Using SCAMPI Appraisals for Other Process Models
SOX, DoD 5000, . . . !

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Predicting Success

- "It's tough to make predictions, especially about the future." —popularly attributed to Yogi Berra
- In most endeavors, we are interested in accurately predicting if we will succeed at that endeavor.
  - A general truism: If we expect that we will not succeed, then we will change in order to become successful.
- Question: for a well-defined body of knowledge, can we develop a model for predicting success for "precedented" projects?

The Value of Predicting Success

- The real value of predicting success is in being able to avoid ***failure***.
- Beyond the obvious, avoiding failure is valuable because:
  - We can avoid rework by making corrections before problems happen or as close to the problem origin as possible.
  - We can apply constrained resources where they would do the most good.
  - We can cancel activities that are doomed to fail.
- We would like to have a failure (or success) predictor.
- Inherent in a predictor is the concept of "chance": a predictor will not determine success or failure, but assign a probability of occurrence to them.

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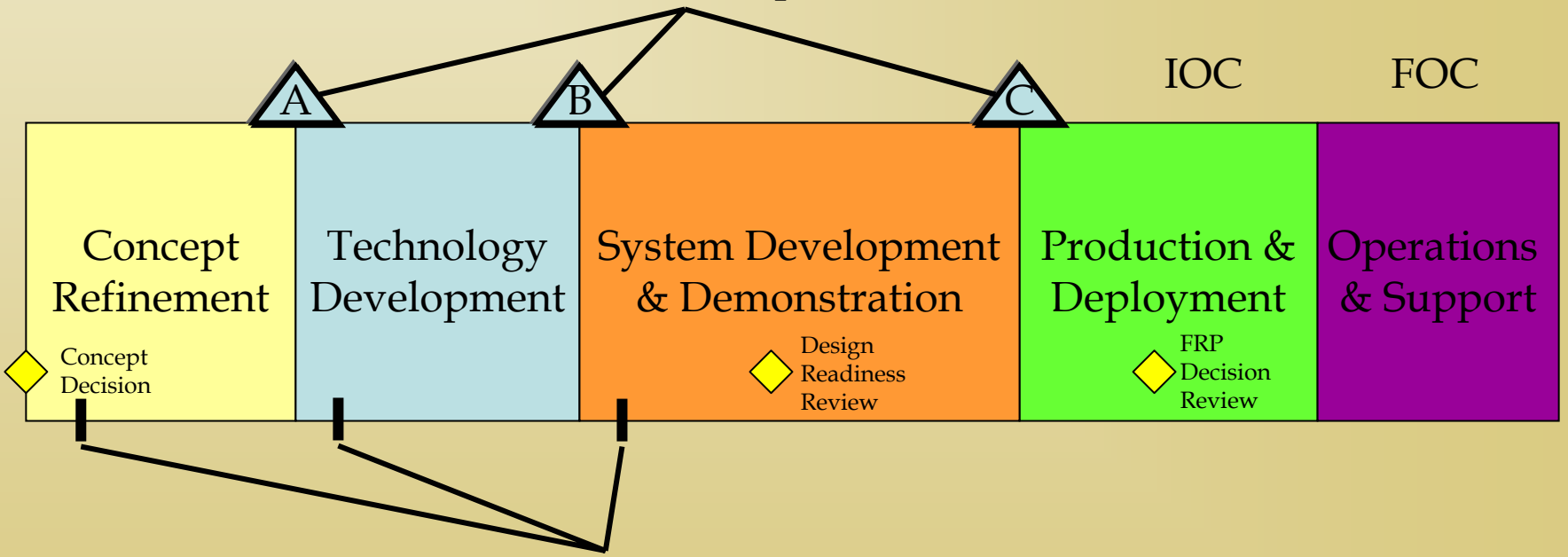
Example: Predicting DoD 5000 Life Cycle

Significant control gate reviews occur at the triangles marked "A", "B", and "C" — *after* work has been accomplished.



We would like to *predict* the results of the "A", "B", and "C" reviews at these points!

Don't Predictors Already Exist?

- In some areas, such as program performance, there are some measures that are used as predictors:
  - Earned value management systems include measures such as Cost Performance Index (CPI) and Schedule Performance Index (SPI).
- Unfortunately, these measures are not universally applicable nor do they take advantage of all available information:
  - The measures do not inherently provide direct insight as to why activities are likely to succeed or fail—further analysis is required.
  - Creating the mechanisms for collecting the data for the measurements is non-trivial.
  - The measures are derived from evaluating performance data against current and future plans, but do not account for an organization's inherent ability to fulfill (or not) the plans.

