Avoiding Overruns in the Specification of Non-Functional Requirements

Barry Boehm, USC CSSE

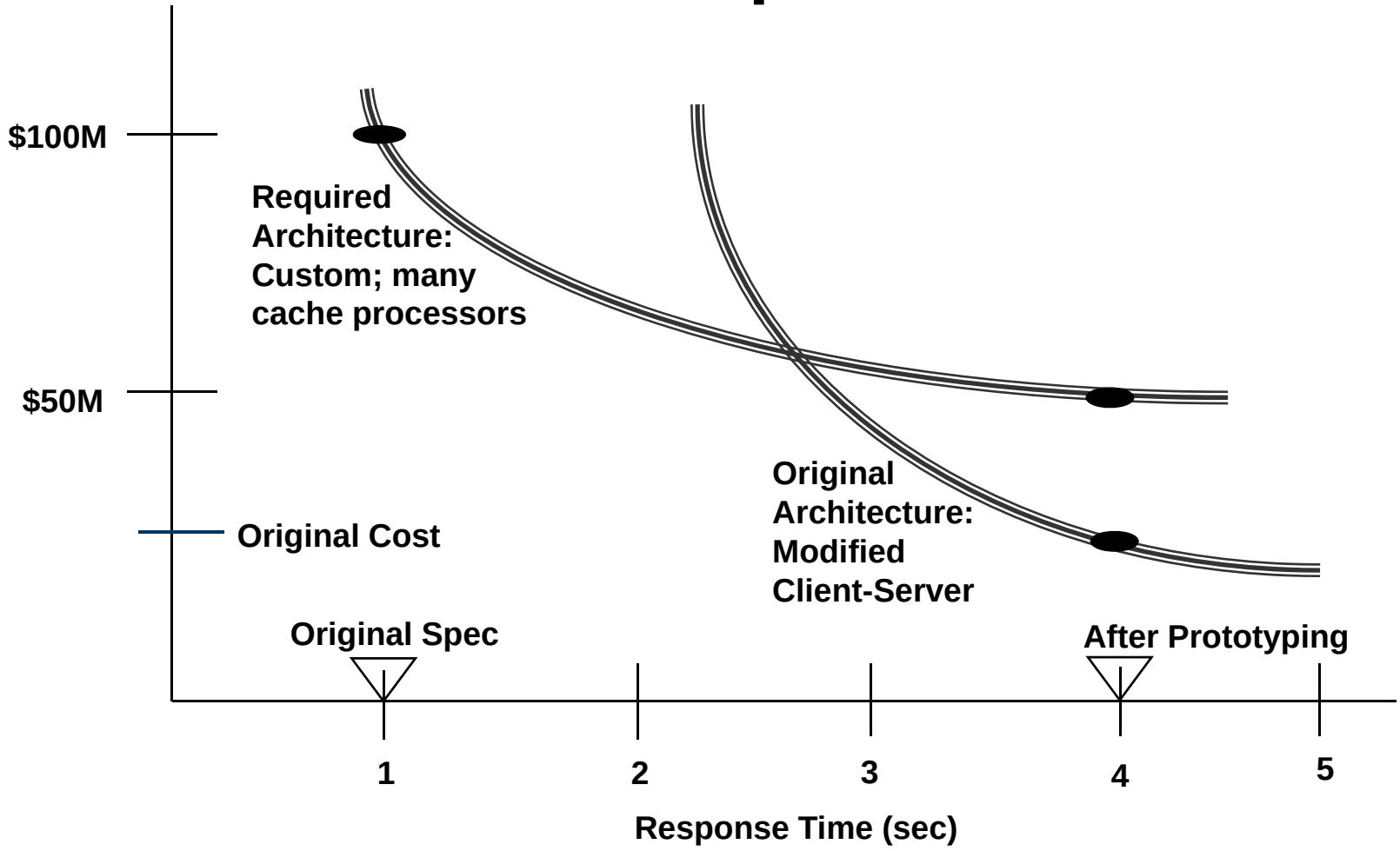
GSAW 2016

March 2, 2016

Summary: Avoiding NFR Overruns

- **The Multiplicative Effect of NFRs on Cost**
  - **Response-time NFR example**
  - **The need for evidence-based reviews (EBRs)**
- **Avoiding NFR Architecture-Breakers**
  - **Build it now; tune it later**
  - **Agile methods: NFRs as deferrable stories**
- **The Exponential Effect of Architecture-Breakers on Cost**
  - **Confronting the Conspiracy of Optimism**
- **Steps for Performing Evidence-Based Decision Reviews**
  - **"An Evidence-Based Systems Engineering (SE) Data Item Description"**

