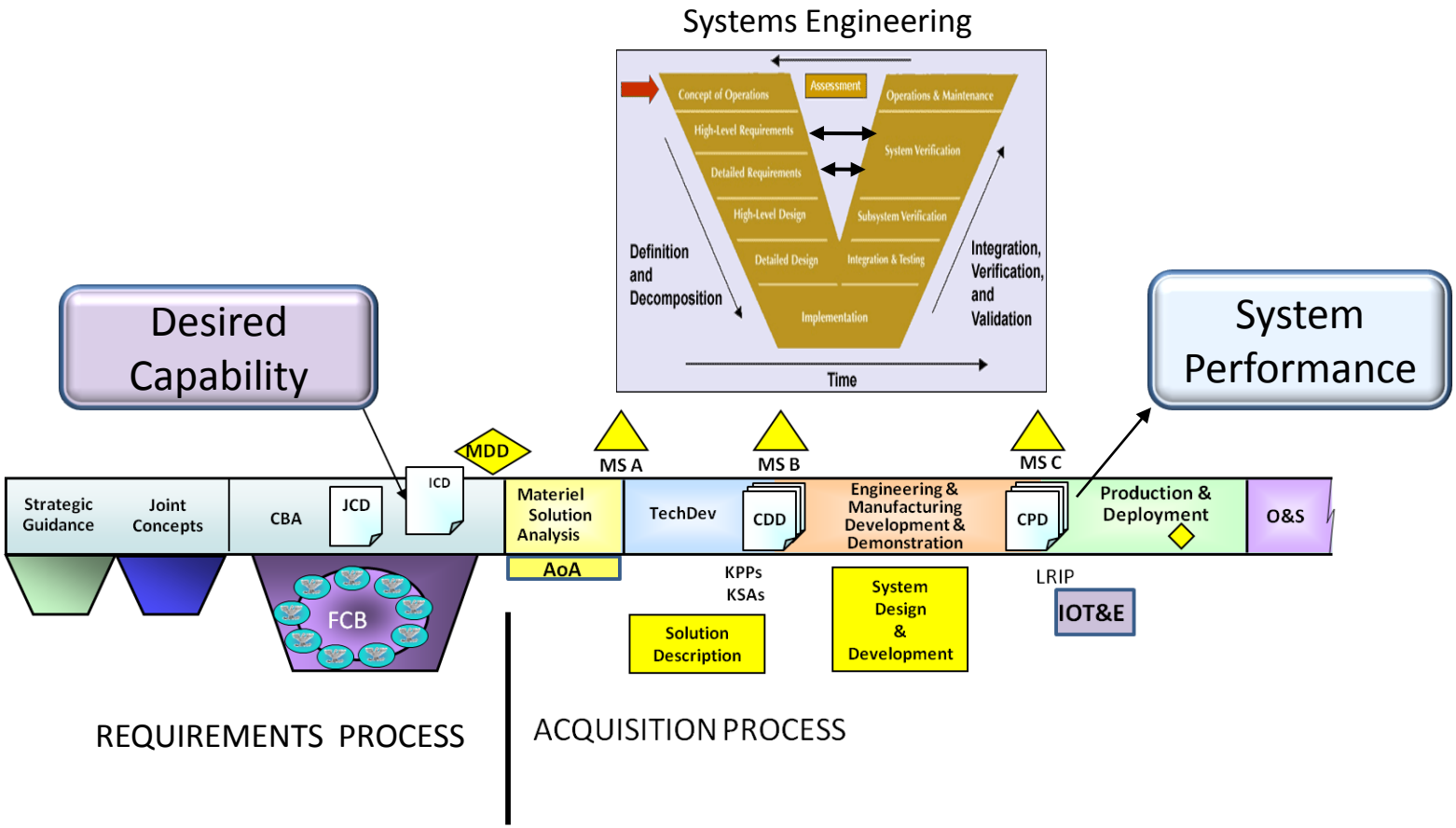
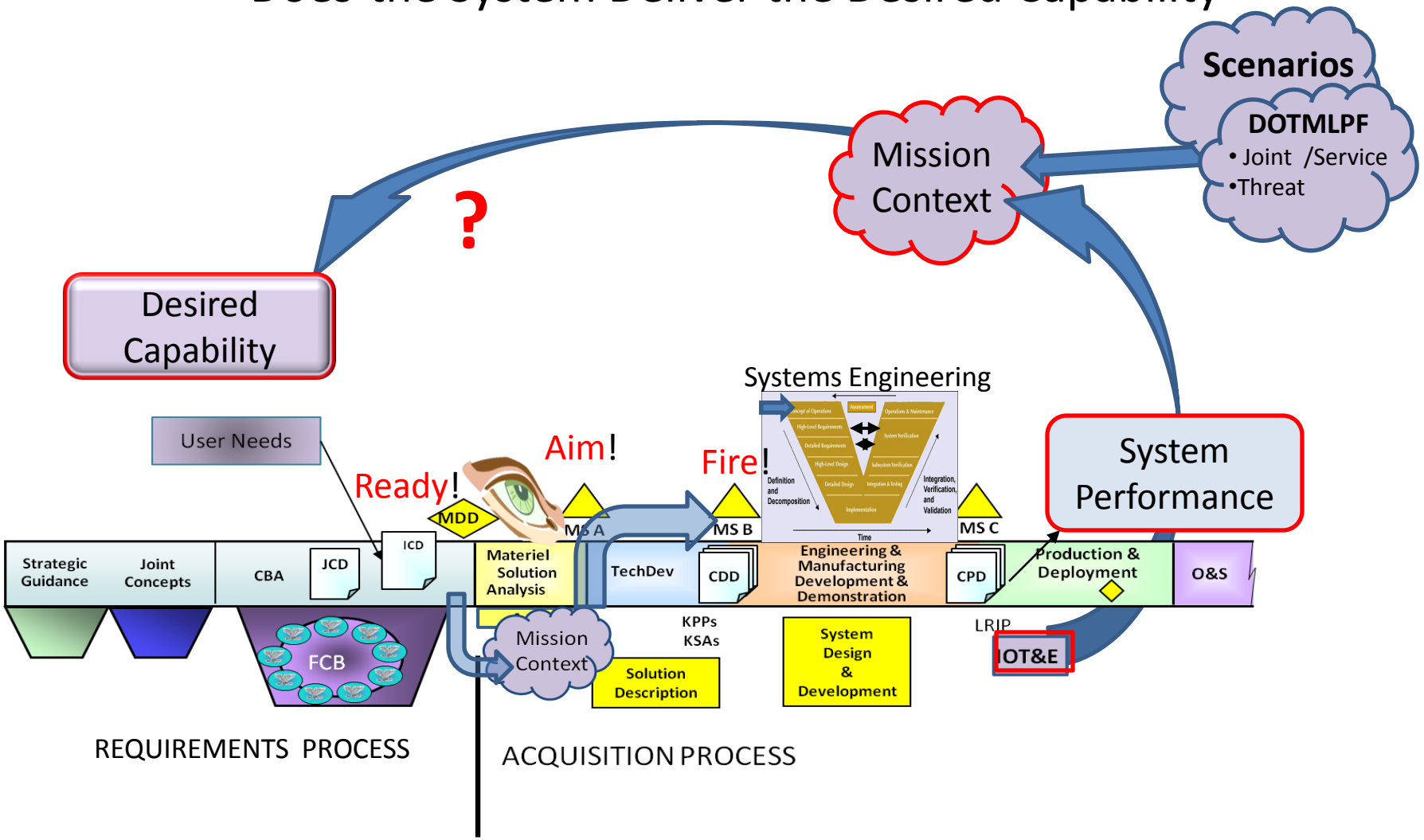
RQMTS and ACQ Processes

Typical Depiction



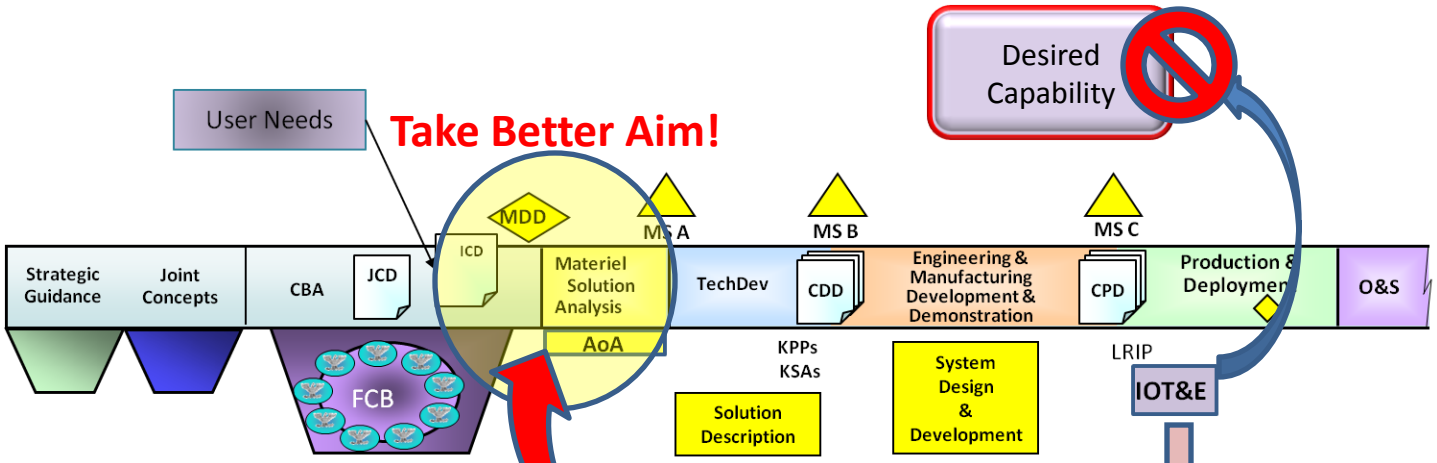
RQMTS and ACQ Closures

Does the System Deliver the Desired Capability



When Things Go Wrong

Recurring Effort to Fix the "Front End"