Predictive Modeling: A Qualified "Yes" for HW/SE/SW Development

- The concept of having a model to help predict success for aspects of development activities is familiar to us from CMMI Capability/Maturity levels 4 and 5.
- With some quibbles, we act as if a CMMI level is a predictor of success:
  - Organization X:
    - Experienced at developing signal processing software.
    - CMMI Maturity Level 3.
  - Organization Y:
    - Experienced at developing signal processing software.
    - CMMI Maturity Level 2.
  - We expect that organization X is more likely to succeed at developing a new signal processing software application than organization Y.

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How We Assess Likelihood of Success

- Standard assessment techniques, whether applied to engineering, enterprise or program management, or finance, usually consider where we have been, rather than where we are going to.
  - For discussion purposes, let us label traditional assessment techniques as “audits”.

Traditional Audit Examples

- In finance, standard financial and managerial audits focus on verifying that audited artifacts accurately and completely reflect reality.
  - Example: does the balance sheet correctly represent a company's financial health?
- The DoD 5000 acquisition milestones represent control gates to determine if a defense program has met expectations.
  - Example: Is the documented Technology Development Strategy approved by the Milestone Decision Authority in order to enter the Technology Development Phase?

Foresight & Hindsight

- The questions to be asked are really two-fold:
  1. Are the results achieved to date acceptable?
  2. Given that the current results are acceptable, is the process that we are following going to lead to more acceptable results?
- Hindsight: question #1 is answered with traditional audit.
- Foresight: process assessment methods *may* help with question #2.

What Predictive Results Can A Process Assessment Produce?

- An audit compares the outputs of a process against expectations.
- A process assessment provides insight to evaluate if:
  - Processes are documented,
  - Processes are capable of delivering a specified output,
  - Processes are being consistently followed,
  - Process outputs exist and are correct.
- *An assertion*: given a known starting point, a process assessment can be used to predict if the desired result(s) can be achieved.

Validity of Process Assessment Predictions

- A measurement system is valid if it is accurate and precise.
  - Accuracy: the degree of closeness of a measured or calculated quantity to its true value.
  - Precision: the degree to which repeated measurements or calculations will show the same or similar results.

Conditions for Using a Process Assessment for Prediction

- Requirements for using a process assessment for predicting results:
  - There must be a defined method to structure how process assessments will evaluate inputs (e.g., artifacts) and produce the predictors of success.
  - There must be a defined body of knowledge that defines what constitutes success.
  - The activities to be evaluated must be precedented; that is, creative and research activities are difficult to evaluate.

Are There Process Assessment Methods Available?

- There are existing process assessment models that may be used as predictors.
- This presentation discusses the one that's familiar to us: Standard CMMI Appraisal Methodology for Process Improvement (SCAMPI).
- Among process assessment models, SCAMPI has some pedigree:
  - SCAMPI or its predecessors have been in use for almost 20 years.
  - SCAMPI has a rich collection of assessment approaches at increasing degrees of formality
  - SCAMPI is used throughout the US and much of the world.
  - According to SEI's September 2008 report, there have been 3,553 SCAMPI Class A appraisals covering 2,168 companies reported to the SEI from April 2002 to July 2008.

Is a Process Assessment a Valid Predictor of Success?

- Unknown, but . . . is a SCAMPI Class A appraisal a valid predictor of future success for an organization doing HW/SE/SW development?
  - The SCAMPI appraisal method fulfills the conditions given on the previous slide.
  - We generally recognize a Class A appraisal as a more valid measurement system than a Class B than a Class C.
  - There is evidence that if the conditions on the previous slide are violated, then the SCAMPI method is not a predictor—specifically, experience in one type of work does *not* guarantee success in an unrelated type of work.
  - Unfortunately, we are forced to beg the question: we all act like appraisals are good predictors, but there is limited evidence.

