A Data Item Description for System Feasibility Evidence

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Summary

- Schedule-based and event-based reviews are risk-prone
  - Their DIDs focus on specifications and traceability
  - Optional evidence preparation is frequently absent
- Evidence-based reviews enable early risk resolution
  - They require more up-front systems engineering effort
  - They have a high ROI for high-risk projects
  - They synchronize and stabilize concurrent engineering
  - The evidence becomes a first-class deliverable
    - It requires planning and earned value management
- There are no DIDs for feasibility evidence
  - Path of least resistance is to use existing DIDs
- Proposed DID provides an evidence-based alternative
  - Based on successful use on related very large and small projects
  - Enables taioring-up vs. always tailoring down

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

Nature of Feasibility Evidence

- Not just traceability matrices and PowerPoint charts
- Evidence can include results of
  - Prototypes: of networks, robots, user interfaces, COTS interoperability
  - Benchmarks: for performance, scalability, accuracy
  - Exercises: for mission performance, interoperability, security
  - Models: for cost, schedule, performance, reliability; tradeoffs
  - Simulations: for mission scalability, performance, reliability
  - Early working versions: of infrastructure, data fusion, legacy compatibility
  - Previous experience
  - Combinations of the above
- Validated by independent experts
  - Realism of assumptions
  - Representativeness of scenarios
  - Thoroughness of analysis
  - Coverage of key off-nominal conditions

Steps for Developing FED

Step	Description	Examples/Detail
A	Develop phase work-products/artifacts	For a Development Commitment Review, this would include the system's operational concept, prototypes, requirements, architecture, life cycle plans, and associated assumptions
B	Determine most critical feasibility assurance issues	Issues for which lack of feasibility evidence is program-critical
C	Evaluate feasibility assessment options	Cost-effectiveness; necessary tool, data, scenario availability
D	Select options, develop feasibility assessment plans	What, who, when, where, how…
E	Prepare FED assessment plans and earned value milestones	Example to follow…
F	Begin monitoring progress with respect to plans	Also monitor changes to the project, technology, and objectives, 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	Short bottom-line summaries and pointers to evidence files are generally sufficient
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	Review of evidence and independent experts' assessments

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

Feasibility Evidence DID Overview

- Tailorable up from simple-project version
  - Criteria provided for simple, intermediate, and complex projects
- Complex-project version based on key SE studies
  - NRC Early Systems Engineering study
  - Services Probability of Program Success frameworks
  - NDIA-SEI SE Effectiveness Survey
  - INCOSE SE Leading Indicators
  - SISAIG SE Early Warning Indicators
- Organized into Goal-Critical Success Factor-Question Hierarchy
  - Tailorable up at each hierarchy level

Criteria for Simple, Intermediate, and Complex Projects

Criterion	Size	Complexity	Criticality	Capability
Criterion Content	Number of personnel	Novelty; Technical Risk; Stakeholder Conflicts; External Constraints	Loss due to defects	Personnel; Organization: relative to complexity & criticality
Simple Level	1 – 10	Low	Comfort; Discretionary funds	High - Very High
Intermediate Level	10 – 100	Mixed	Serious funds; Quality of life factors	Mixed
Complex Level	Over 100	All high to very high	Essential funds; Loss of human life	Low

FED DID General Information for Simple Projects

Project Name: _____

Project Primary Objective: _____

Success-Critical Stakeholders: _____

_____

_____

(Includes Role, Organization, Authorized Representatives and Contact Info for each stakeholder)

Life Cycle Process: ☐ Agile ☐ Architected Agile ☐ IC Spiral ☐ RUP ☐ Vee ☐ Other _____

Decision Milestone: _____

Key FED Dates:

Review Version Complete _____

Review Complete ____

Decision Meeting and Outcome Decided _____

The DID Tailoring-Up Framework: Goals, Critical Success Factors, and Questions

Goal 1. Concurrent definition of system requirements and solutions

CSF 1.1 Understanding of stakeholder needs: capabilities, operational concept, key performance parameters, enterprise fit (legacy)

1. At Milestone A, have the Key Performance Parameters (KPPs) been identified in clear, comprehensive, concise terms that are understandable to the users of the system?