Fix the Front End

- Expand JROC membership
- Better CBAs
- **Stronger ICDs**
- ACQ engage early in JCIDS
- Strengthen the AoA
- Better TEMPs
- Better System Engineering

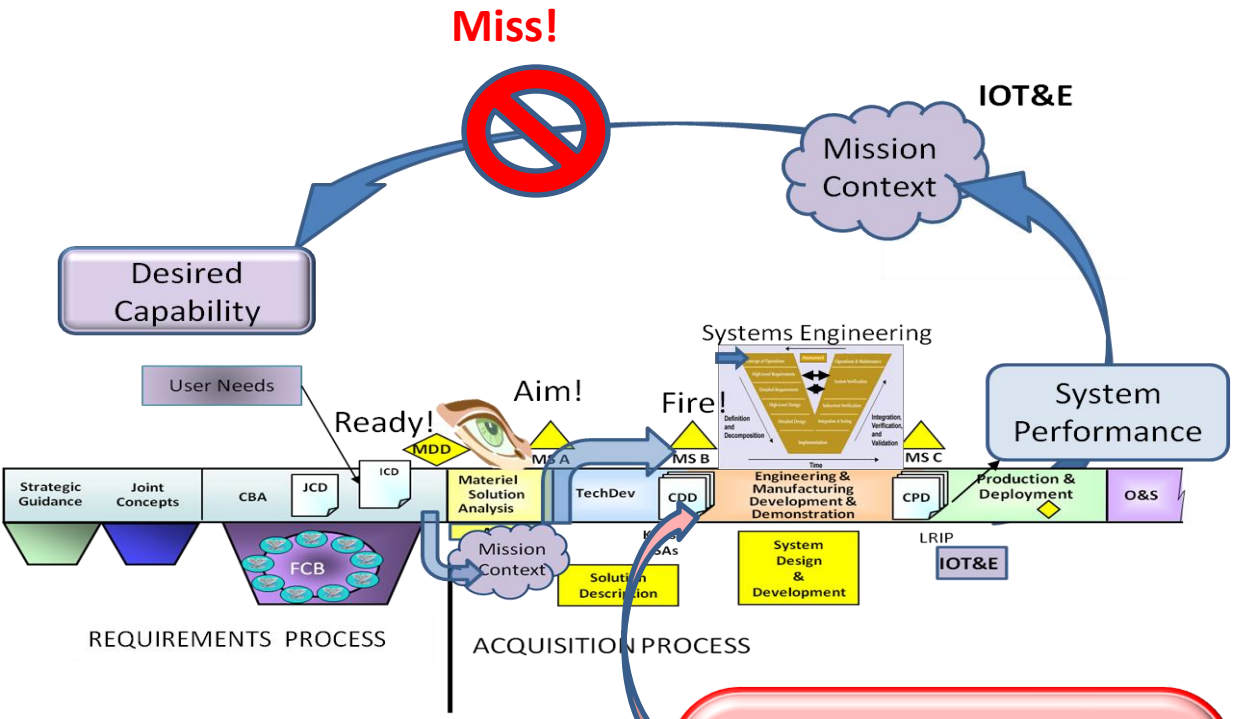
Performance/Cost/Schedule Failures

•Cost	X	•Performance	X
•Schedule	X	•Reliability	X

*Roughly a third of programs still fail **effectiveness** assessment and three quarters of programs fail **suitability** (DOTMLPF) assessments at IOT&E. (DSB DT&E Report, 2008)*

Why Do Systems Fail IOT&E?

1. Deficient Specification, Design or Construction



Failed IOT&E

Poor Effectiveness and/or Suitability

- Inadequate System Performance
- Inadequate Mission Performance
  - Poor Reliability
  - Poor Maintainability
  - Poor Compatibility

Inadequate

SPECIFICATION

- **Unclear Capability Statement**
- **Vague Mission Context**
- **Ignored Support Infrastructure**

DESIGN

CONSTRUCTION

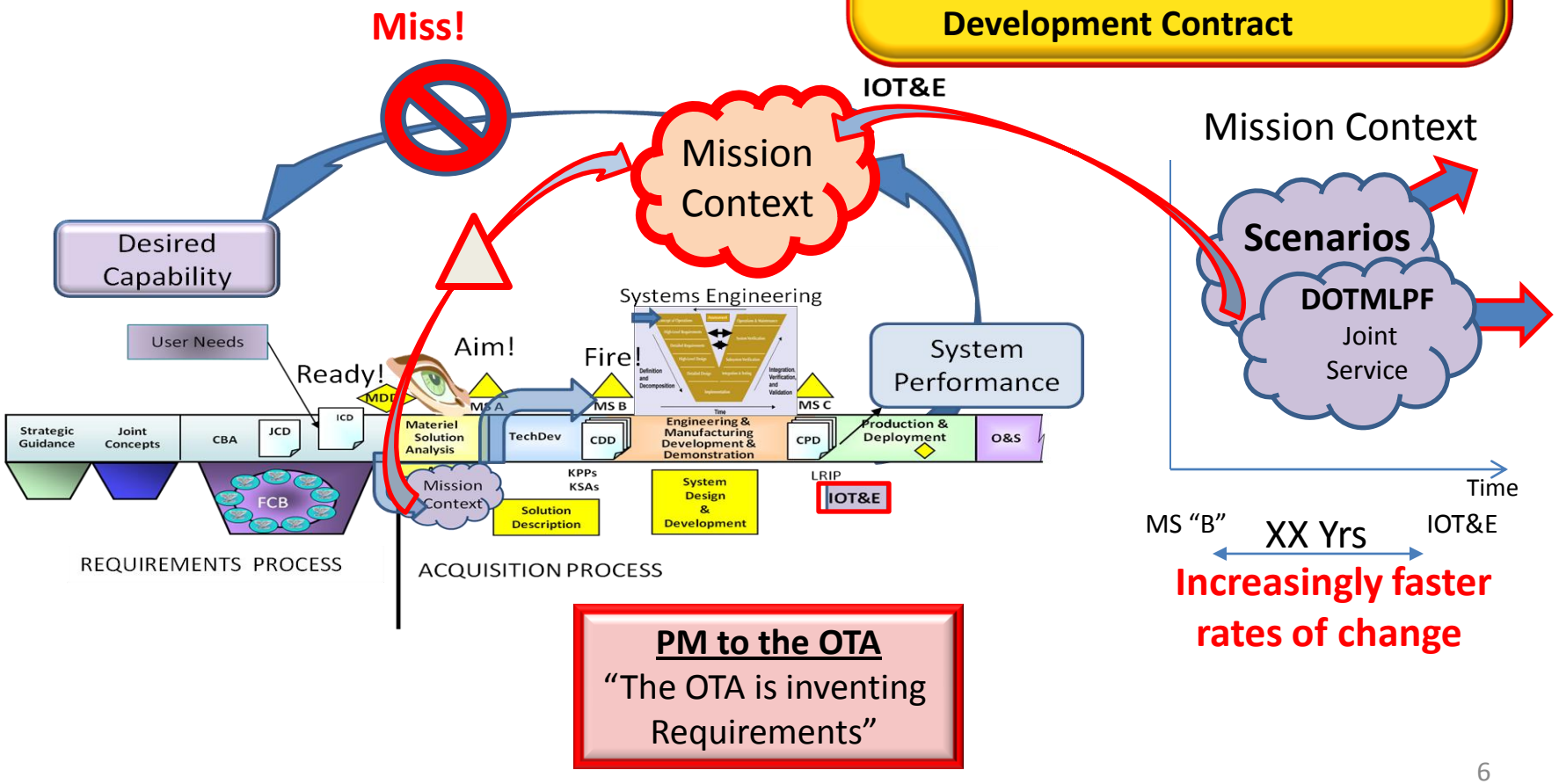
Why Do Systems Fail IOT&E?

2. The Mission Context Changes

- **Mission context evolves after the AoA and MS "B"**

BUT,

- **System Engineering remains focused by MS "B" and the System Development Contract**



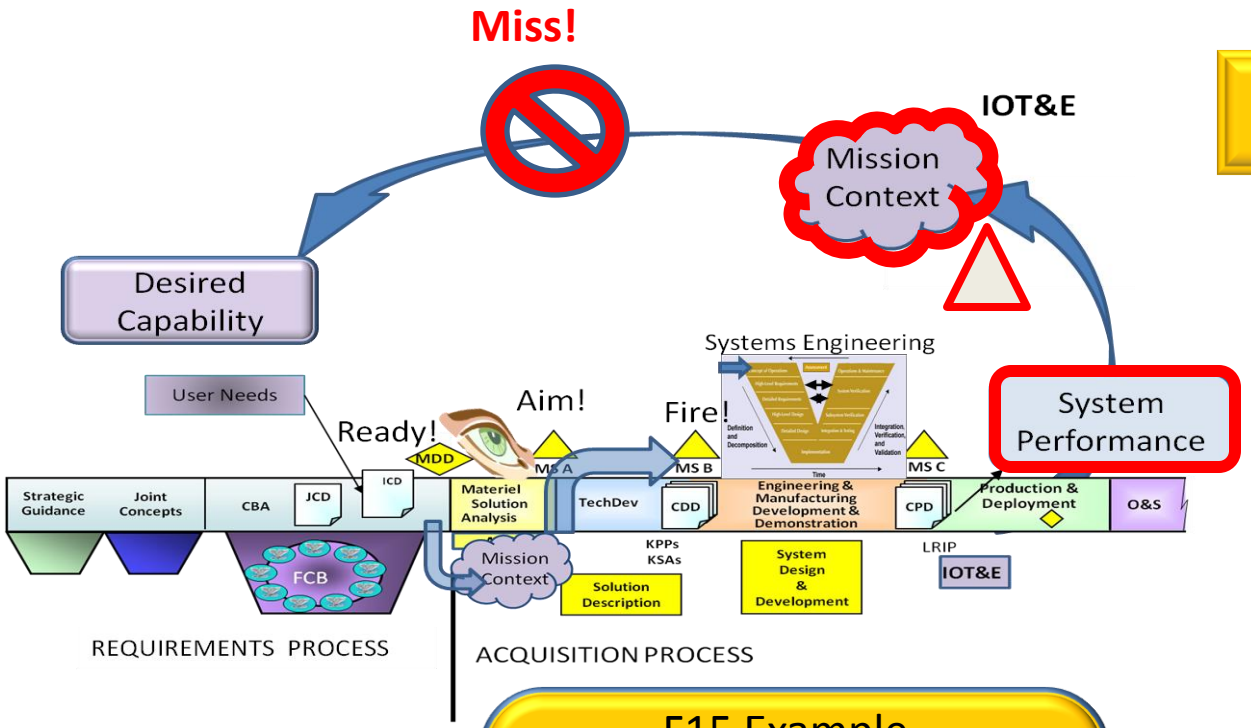
PM to the OTA

"The OTA is inventing Requirements"

Why Do Systems Fail IOT&E?

