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Replacing Promises with Data: A Structured Way to Assess Software Health

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Introduction: Assessing Software Health at PEO GCS

A primary source of acquisition program risk is **software**.

How can you determine the status of your software projects across projects and platforms?

Program Executive Office Ground Combat Systems (PEO GCS) (US Army TACOM) has developed a structured approach to assessing software project health in order to maintain quality and consistency across projects and platforms.

This approach:

- focuses on practical guidance
- encompasses all phases of the acquisition life cycle
- relies on reusable artifacts, evaluation criteria, and reporting templates



This Presentation

Outline

- Background
- Incorporating metrics into the acquisition process
- Indicators for software health
- Getting the right data
- Analyzing the data
- Example indicator guidance
- Conclusions

Goal

To inspire broader adoption of a structured approach for software health by the acquisition community



Project Background

The Issue

- Software is sometimes inaccurately assessed for systems failures, delays, or cost growth.
- Further, there is a perception that the software can always be changed to accommodate late changes.

Even minor changes in software scope can have significant impact on project cost, schedule, and performance.

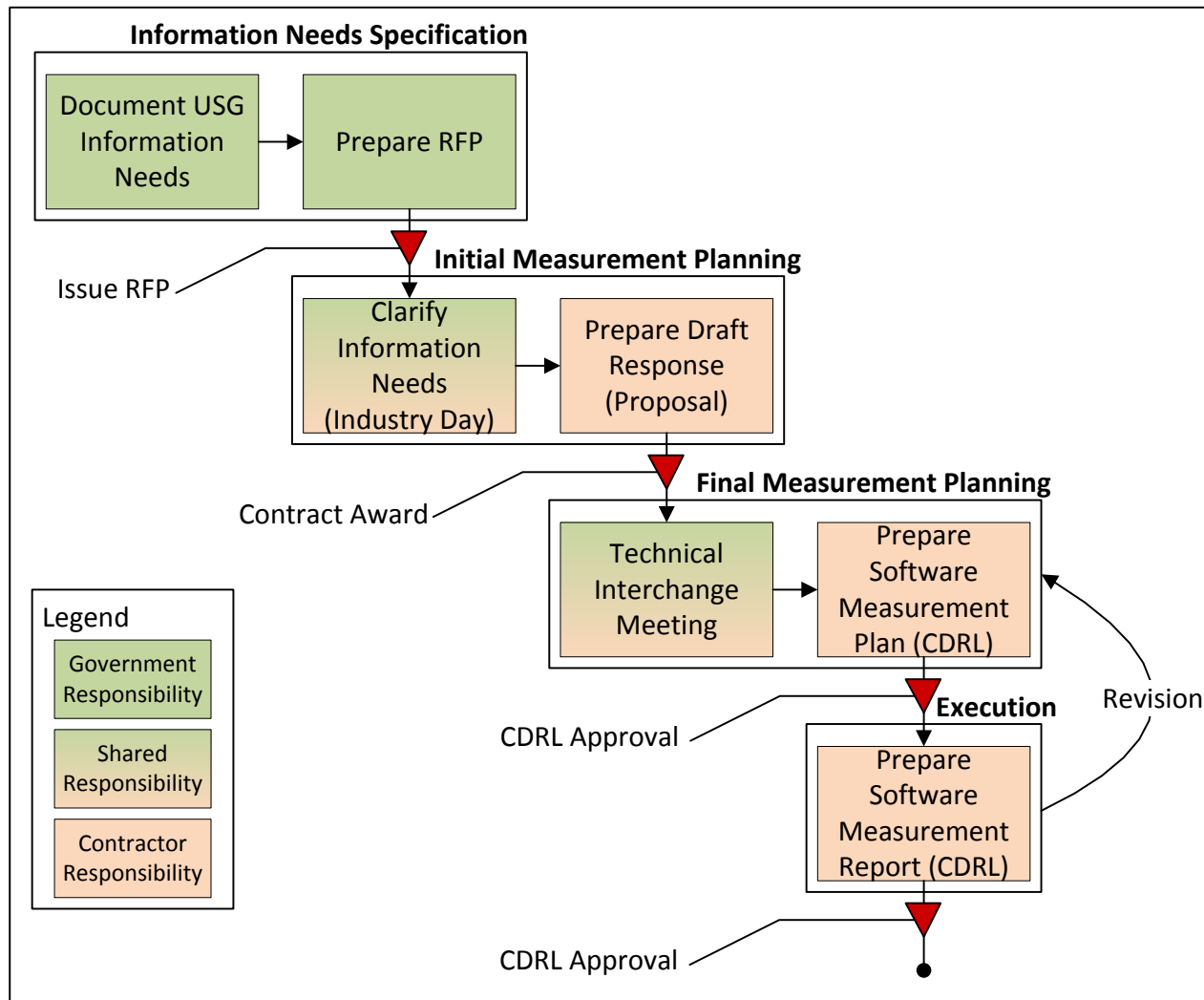
Solution Approach

PEO GCS' process improvement addresses the need for project management visibility of potential software issues:

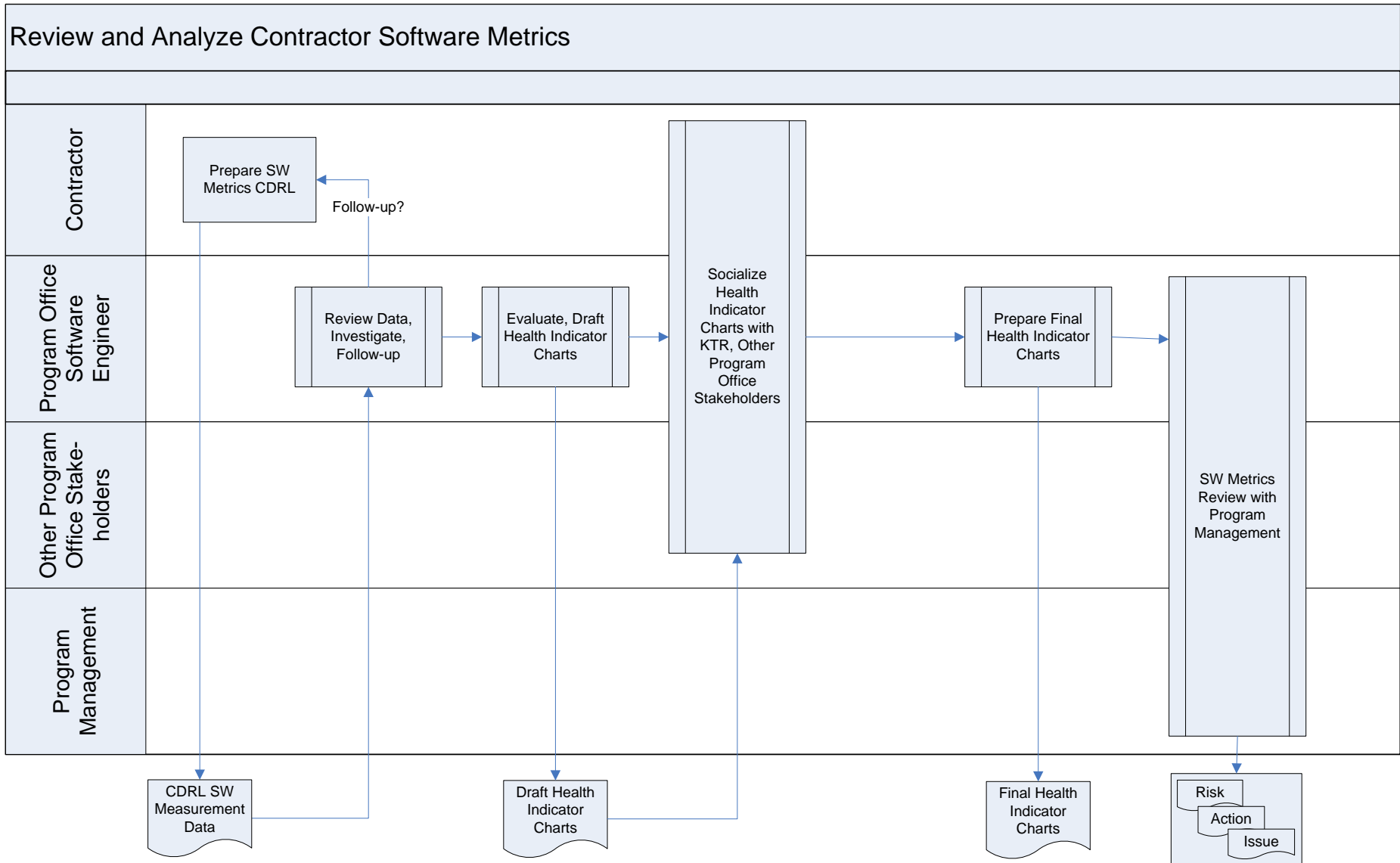
- consistency across projects/platforms
- standard contract language for consistent contractor deliverables
- guidance to enable software engineers to report status consistently