SCAMPI A vs. B vs. C

Characteristics	Class A	Class B	Class C
Amount of Objective Evidence Gathered (relative)	High	Medium	Low
Ratings Generated	Yes	No	No
Resource Needs (relative)	High	Medium	Low
Team Size (relative)	Large	Medium	Small
Appraisal Team Leader Requirements	Lead appraiser	Lead appraiser or person trained and experienced	Person trained and experienced

Extracted from Appraisal Requirements for CMMI, Version 1.2 (ARC)

Think SCAMPI C or B, not A

- Given our goal of predicting a result as early as possible, much of the evidence that we see is likely to be incomplete.
- We may not be able to conduct our assessment as a Class A appraisal.
- Class B and C appraisal rules provide more adaptability in terms of letting us consider works-in-progress and intentions rather than finished product.
  - We will need to select the appraisal class rules that we use based on how early we are doing our assessment.

Using SCAMPI for Bodies of Knowledge Other Than CMMI

- Every SCAMPI appraisal has two components:
  1. Component 1: The body of knowledge against which HW/SE/SW processes are evaluated; that is, the CMMI.
  2. Component 2: Information collection and analysis procedures and rules (some of which depend on component 1).
     - An example of these dependencies is the structural relationship used in aggregating characterizations from practices to goals.
- To apply SCAMPI to non-CMMI bodies of knowledge, we must:
  - Replace component 1.
  - Remove any CMMI dependencies from component 2.

Structuring Other Bodies of Knowledge for use with CMMI

- There are two alternative approaches:
  1. Rewrite components 1 and 2 to adapt SCAMPI to the other body of knowledge.
  2. Structure the body of knowledge so that it matches CMMI's structure.
- This presentation discusses approach #2.
- To make the ideas concrete, let us examine applying SCAMPI to DoD acquisition programs seeking to comply with DoD 5000.1/5000.2.
  - Given space and time constraints, obviously the presentation cannot cover the entire DoD 5000 series!

Why Do A DOD 5000 "SCAMPI"?

- Depending on the size and importance of a program, passing the DoD 5000 milestone reviews may be a challenge.
- Finding out at a milestone review that there are issues may cause significant acquisition delays and increase costs.
- Predicting as early as possible that a program's approach is likely to result in milestone review approval is useful!

Steps in Performing a DOD 5000 "SCAMPI"

Step 1—Entry Condition: determine if a program's current state (e.g., from a previous milestone review) was acceptable.

Step 2—Model Translation: for any given milestone review, translate that review's requirements into CMMI-like goals and practices.

- This translation will be used in step 3 below to determine if existing results (from step 1 above) can lead to success using the program's planned activities.
- This step is primarily applicable with what will become the DOD 5000 analogues of the specific goals and practices.
- The generic goals and practices, particularly for Generic Goal (GG) 2, translate easily from a success prediction viewpoint.

Step 3—Evaluation: apply SCAMPI artifact collection and evaluation rules to identify "good" artifacts and use them to drive assessment findings as a basis for predicting success.

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Step #1
Entry Condition Determination

- Determining if the "current" state of the program is acceptable is straightforward—simply look at the results from the previous control gate and associated reviews.

Step #2
Model Translation

- In the interest of time, let's work model translation with respect to the Milestone B control gate.
- For Generic Goals, we translate CMMI concepts into DoD 5000 language.
- For Specific Goals, we translate DoD 5000 requirements into a CMMI structure expressed in the language of DoD 5000.

Translating Generic Goals and Practices (1)

- Generic Practice (GP) 2.1: is there clear, documented management direction for performing the work required for the milestone B review?
- GP 2.2: is there a documented plan that is both used and kept up-to-date for reaching milestone B?
- GP 2.3: are there adequate resources (people, technology, facilities) for fulfilling the plan?
- GP 2.4: are the responsibilities and authorities needed to implement the plan documented and followed?
- GP 2.5: do the people to whom work is assigned have the knowledge and skills to accomplish the work?

Translating Generic Goals and Practices (2)

- GP 2.6: is there appropriate change control and approval over both the artifacts (e.g., plans, studies) and the inputs to these artifacts needed for Milestone B?
- GP 2.7: are the various organizations and personnel ("stakeholders") who need to participate in or make decisions about program activities both identified and actually involved as needed?
- GP 2.8: are the planned activities for reaching Milestone B being monitored and controlled to the plan and corrective action being taken for deviations?

Translating Generic Goals and Practices (3)

- GP 2.9: are the program's work products being evaluated for adequacy against Milestone B requirements and the program's processes being adhered to?
- GP 2.10: is higher-level management being honestly informed about the program's progress against plan?