2a. The Mission Context as a Variable

Even the **System** Can Change the Mission Context



Mission Context as a Variable
affecting delivered Capability

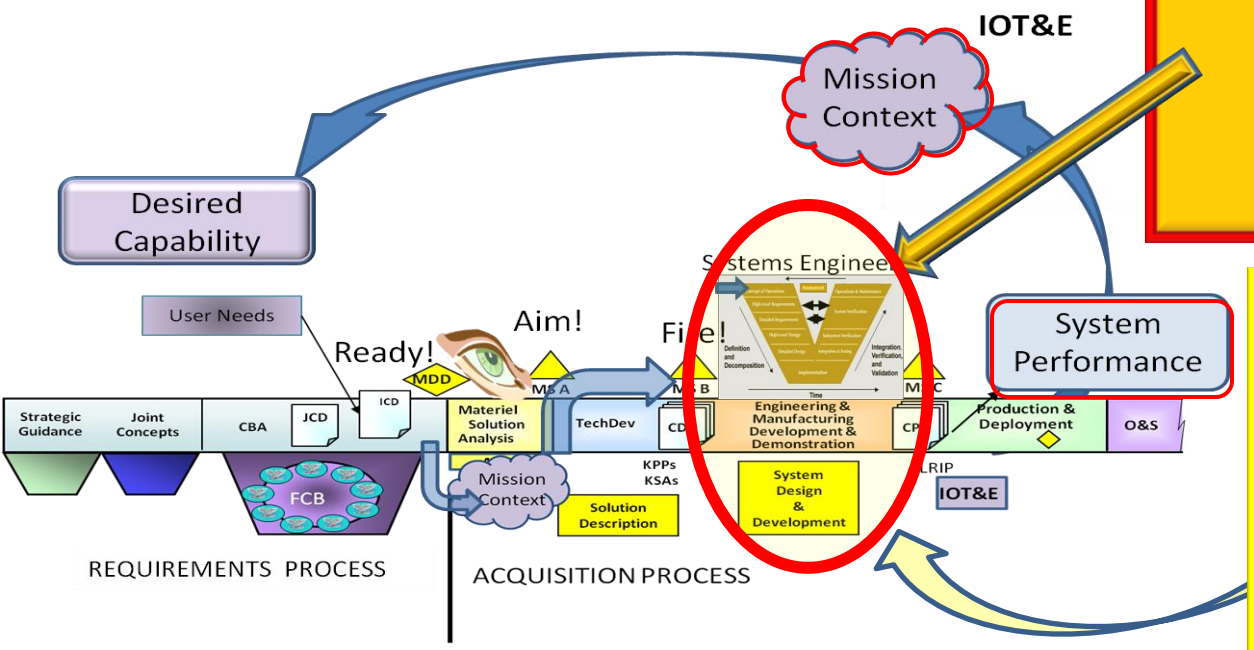
Capability Performance Metrics
Mission to System Performance Levels and Conditions That produce the Desired Capability in the Mission Context

F15 Example

- Increased F15 performance over the F4 assessed as no significant increase in Capabilities
- **UNTIL** ….new ways of doing the missions were developed to exploit the F15 increased performance

Summary: Why Do Systems Fail IOT&E?

Inadequate "Midcourse" Guidance Process for Managing Change



The Midcourse Between MS B & C

Where Change Happens!

- **Mission Context evolves**
- **Schedules slip**
- **Costs increase**
- **Performance goes off track for *Delivering Desired Capability***

NEEDED

A Midcourse Guidance Process

Discover, Assess, & Adjust to:

- **Inadequate Specification**
- **Changing Mission Context**
  - **Changed Scenarios**
  - **Changed DOTMPLF**
  - **Changed Performance needs**
  - **Getting smarter about how best to exploit what the system offers**

To Deliver the Desired Capability

Mitigating Impacts from "Change" in the ACQ Midcourse

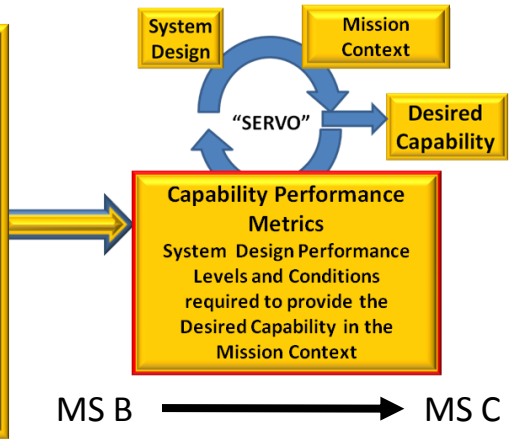
1. For **Rapid Acquisition:** "The Need for Speed"
   - •State the Requirement well
   - •Design, Construct and Deliver ….Quickly
     - •BEFORE the **Mission Context** can change
   - •Manage the Design and Development to Cost, Schedule and **Performance** Objectives

"TCP" metrics

2. For **Longer Term Acquisition:** Where the Mission Context May Change
   - •State the Requirement well
   - •**Manage change in System Performance Objectives between Milestone B and C**
     - •**M**aintain alignment among the **Mission Context,** the **System Design and System Performance** so as to deliver the **Desired Capability** at **IOT&E**
   - •Manage System Design and Development to Cost, Schedule and to **Performance Objectives**

INTRODUCING: Technical Capability Performance (TCP) metrics
Measures of Performance (MOP) that indicate **the levels and conditions** of system, subsystem or component level performance required to deliver the Desired Capability in the "Current" Mission Context

- •TCP adapt as needed to changes in the Mission Context between MS B & C
- •Current Mission Context converging to Mission Context at IOT&E