Early identification and mitigation of software cost, schedule, or performance risks enables program management to establish adequate contingency.

Fitting Software Health (Metrics) into the Acquisition



Program Office Software Health Process



What Indicators Are Used for Software Health?

The PEO GCS assessment uses eight indicators to track software health:

1. scope
2. progress
3. scope stability
4. effort
5. staffing
6. schedule
7. quality
8. computer resources



For your reference, these indicators are described in detail on the next three slides.

Health Indicators – 1

Health Indicator	Description
Scope	<ul style="list-style-type: none"> • Management needs to understand and control changes in the scope of work to be accomplished. • Generally, scope directly or indirectly measures the size of work products to be accomplished. • Organizations find it useful to keep measures of scope separate from productivity (e.g., human effort) because it is helpful in project planning and estimation to distinguish poor estimates of scope from poor execution (e.g., low productivity).
Progress	<p>Management needs to be kept informed of how much of the planned work has actually been completed. With that said, organizations have learned the importance of distinguishing between signal and noise and not to overreact to noise (e.g., normal variation occurring with the progress of the work).</p>
Scope Stability	<ul style="list-style-type: none"> • Evaluate the stability and adequacy of the requirements to better understand the risks to other activities in providing required capability, on-time and within budget. • Understand the growth, change, completeness and correctness of the definition of the software requirements.

Health Indicators – 2

Health Indicator	Description
Effort	<ul style="list-style-type: none"> • The application of effort as specified in a SW project plan is the agreed-to investment to accomplishing the SW project's objectives. Effort is also the key cost driver. • We need to know if the level of effort expended is in accordance with the SW project plan and is producing the planned value to stakeholders.
Schedule	<ul style="list-style-type: none"> • Whether individual work items (features, artifacts, tasks, activities, work packages, etc.) and milestones that make up the project are being completed per the planned schedule. • The status of particular work items and milestones that could cause significant schedule slippage if they are not completed on time.
Staffing	<p>Whether sufficient and critical skills required by the project are made available in a timely fashion, as needed.</p> <ul style="list-style-type: none"> • Software development is a critical skill for the development of many subsystems. • Tracking staff related to critical skills; software development can be decomposed into specific software-related critical skills, for example, board support programmers or for particular domains (e.g., fire control).

Health Indicators – 3

Health Indicator	Description
Quality	Evaluate the quality of the software engineering lifecycle artifacts as represented by the generation and resolution of software defects.
Computer Resources	<ul style="list-style-type: none"> • The main processing unit and display processing units provide the Control and Operation; Lethality and Survivability; Command and Control; System Support and Sustainment; and Mobility functionality. • The computer memory and processor capacity data is collected for each build under varying circumstances and tracked to assess the computing resource utilization.

Using Questions to Get the Right Data

There are many ways to ask contractors for data that are intended to help management understand if and when software risk is introduced.