Problems Encountered without EBRs: Factor-of-3 Impact on Cost



Problems Avoidable with EBRs

- Attempt to validate 1-second response time
  - Commercial system benchmarking and architecture analysis: needs expensive custom solution
  - Prototype: 4-second response time OK 90% of the time
- Negotiate response time ranges
  - 2 seconds desirable
  - 4 seconds acceptable with some 2-second special cases
- Benchmark commercial system add-ons to validate their feasibility
- Present solution and feasibility evidence at anchor point milestone review
  - Result: Acceptable solution with minimal delay

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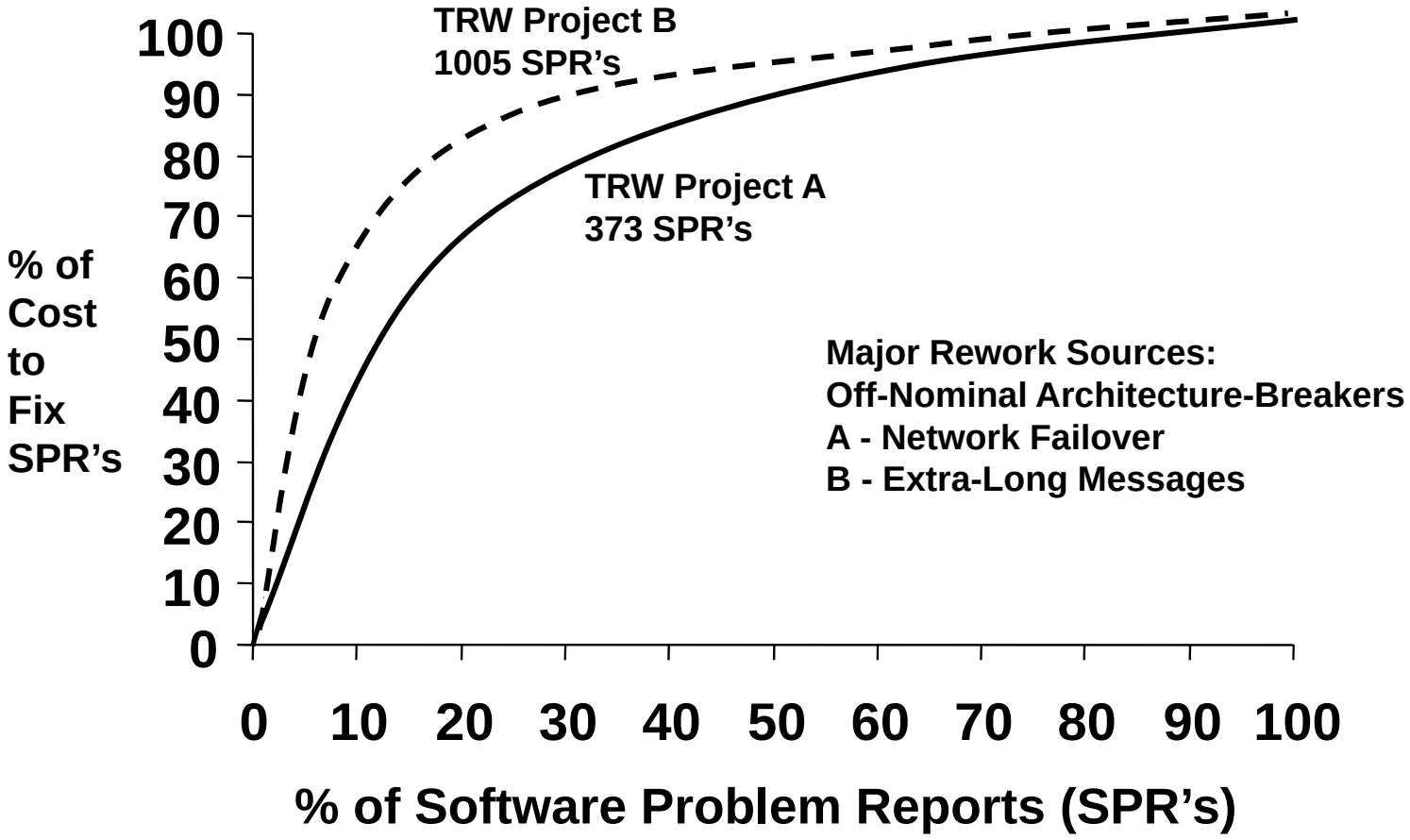
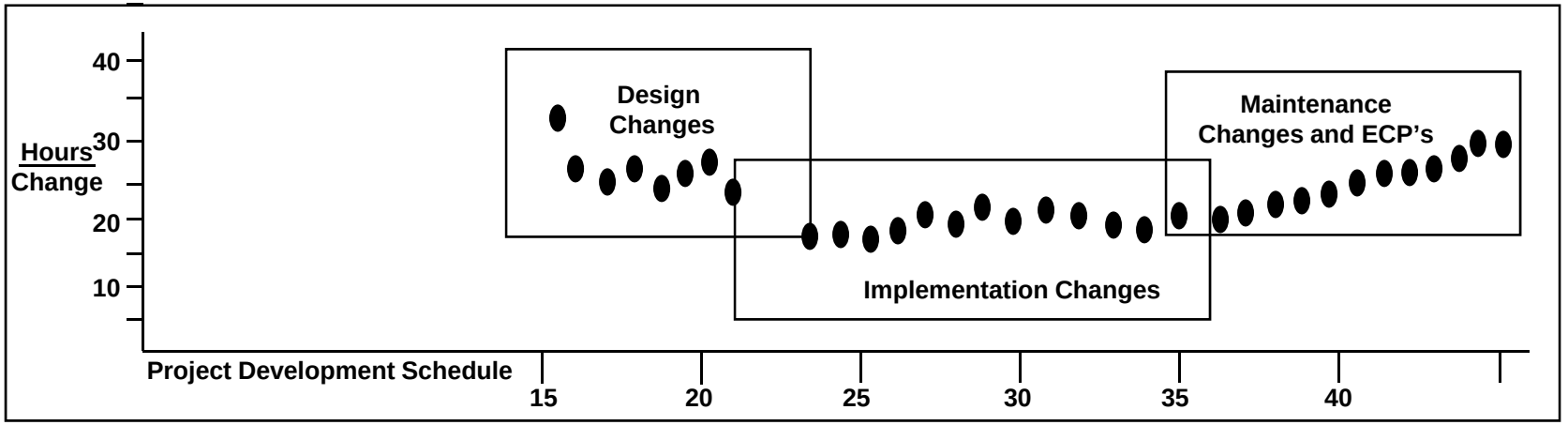
Off-Nominal Architecture-Breakers