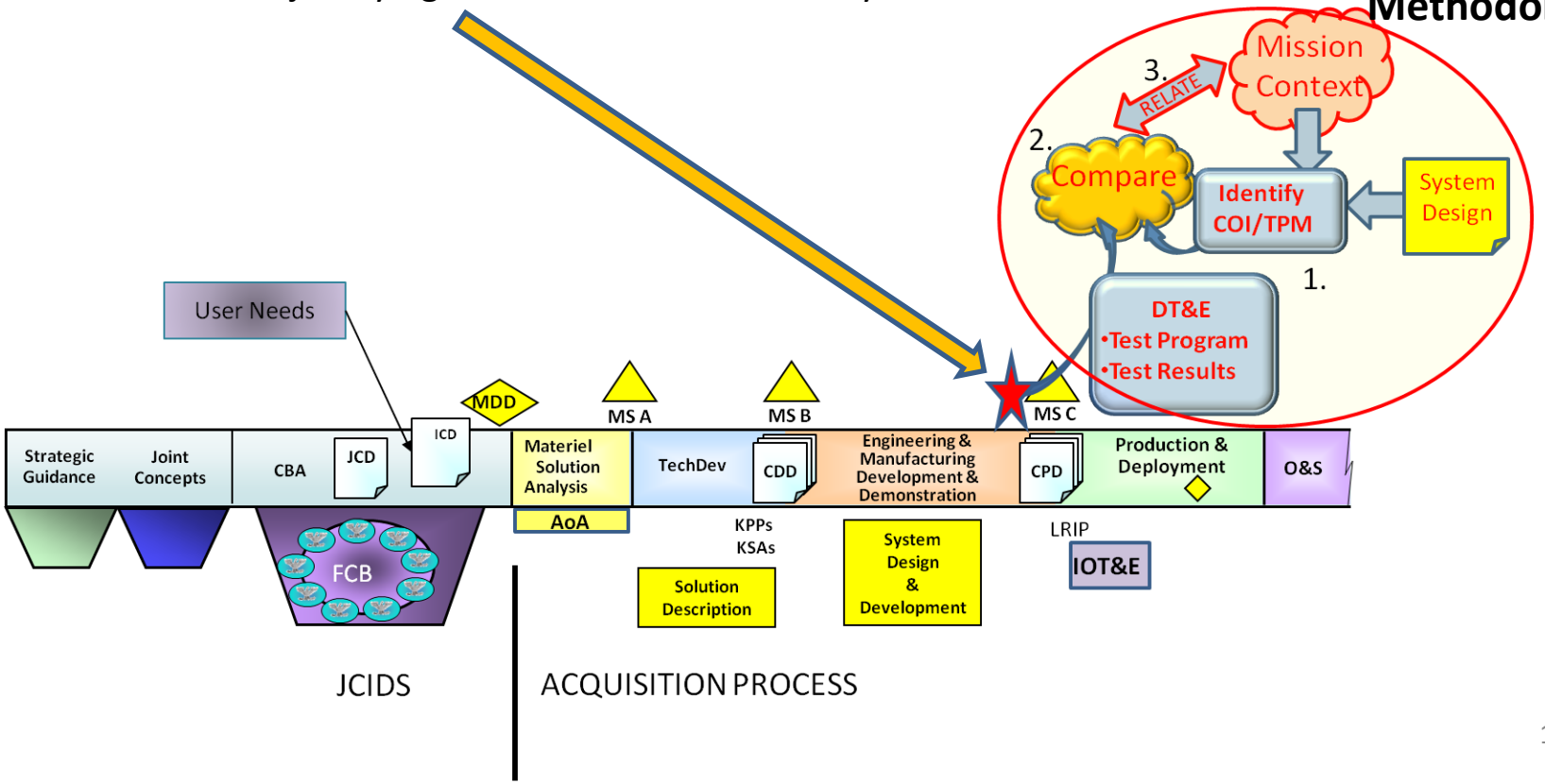


DT&E Program Assessment

A Current Method for Forecasting Success at IOT&E

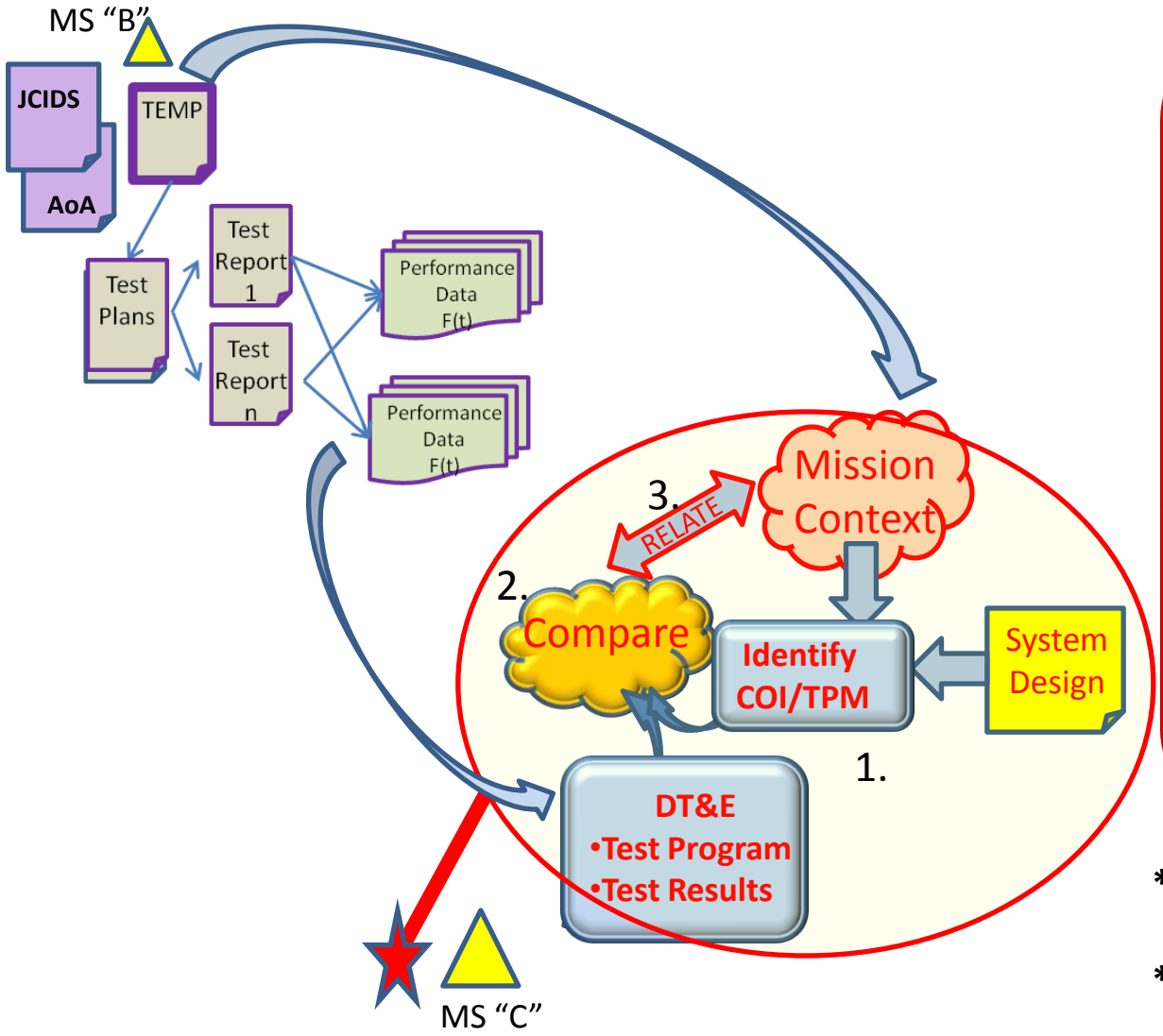
- DASD, DT&E has initiated assessments of the adequacy of the DT&E in selected Major Defense Acquisition Programs
  - Examines the development test program to assess the demonstrated performance of the system…
  - Provides assessment input into Acquisition Decision Milestone C
    - Relative to justifying an LRIP decision and entry into IOT&E

DT&E Program Assessment Methodology



Current DT&E Assessment Process

Is the T&E Adequate to Justify LRIP & Entering IOT&E?



Assessment Process

1. Infer a **Mission Context** from MS B and earlier JCIDS documentation
2. Express **Mission Success** via **COI** and system design derived ***TPMs*** *at the:*
   - *System Level*
   - *Subsystems Level*
   - *Components Level*
3. Compare test item level **DT&E Test Results** to the mission success oriented **TPM**
4. Use the comparison to **forecast IOT&E success**

***COI=Critical Operational Issues**

***TPMs= Technical Performance Measures**

Example: Current DT&E Program Assessment

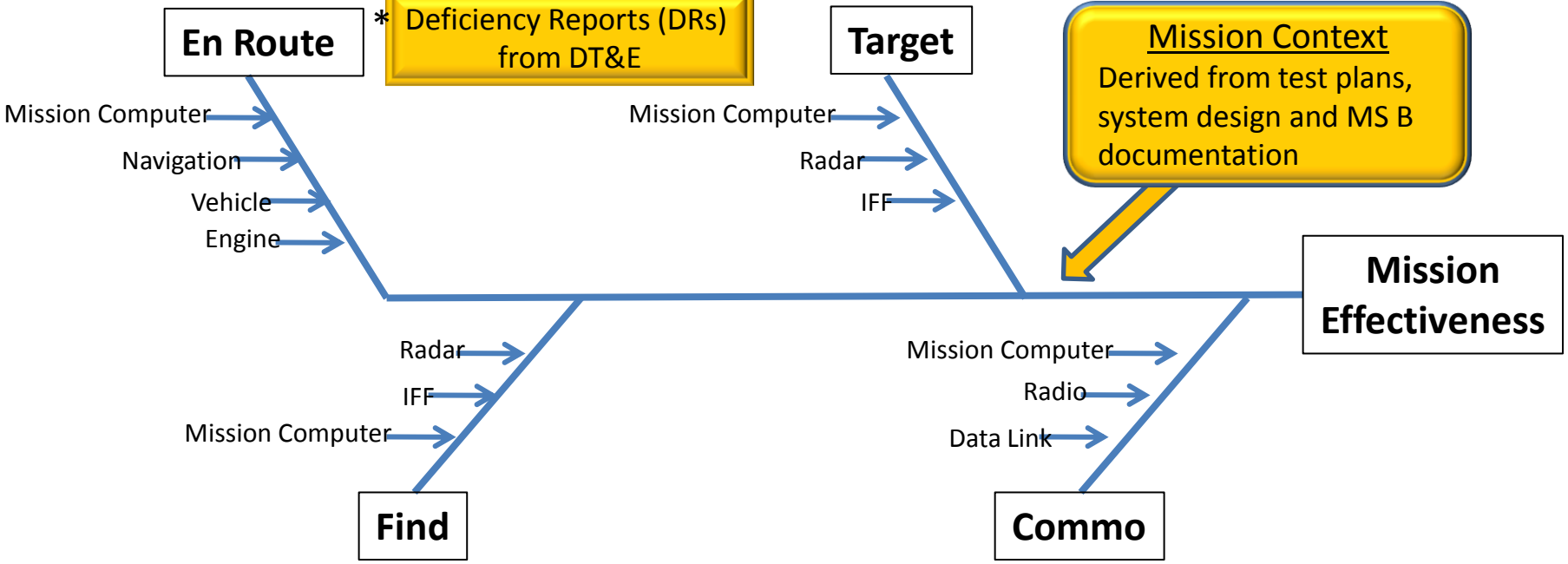
*

	Priority 1 DRs Fixed	Priority 2 DRs Fixed	Priority 3 DRs Fixed
Mission Computer	10%	15%	0%
Navigation	15%	30%	5%
Vehicle	20%	10%	4%
Engine	8%	30%	8%

	Priority 1 DRs Fixed	Priority 2 DRs Fixed	Priority 3 DRs Fixed
Mission Computer	30%	12%	26%
Radar	10%	20%	15%
IFF	40%	5%	24%