- Asking for broad topic data or for exact measurements is inefficient and does not typically produce helpful data.
- If you don't have the right data, the assessment of technical progress will not be as accurate, or could be misleading.



- Specific questions can be used to shortcut a sometimes painful process.
- If agreement is reached on how specific questions are answered, there is a better chance you will get the right data, and get it sooner.
For example:
 - What is the requirements/ scope baseline for each software version?
 - How will volatility be measured?

Understanding how the contractor manages its software will enable the PM to better assess and mitigate risk.

Example: Project Data Adequacy Summary

OVERALL RATING

- Overall rating takes into account interrelationships between individual measures. Schedule, effort, scope, and progress data in hand are enough to suggest that, in this case, the lack of data for staffing does not pose a clear risk. Difficulty of analysis is compounded by discrepancies within (and between) contractor reports.
- STAFFING – No data provided on breakout of overall effort/role
- PROJECT SCOPE – Scope definition is provided, although it is not well defined because the size (or start/stopping points) cannot be determined from text descriptions.
- PROGRESS – While Overall status of combined scope is provided by visualization of schedule, no planned/actual % complete data for combined or individual scope items (or method to compute) is provided.

MEASURE	RATING
Development Schedule	GREEN
Development Effort	GREEN
Staffing	RED
Project Scope	YELLOW
Progress	YELLOW
Scope Stability	GREEN
Defects	GREEN
Computer Resource Utilization	GREEN

*Quantifying data adequacy: Each category carries the same weight, GREEN=12.5 points, YELLOW=6.25, RED=0
Overall data adequacy improved from $(12.5*4+6.25*2+0*2) = 62\%$ to $(12.5*5+6.25*2+0*1) = 75\%$*

What Are the Data Sources? How is the Data Analyzed?

Data Sources

Data may come from Integrated Product Team meetings, contract deliverables (CDRLs), SIL testing

Analysis

- Analyze data for each health indicator individually, then analyze in groups to see if the conclusion makes sense and is consistent with the status the contractor has provided.
- Compare current data with previous data (and across projects) to ensure it is consistent, complete, and to look for trends.

Assessment Criteria

- PEO GCS established standard assessment criteria based on program level schedule:
 - Red: Definite schedule impact
 - Yellow: Potential schedule impact
 - Green: No impact
 - White: Not enough data to assess

Develop a structured analysis approach to maintain consistency and quality.

Example Indicator Guidance – 1

Why Are We Measuring This?

- What are the information needs? What questions are we trying to address?
- What measurable concepts do we need to describe?
- What is the insight that this indicator provides?
- How does it connect to other indicators?
- What possible risks might need to be identified as a result of poor performance on this indicator?