CCPDS-R Results: No Late 80-20 Rework

- Architecture and evidence first
  - -Integration during the design phase
  - -Demonstration-based evaluation
- Risk Management
- Configuration baseline change metrics:



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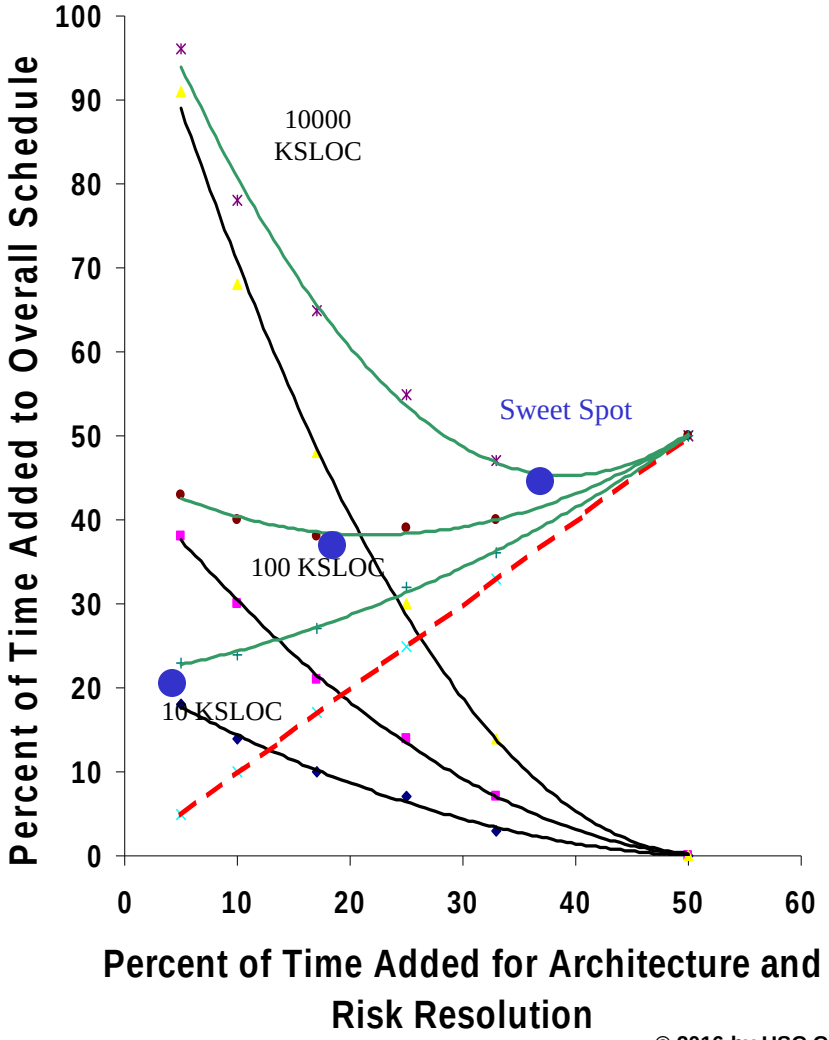
Need for EBRs in Large Systems of Systems



Percent of Project Schedule Devoted to Initial Architecture and Risk Resolution

Added Schedule Devoted to Rework (COCOMO II RESL factor)

Total % Added Schedule

Sweet Spot Drivers:

Rapid Change: leftward

High Assurance: rightward

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Steps for Developing Feasibility Evidence

A. Develop phase work-products/artifacts
   - ConOps, Rqts., Architecture, Plans, Budgets, Schedules

B. Determine most critical feasibility assurance issues
   - Issues for which lack of feasibility evidence is program-critical

C. Evaluate feasibility assessment options
   - Cost-effectiveness, risk reduction leverage/ROI, rework avoidance
   - Tool, data, scenario availability

D. Select options, develop feasibility assessment plans

E. Prepare FE assessment plans and earned value milestones
   - Try to relate earned value to risk-exposure avoided rather than budgeted cost

"Steps" denoted by letters rather than numbers to indicate that many are done concurrently

Steps for Developing Feasibility Evidence
(continued)

F. Begin monitoring progress with respect to plans
   - Also monitor project/technology/objectives changes and adapt plans

G. Prepare evidence-generation enablers
   - Assessment criteria
   - Parametric models, parameter values, bases of estimate
   - COTS assessment criteria and plans
   - Benchmarking candidates, test cases
   - Prototypes/simulations, evaluation plans, subjects, and scenarios
   - Instrumentation, data analysis capabilities

H. Perform pilot assessments; evaluate and iterate plans and enablers

I. Assess readiness for Commitment Review
   - Shortfalls identified as risks and covered by risk mitigation plans
   - Proceed to Commitment Review if ready

J. Hold Commitment Review when ready; adjust plans based on review outcomes

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- **Backup Charts**

Types of Milestone Reviews

- Schedule-based reviews (contract-driven)
  - We'll hold the PDR on April 1 whether we have a design or not
  - High probability of proceeding into a Death March
- Event-based reviews (artifact-driven)
  - The design will be done by June 1, so we'll have the review then
  - Large "Death by PowerPoint and UML" event
    - Hard to avoid proceeding with many unresolved risks and interfaces
- Evidence-based commitment reviews (risk-driven)
  - Evidence provided in Feasibility Evidence Description (FED)
    - A first-class deliverable
  - Shortfalls in evidence are uncertainties and risks
  - Should be covered by risk mitigation plans
  - Stakeholders decide to commit based on risks of going forward