* Deficiency Reports (DRs) from DT&E

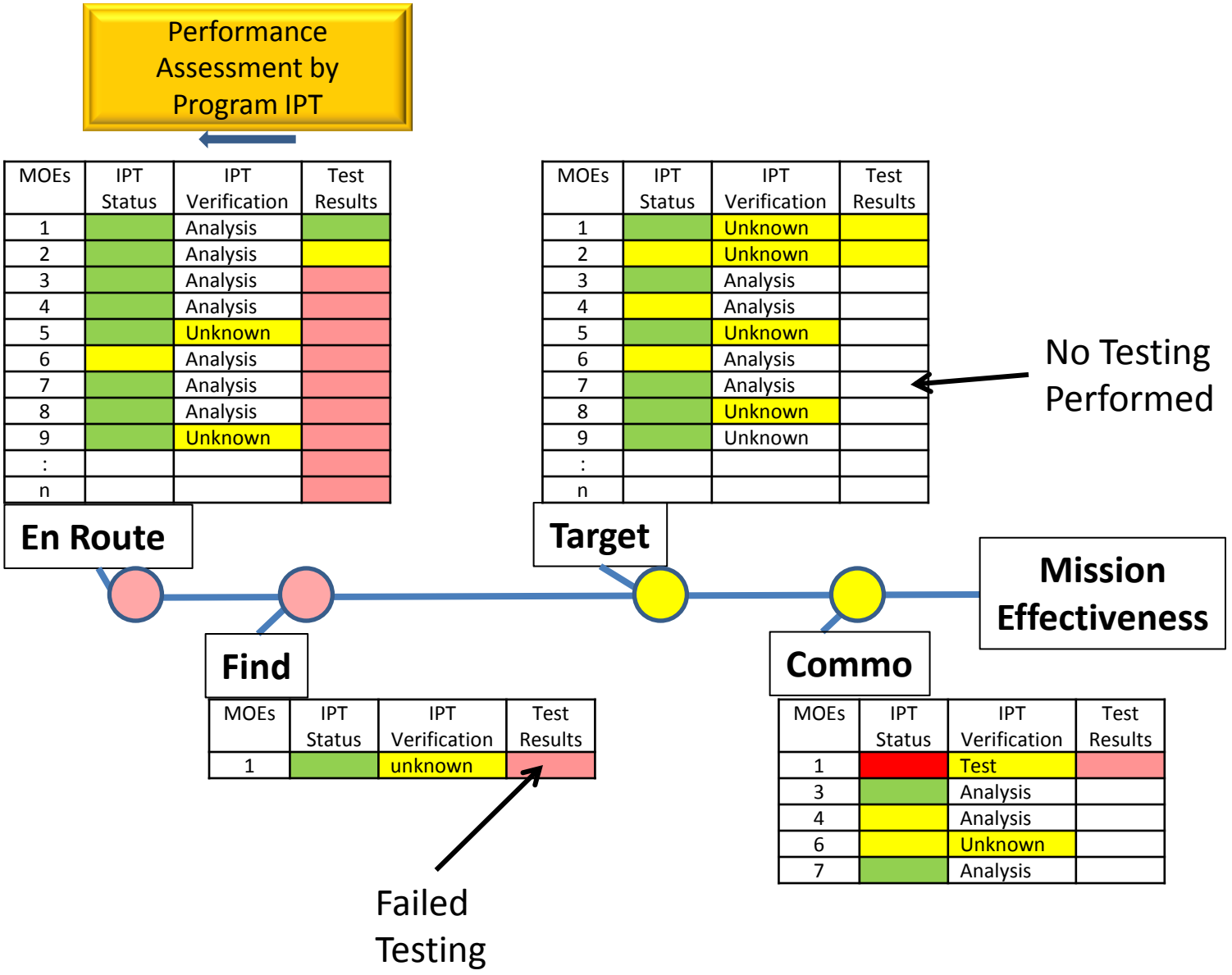
Mission Context
Derived from test plans, system design and MS B documentation



	Priority 1 DRs Fixed	Priority 2 DRs Fixed	Priority 3 DRs Fixed
Mission Computer	30%	12%	26%
Radar	10%	20%	15%
IFF	40%	5%	24%

	Priority 1 DRs Fixed	Priority 2 DRs Fixed	Priority 3 DRs Fixed
Mission Computer	23%	10%	7%
Radio	15%	30%	5%
Data Link	20%	10%	4%

Example: Current DT&E Program Assessment



A Midcourse Guidance Approach

A Critique of the Current DT&E Program Assessment Process

Current DT&E Program Assessment process is **Performance-based; Good**

BUT:

- **Informs too late: Milestone C** is too late to become informed that either the system design or the test program has been inadequate
  - Out of options to enable effective correction

- **Assesses "Retro"**, based on performance defined in a Milestone "B" context …. in the past;
  - Not focused on the performance needed for success in **current** conditions at IOT&E

- **Mission Context is not authoritative:**
  - Derived by Analysts, Engineers, & Scientists
    - No operational or Acquisition authority subscribing to the inferred Mission Context

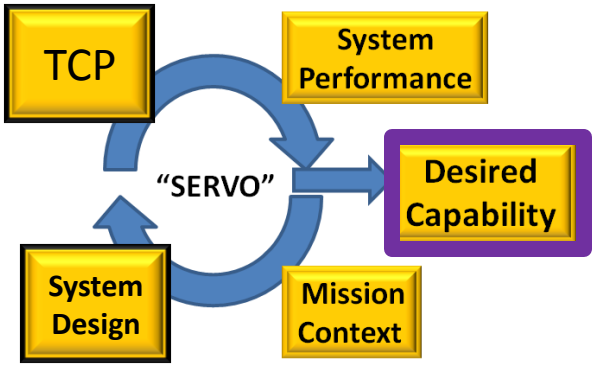
- **Resource intensive:** Involves manual review, organization and analysis of massive amounts of unstructured T&E and design documentation

- **Amorphous:** Scope and content of each assessment depends heavily on the skill & experience of the assigned analyst, engineer, or scientist

An Enhanced DT&E Program Assessment:

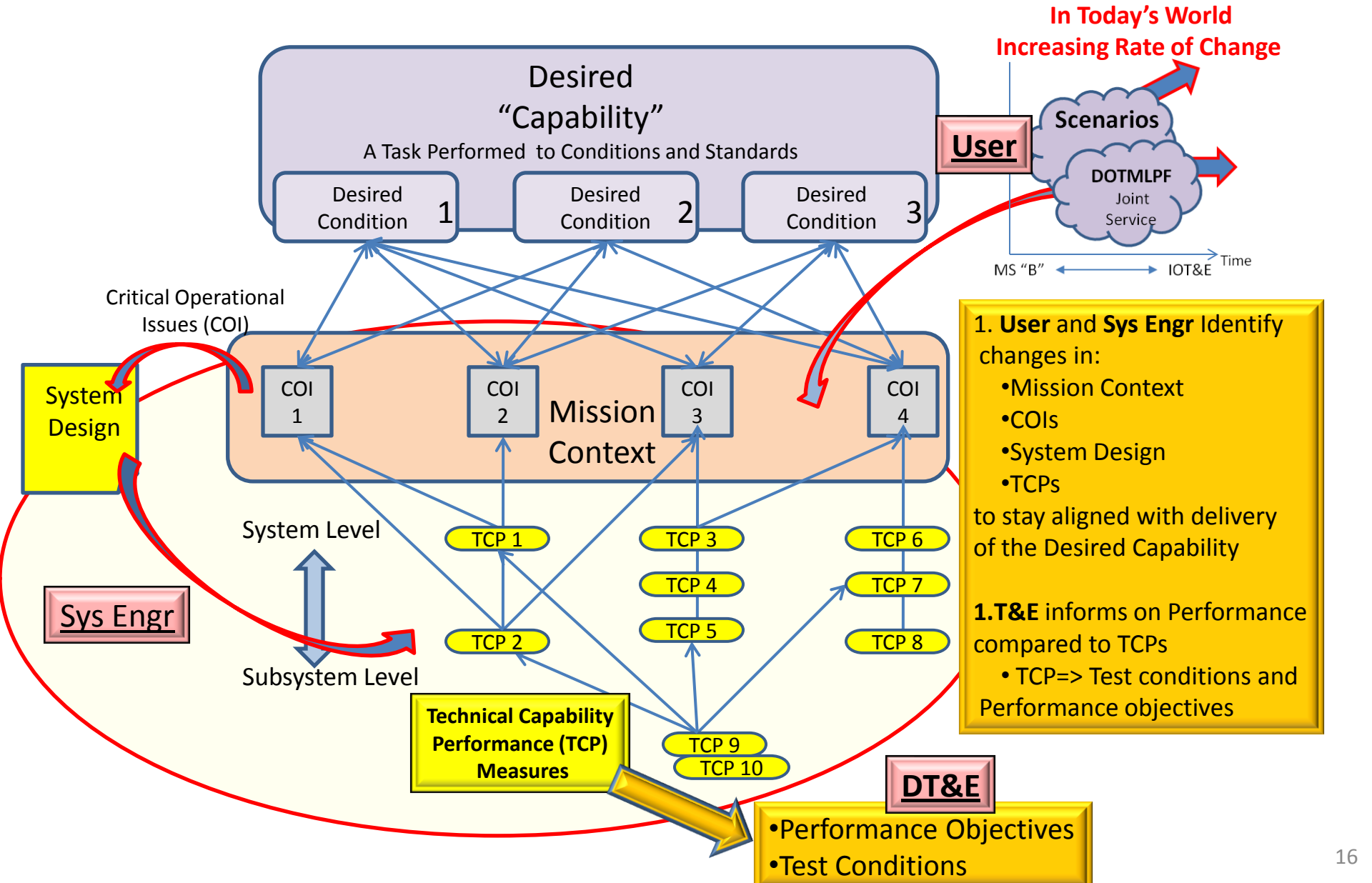
- **Assess in the present:** For system capability at IOT&E
  - Use an Authoritative, Current Mission Context to derive T&E performance objectives
  - Use Performance **Metrics** that inform on "Capability"
    - Capability => Informing on Performance Levels in Conditions (the Mission Context)
    - **Technical Capability Performance** (**TCP)** metrics relate system performance to delivery of the desired Capability in the Current Mission Context ; for assessing success at IOT&E
      - **TPM**: Are derived in a Milestone B Context **=> "System works as designed"**
        - Focus is on satisfying the contract
      - **TCP:** Are derived in a Current Mission Context **=> "Too bad it was designed that way"**
        - Focus on the system's ability to **Deliver** the Desired Capability….today
          - Forecasting success, or not, in the IOT&E Mission Context