2. Has a Concept of Operations (CONOPS) been developed showing that the system can be operated to handle both nominal and off-nominal workloads and meet response time requirements?

3. Has the ability of the system to meet mission effectiveness goals been verified through the use of modeling and simulation?

4. Have the success-critical stakeholders been identified and their roles and responsibilities negotiated?

(a) Have questions about the fit of the system into the stakeholders' context—acquirers, end users, administrators, interoperators, maintainers, etc.—been adequately explored?

Can Tailor DID Up at Goal or CSF Level

High-level Goals	Critical Success Factors
Concurrent definition of system requirements & solutions	Understanding of stakeholder needs
	Concurrent exploration of solutions
	System scoping & requirements definition
	Prioritization/allocation of requirements
System life-cycle organization, planning & staffing	Establishment of stakeholder RAAs
	Establishment of IPT RAAs
	Establishment of resources to meet objectives
	Establishment of selection/contracting/incentives
	Assurance of necessary personnel competencies
Technology maturing & architecting	COTS/NDI evaluation, selection, validation
	Life-cycle architecture definition & validation
	Use of prototypes, models, etc. to validate maturity
	Validated budgets & schedules
Evidence-based progress monitoring & commitment reviews	Monitoring of system definition
	Monitoring of feasibility evidence development
	Monitoring/assessment/re-planning for changes
	Identification and mitigation for feasibility risks

Example of Tailoring-Up Use

- Quantitative Methods, Inc. (QMI) is a leader in developing complex object-recognition systems (ORS)
- Coast Guard contracting with QMI for an ORS
  - Simpler than ORSs developed for Navy, Air Force
  - But includes new university-research algorithms
  - Uncertainty in performance leads to KPP ranges in contract
- Only a few of Goals and CSFs need to be tailored in
  - CSF 1.1 Understanding of stakeholder needs: key performance parameters
  - Question 1 on KPP identification covered by KPP ranges
  - Question 3 on effectiveness verification tailored in
  - CSF 1.2 Concurrent exploration of solution opportunities tailored in to address alternative high-performance-computing platforms
  - CSF 1.3 on system scoping and CSF 1.4 on requirements prioritization tailored out due to being already covered

Spreadsheet Tool Enables Risk Monitoring

Exposure	Question #	Impact: Critical / 40-100%	Impact: Significant / 20-40%	Impact: Moderate / 2-20%	Impact: Little-No impact / 0-2%	Evidence/Risk: Little-None / p(0.4-1.0)	Evidence/Risk: Weak / p(0.2-0.4)	Evidence/Risk: Partial / p(0.02-0.2)	Evidence/Risk: Strong / p(0.0-0.02)	NOTE: Impact and evidence/risk ratings should be done independently. The impact rating should estimate the effect a failure to address the specified item might have on the program. The evidence rating should specify the qualtity of evidence that has been provided, which demonstrates that the specified risk item has been satisfactorily addressed.	Reset / Risk Exposure	
	Goal 1:									**Concurrent definition of system requirements and solutions**		
	Critical Success Factor 1.1									**Understanding of stakeholder needs: capabilities, operational concept, key performance parameters, enterprise fit (legacy)**	4	
1	1.1(a)				●					At Milestone A, have the KPPs been identified in clear, comprehensive, concise terms that are understandable to all stakeholders?		No forma
3	1.1(b)			●			●			Has a CONOPS been developed showing that the system can be operated to handle both nominal and off-nominal workloads, to meet response time requirements, and generally to meet the defined KPPs?		IT system
3	1.1(c)			●			●			Has the ability of the system to meet mission effectiveness goals been verified through the use of modeling and simulation?		IT system effectiven
4	1.1(d)	●						●		Have the success-critical stakeholders been identified, their roles and responsibilities negotiated, and their needs clearly represented by the KPPs and CONOPS?		Developm Stakehold
4	1.1(e)	●						●		Have issues about the fit of the system into the stakeholders' context -- acquirers, end users, administrators, interoperators, maintainers, etc. -- been adequately explored?		Explored after syst related to different

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