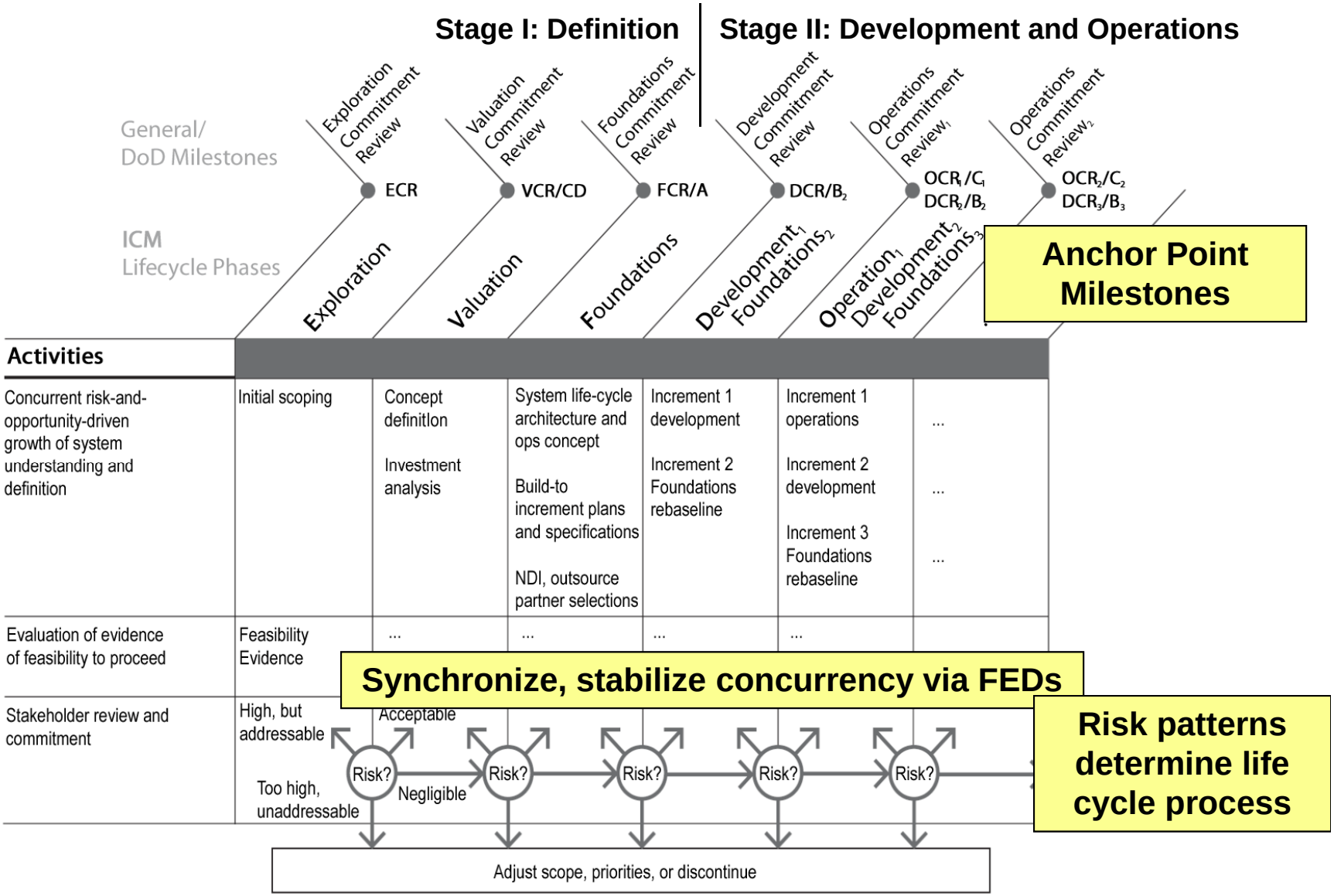
Nature of FEDs and Anchor Point Milestones

- ***Evidence*** **provided by developer and validated by independent experts that:**