- **Assesses Early and Persistently:** Throughout the DT&E
  - Offering an enhanced **Integrated DT/OT** paradigm
    - Identifying emerging deficiencies early while there is time and resources to correct them
    - Prompting increased IOT&E success



Enhanced DT&E Program Assessment

Managing Change via TCPs

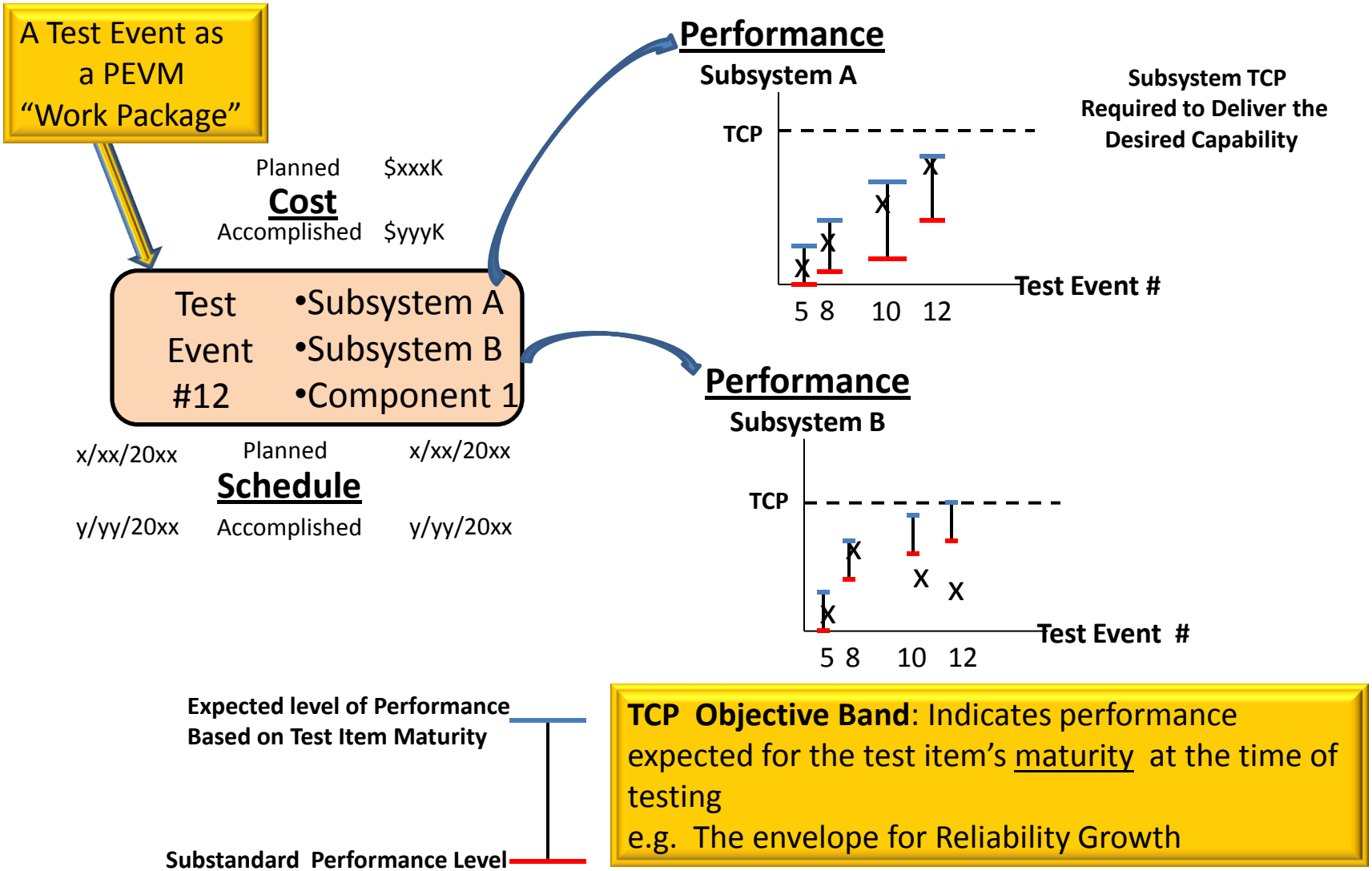


Enhanced DT&E Program Assessment Process
Enabling Performance-Based EVM

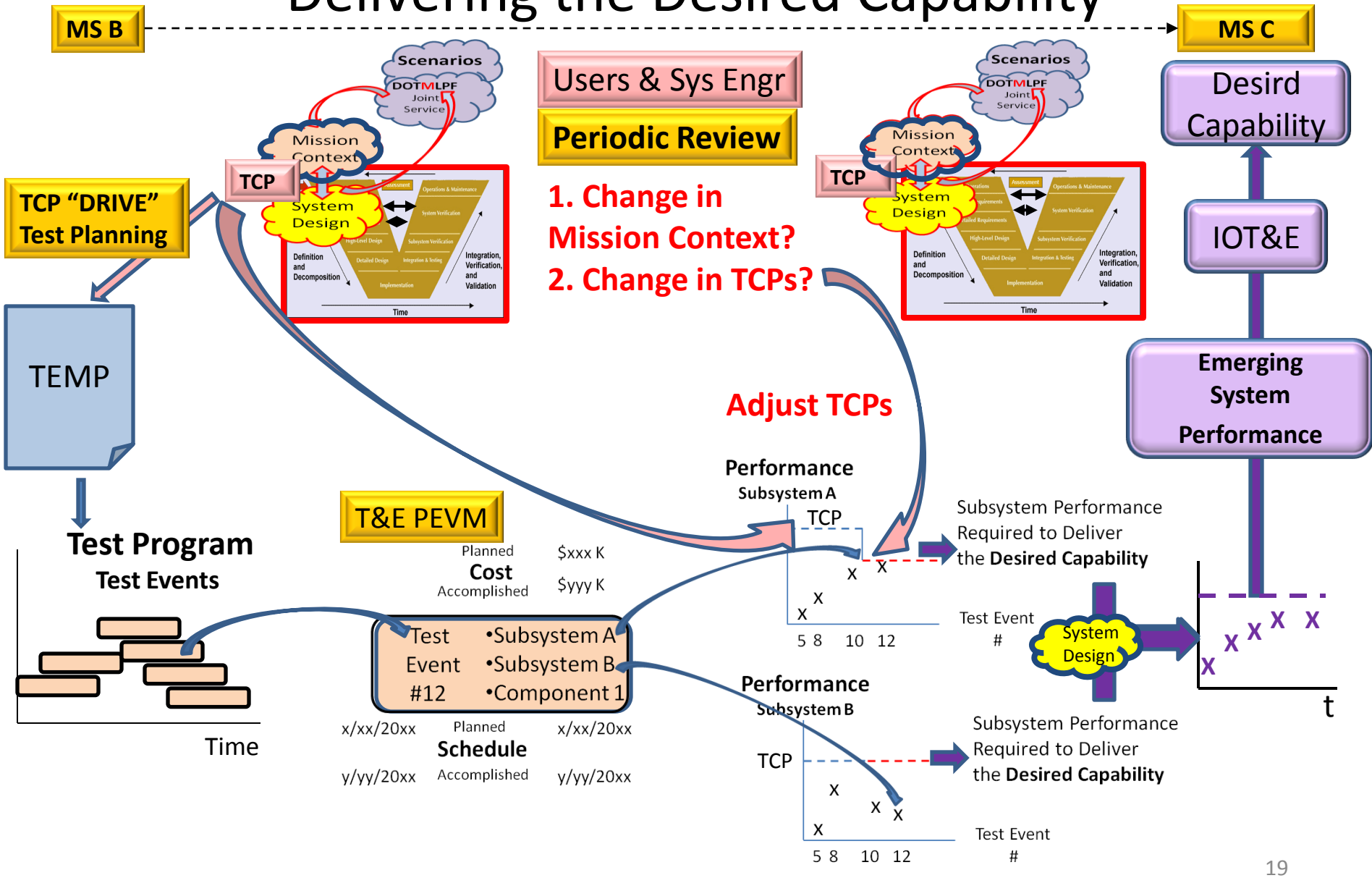
- **Apply Performance-based Earned Value Management (PEVM) in DT&E**
  - Provides Capability oriented Performance Metrics for use with Earned Value Management (EVM) System Cost and Schedule Metrics
  - Responsive to Gov't & Industry increasing emphasis on PEVM:
    - OMB, FY2011 Authorizations Act , WSARA 2009, and ANSII initiatives, etc

- A T&E PEVM methodology :
  - Treats **Test Events** as **Work Packages**
  - Treats **Test Results** as **Performance Measures** for comparison to TCP
    - Informs on a system performance progress toward IOT&E
    - Informs on performance maturity trends early and persistently between MS B & C
  - **Orients TEMPs and Test Plans toward assessment of Capability**
    - Uses capability derived **TCP** as **Test objectives and test conditions** for the system, subsystems and components
  - Enables an Earlier and Enhanced form of **Integrated DT/OT**
  - Motivates more effective **Contracting**
    - Incentivizing system engineering agility to enable:
      - Management of change during the system development phase
      - Delivery of more useful capability at IOT&E