Translating Specific Goals and Practices

- Let us consider the (regulatory) requirements for Milestone B:
  - Initial Capabilities Document
  - Capability Development Document
  - Acquisition Strategy
  - System Threat Assessment
  - Technology Readiness Assessment
  - C4ISP
  - Test and Evaluation Master Plan
  - Operational Test and Evaluation Results

Capability Development Document Goals and Practices

- Specific Goal 1: The CDD shall outline an affordable increment of militarily useful capability.
  - Specific Practice 1.1: The CDD shall contain a system architecture.
  - Specific Practice 1.2: The CDD shall contain an operational architecture.
  - Specific Practice 1.3: The CDD shall define Key Performance Parameters that document the system's military capability.
- Specific Goal 2: The CDD shall outline an affordable increment of logistically supportable capability.
- Specific Goal 3: The CDD shall outline an affordable increment of technically mature capability.

Test and Evaluation Master Plan Goals and Practices (1)

- Specific Goal 1: The TEMP shall be consistent with and complementary to the other Milestone B acquisition documents.
  - Specific Practice 1.1: The TEMP shall be consistent with the Capability Development Document.
  - Specific Practice 1.2: The TEMP shall be consistent with the System Threat Assessment.
  - Specific Practice 1.3: The TEMP shall be consistent with the Information Support Plan.
  - Specific Practice 1.4: The TEMP shall be consistent with and complementary to the Systems Engineering Plan.

Test and Evaluation Master Plan Goals and Practices (2)

- Specific Goal 2: The TEMP shall explicitly contain all of the information in the TEMP recommended format.
  - Specific Practice 2.1: The TEMP shall define the system measures of effectiveness.
  - Specific Practice 2.2: The TEMP shall define the integrated test program schedule.
  - …

#3 Evaluation

- SCAMPI provides good guidance for actually evaluating a program:
  - Guidance on the types of evidence to collect for an assessment and how to organize that evidence.
  - Guidance on how to evaluate and characterize the evidence collected.
  - Guidance on how to report findings.

Evidence Types

- Evidence types needed to evaluate a program:
  - Direct Artifacts: tangible evidence that is the expected output of the Milestone B practices defined in previous slides.
    - Example: a list of Measures of Effectiveness contained in the TEMP.
  - Indirect Artifacts: circumstantial evidence supporting the direct artifacts.
    - Example: notes from review meetings concerning establishing the MOEs in coordination with other acquisition documents.
  - Affirmations: testimony concerning the direct and indirect artifacts.
    - Example: interviews with personnel involved in defining and coordinating the MOEs.

Characterizing Evidence (1)

- Once we have defined the specific and generic goals and practices, SCAMPI's characterization rules appear adequate for making predictions.
  - The Green/Yellow/Red scale from Class B appraisals is a more understandable scale than the Fully Implemented/Largely Implemented/Partially Implemented/Not Implemented/Not Yet of a Class A for most potential consumers of the assessment.
    - Many organizations use Green/Yellow/Red—only the SCAMPI-savvy use FI/LI/PI/NI/NY!

Characterizing Evidence (2)

Label	Meaning
Red	**The intent of the practice is judged to be absent or poorly addressed in the implemented practices—gaps or issues that will prevent success were identified.**
Yellow	**The intent of the practice is judged to be partially addressed in the set of implemented practices—some gaps or issues were identified, which might threaten success were identified.**
Green	**The intent of the practice is judged to be adequately addressed in the implemented success is likely.**

Reporting Findings

- SCAMPI findings are usually reported in a "findings briefing" delivered to the organization or program that was assessed.
  - This findings briefing usually lists the program-practice characterizations and descriptive findings of any implementation gaps.
- For an assessment for a program seeking to pass Milestone B, this briefing should report:
  - The current state of the program with respect to Milestone B artifacts,
  - The artifact-by-artifact (goal-by-goal) characterization (red/yellow/green) for successfully passing Milestone B.
- Management may want a "roll-up" score the combines the individual characterizations.
  - Once artifact/goal characterizations are determined, the standard SCAMPI aggregation rules could be applied.
    - These rules may not be satisfactory in predicting success in passing Milestone B review, since any artifact/goal rated yellow or worse could trigger rework and further reviews.

Summary

- Process assessments combined with audits of an activity's current status may be used to create a predictive model for the activity's chance of success.
- SCAMPI is a widely-used assessment method that may be adapted to any well-defined body of knowledge.
  - To use SCAMPI requires us to create a framework for expressing the terms of the body of knowledge (e.g., the DoD 5000 series) in terms of the structure, but not the content, of the CMMI.