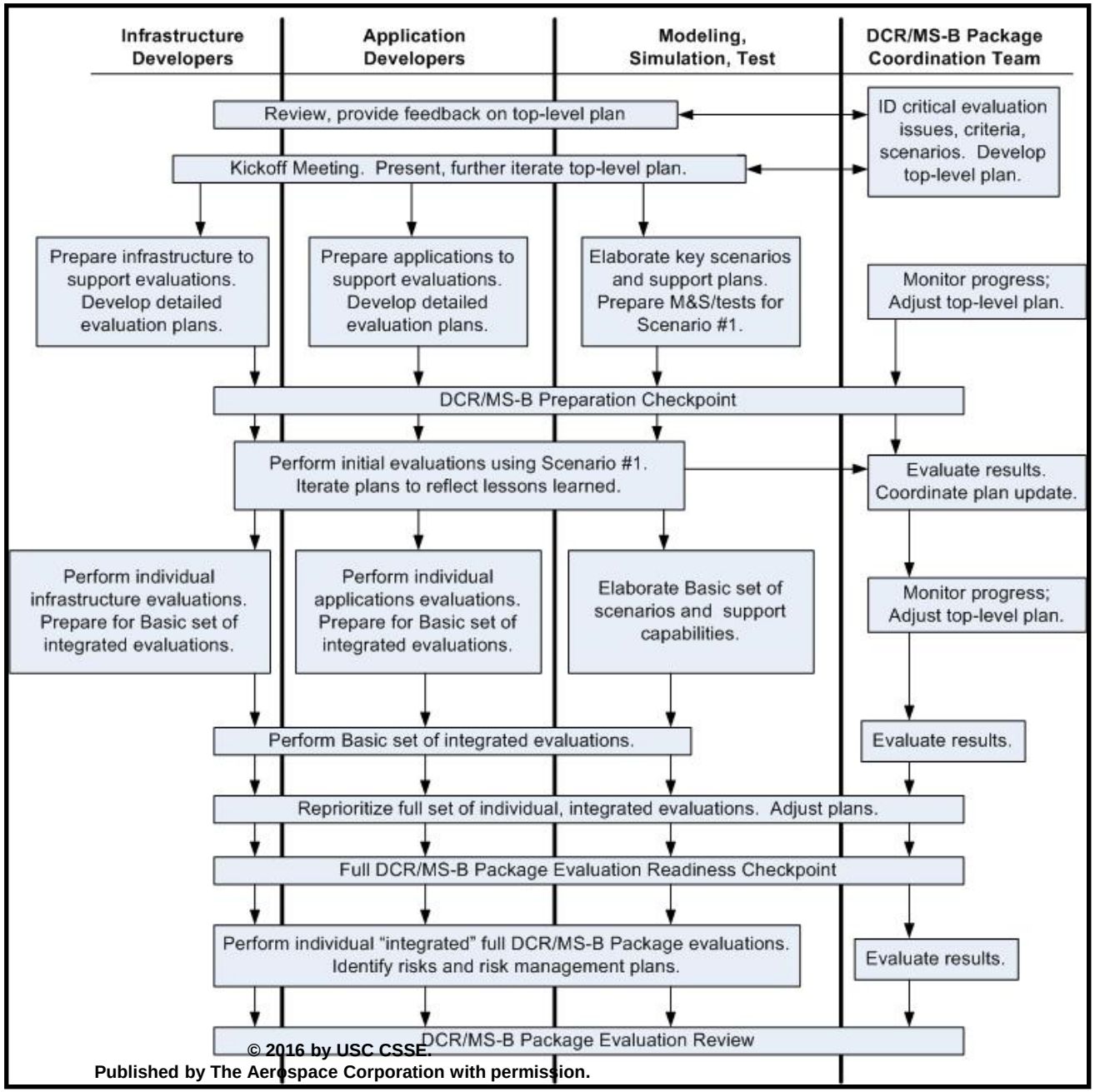
  If the system is built to the specified architecture, it will
  - **Satisfy the specified operational concept and requirements**
    - **Capability, interfaces, level of service, and evolution**
  - **Be buildable within the budgets and schedules in the plan**
  - **Generate a viable return on investment**
  - **Generate satisfactory outcomes for all of the success-critical stakeholders**
- **Shortfalls in evidence are uncertainties and risks**
  - **Should be resolved or covered by risk management plans**
- **Assessed in increasing detail at major anchor point milestones**
  - **Serves as basis for stakeholders' commitment to proceed**
  - **Serves to synchronize and stabilize concurrently engineered elements**

Can be used to strengthen current schedule- or event-based reviews

The Incremental Commitment Life Cycle Process: Overview



Large-Scale Simulation and Testbed FED Preparation Example



Overview of Example Review Process: DCR/MS-B