A T&E Performance–based Earned Value Management (PEVM) Paradigm



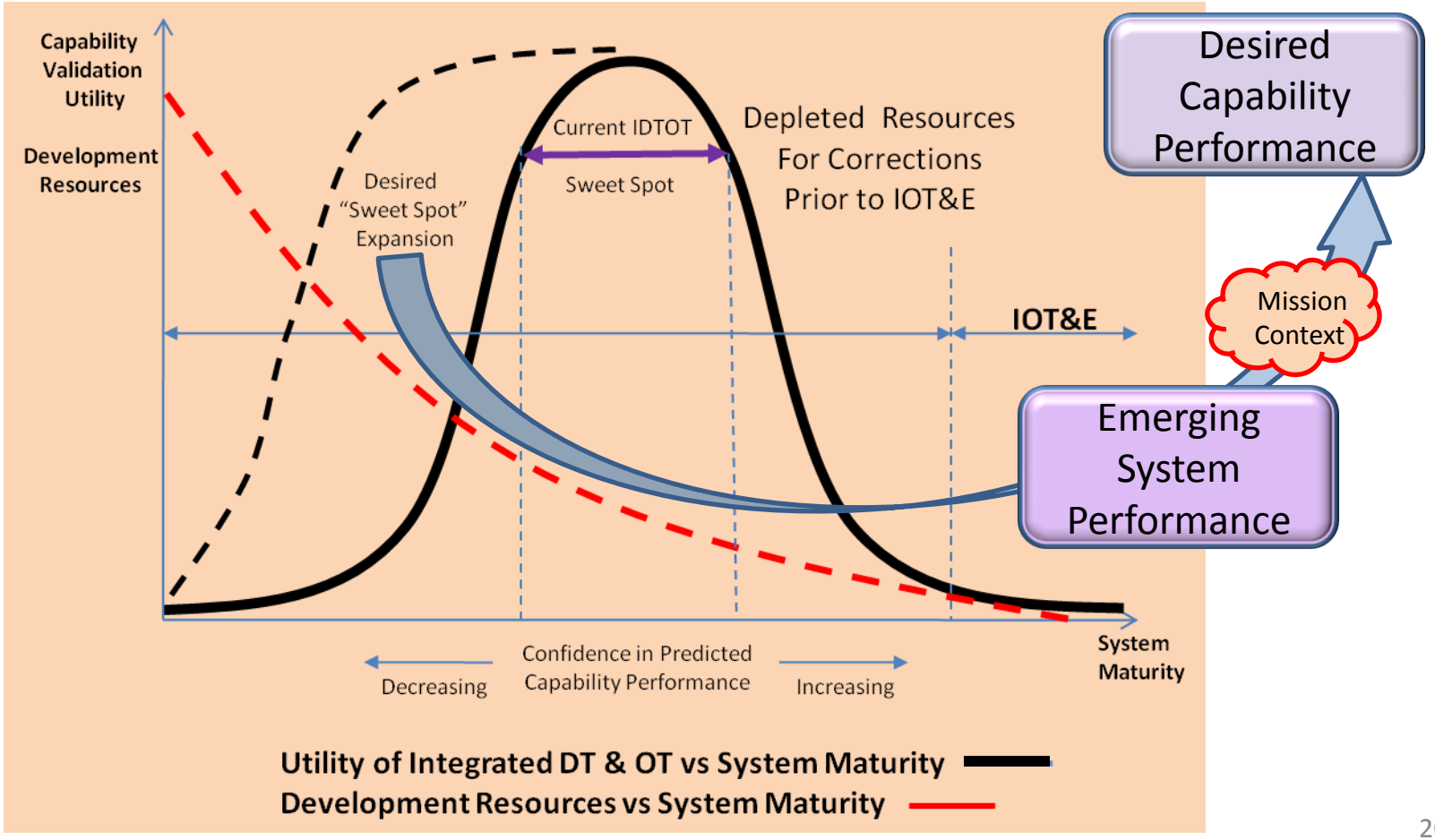
Assessing Emerging Performance Toward Delivering the Desired Capability



An Early & Persistent Integrated DT/OT

Assessing Emerging Performance

•Expands the Integrated DT/OT (IDTOT) "Sweet Spot" to the left , occurring earlier, and persistently informing on a system's progress toward delivering the **Desired Capability at IOT&E**



Anticipated Assessment Methodology

ACQ Midcourse Methodology

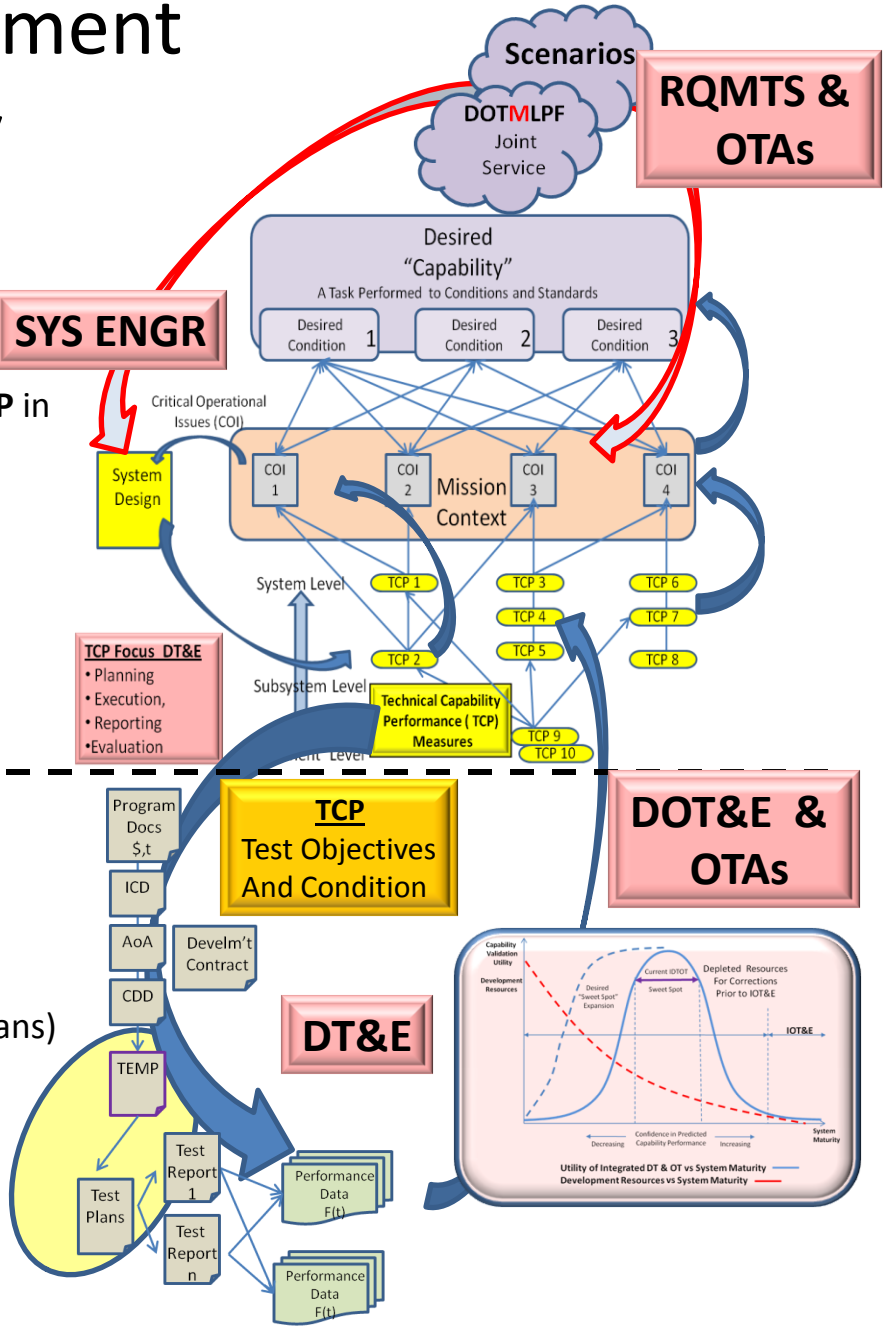
- Maintain system performance Objectives, TCP, in alignment with delivering the desired capability
  - Milestones B to C
- Ensure effective test planning focused on "Metrics that Matter"
  - TCP for Success at IOT&E
- Inform on:
  - T&E Program Cost & Schedule progress
  - System Performance trends toward successful IOT&E
- Provide an early and persistent Integrated DT/OT

Sys Engr Methodology

- **Develops and maintains TCP** in alignment with the **Mission Context**

T&E Methodology

- **Applies TCP** to guide Test Planning (TEMP and Test Plans) and applies **T&E PEVM** to inform on performance progress toward delivery of desired Capability at IOT&E



Implementation

Approach: Build on the recent T&E Program Assessment process

- Apply the Enhanced form of the current DT&E Program Assessment Process
  - **Provide "authority**" to the **Mission Context**
    - Avoid the "House build on Sand" condition
  - **Use <u>Technical Capability Performance (TCP)</u> metrics** to relate System Performance in the Mission Context to delivery of the Desired Capability at IOT&E

- Apply PEVM to T&E planning and management between Milestones B & C
  - Orient Performance on TCP AND on Maturity of the test item at time of testing
    - Enabling early and Persistent IDTOT
  - Use TCP to guide TEMPs and Test planning, execution, evaluation & reporting

- Review and Adjust System Design and TCP as necessary to maintain alignment with delivery of the Desired Capability
  - Establish earlier and persistent Integrated DT & OT
  - Periodically reviewing Mission Context, System Design and TCP
    - Recommend adjustments as needed to foster delivery of the Desired Capability at IOT&E

- Establish and maintain firm control of system changes between Milestones B & C
  - Require **<u>Senior Level Approval</u>** to change Mission Context, System Design or TCP
  - Enforce a strong **<u>Configuration Management</u>** to preclude "Requirements Creep"

Contracting for Success at IOT&E Observations

Use Contractor's proposed T&E PEVM process as a Source Selection consideration Use as a context to motivate more effective Contracting

- Motivate new contracting formats to incentive development agility and success at IOT&E

- **RFP:** Use Contractor's proposed T&E PEVM process as a Source Selection consideration
  - Recognizing program's unique needs and exploiting contractors' experience & capabilities
    - **Section L, Proposal Preparation Instructions**; require bidders to:
      - Describe a TCP-based PEVM process between Milestone B & C (Performance, Cost & Schedule metrics)
        - Based on a concept such as presented here;
        - Informing and facilitating Gov't oversight
        - Applying strong Configuration Management to control requirements creep
        - Incentivizing system design agility and delivery of desired capability at IOT&E
    - **Section M, Evaluation Criteria**; provide valuing criteria for Section L items such as:
      - Extent of Gov't collaboration in TCP development and maintenance
      - Extent of "Agility" in response to approved TCP or system design changes
        - "Credibility" of Cost /Effectiveness methodology for assessing "agility"
      - Valuing Contractor Modeling and Simulation:
        - Extent of M&S contribution to TCP development and PEVM implementation
        - Relating System Design & System Performance to delivery of the Desired Capability in the Mission Context
        - Forecasting convergence of subsystem performance toward overall System performance that delivers the desired Capability in the Current Mission Context

END

Enhanced T&E Program Assessment Methodology Summary

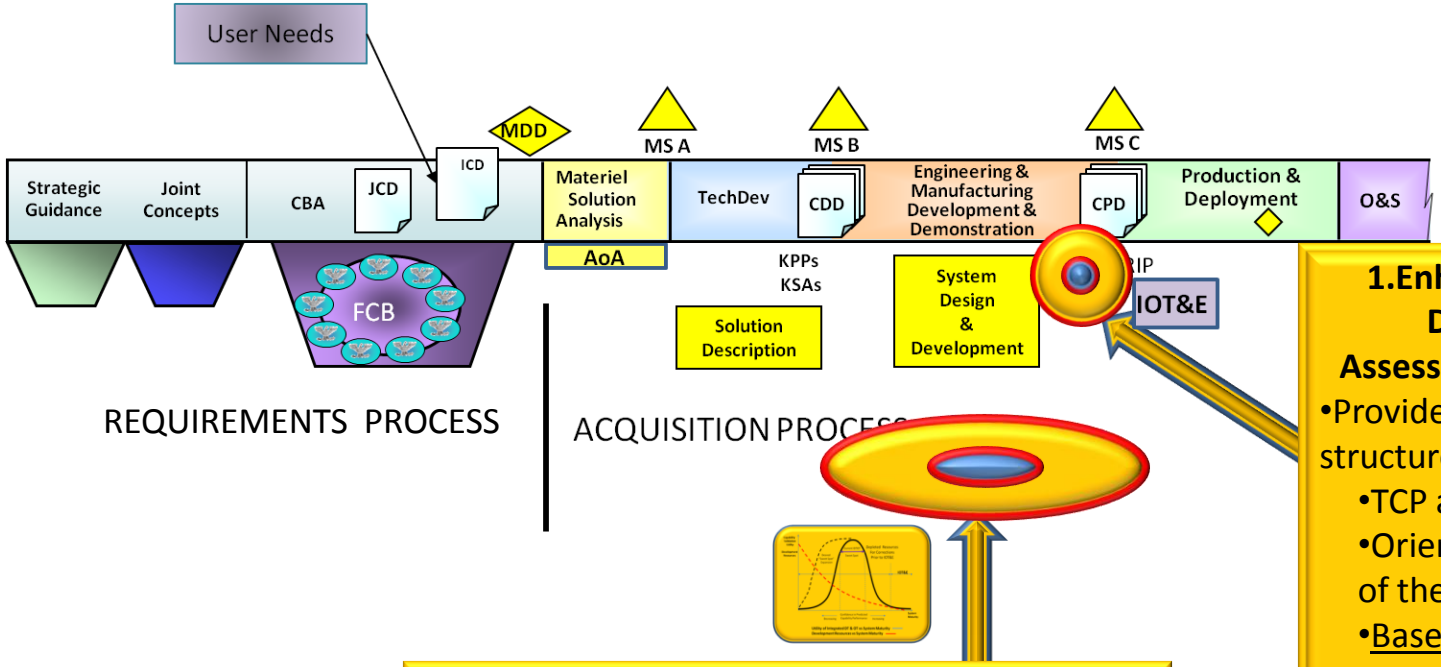
1. Periodically and authoritatively review alignment of the **System Design** with delivery of the **Desired Capability** in the **Current Mission Context**
   - Authoritatively = Collaboration among System Engineering, OTA, and RQMTS authorities
   - Alignment = Auditing of TCP through the current Mission Context for delivery of the capability

2. Establish and maintain **Technical Capability Performance** (TCP) measures as performance objectives and conditions relating system, subsystem and component performance to delivery of the desired capability in the current mission context
   - TCP for Effectiveness and Suitability

3. Orient T&E program planning , execution & evaluation to inform on system progress toward current TCP objectives
   - Applying **Performance-Based EVM** for early and persistent assessment of Test program execution **and** emerging system performance progress toward TCP objectives and hence toward successful IOT&E = Integrated DT/OT

Where to Next?

From Concepts Toward Effective Application



1.Enhance the Current DT&E Program Assessment Methodology

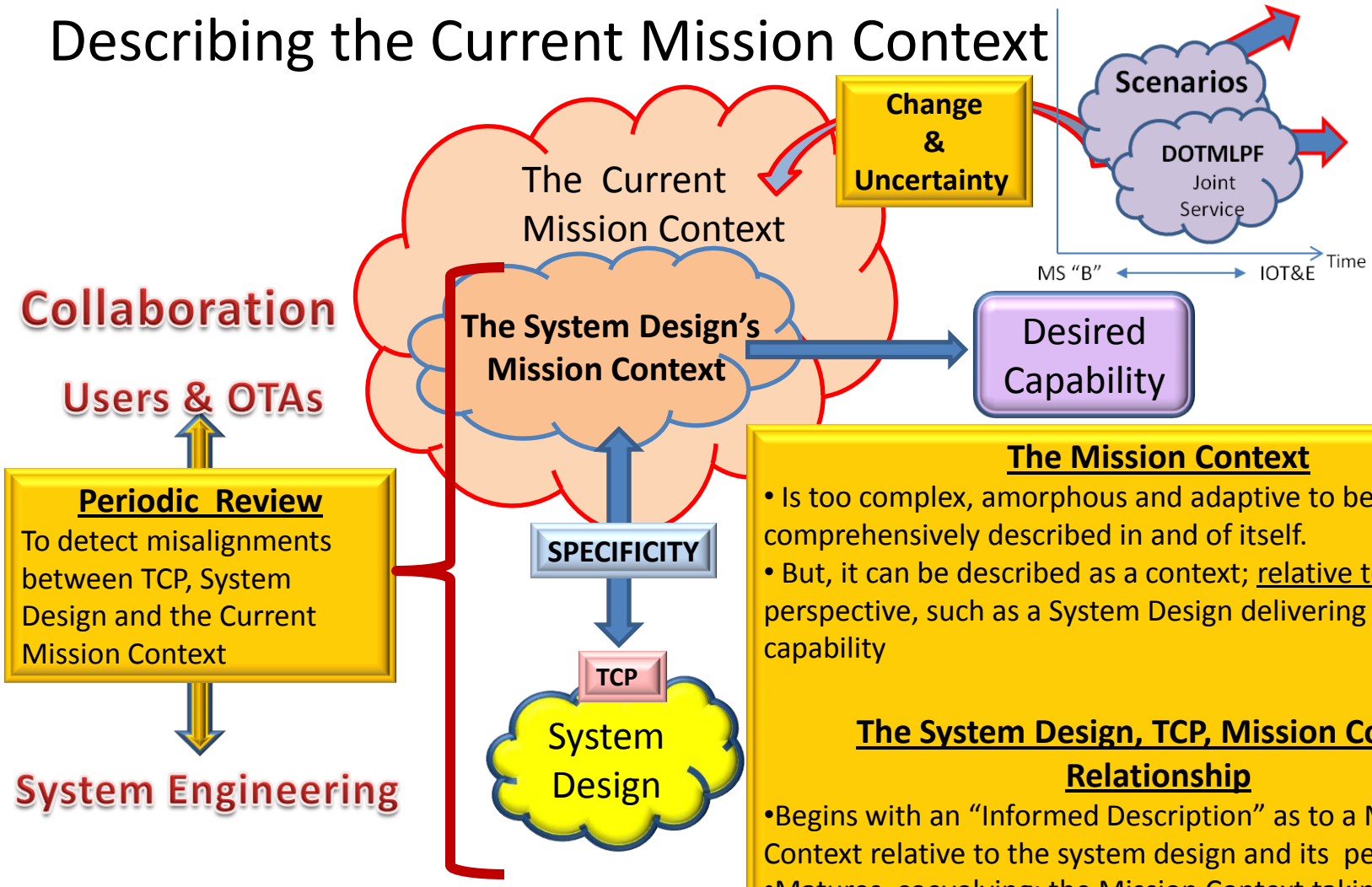
- Provide a methodological structure
  - TCP and PEVM- based
  - Oriented toward delivery of the Desired Capability
  - Based on Authoritative & Current Mission Contexts
- Make it faster, & easier to use
  - COTS for unstructured data mining and asssessmnt

2. Expand into the ACCQ Midcourse, Milestone "B" to "C"

- Use TCP and Performance–based EVM for DT&E
- Apply early & persistent Integrated DT&OT
- Address Changes in the Mission Context
- Be Capability delivery orientated
- Foster Innovative contracting approaches

Managing Change and Uncertainty

Describing the Current Mission Context



The Mission Context

- Is too complex, amorphous and adaptive to be comprehensively described in and of itself.
- But, it can be described as a context; relative to a specific perspective, such as a System Design delivering a desired capability

The System Design, TCP, Mission Context Relationship

- Begins with an "Informed Description" as to a Mission Context relative to the system design and its performance.
- Matures, coevolving; the Mission Context taking increased form in response to and affecting the increasing specificity of the system design so as to achieve delivery of the desired capability.