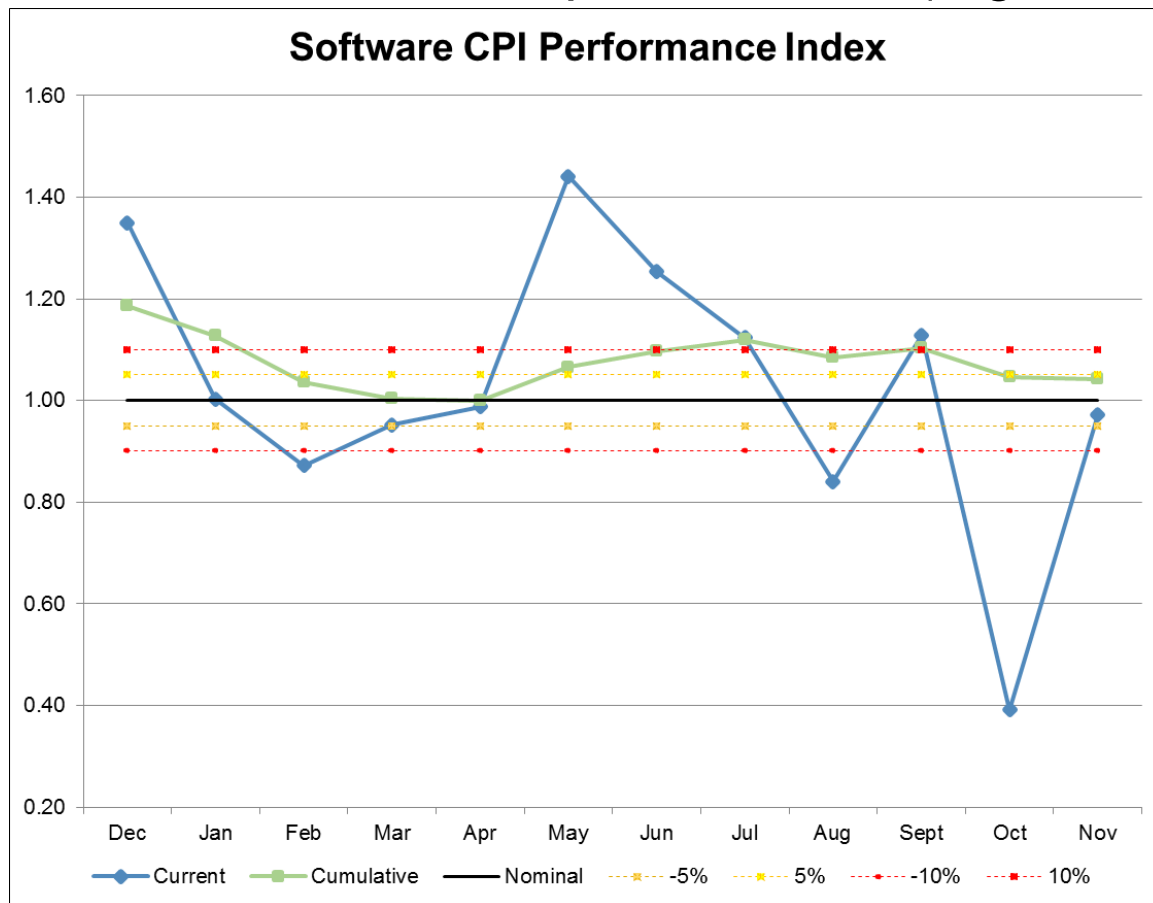
Example Indicator Guidance – 2

What Data/Analysis Do We Need?

- What are the base measures?
- What are the measurement methods? How is the data acquired?
- What other entities might be relevant for this indicator?
- What attributes could be used for this indicator?
- What are the derived measures or measurement functions that are needed?
- What are the assumptions we are making about the data?
- Are there additional considerations that could be employed?

Example Indicator Guidance – 3

What Does an Indicator Graph Look Like (e.g. Effort)?



	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov
Current	1.35	1.00	0.87	0.95	0.99	1.44	1.25	1.12	0.84	1.13	0.39	0.97
Cumulative	1.19	1.13	1.04	1.00	1.00	1.07	1.10	1.12	1.08	1.10	1.05	1.04

Project Assessment Summary

OVERALL RATING



Overall rating is based on four cautionary (YELLOW) indicators and one unknown (WHITE) indicator.

SCOPE – Scope for next drop is TBD pending final review of outstanding defects. In addition, Scope definition is provided, although it is not well defined because the size (or start/stopping points) cannot be determined from text descriptions. Data adequacy is YELLOW, assessment has to be YELLOW.

PROGRESS – Version 1 is on track. Gantt chart progress is not backed by percent complete calculation, and it is unknown if it is measured against baselined scope. While overall status of combined scope is provided via schedule inspection, no planned/actual % complete data for combined or individual scope items (or method to compute) is provided. Data adequacy is YELLOW, assessment has to be YELLOW.

STABILITY, and DEFECTS – The assessments are YELLOW, due to bad or insufficient data presented by the contractor (although they provided accurate data in the past). SCOPE STABILITY and DEFECTS data adequacy is GREEN.

USG is confident that the contractor will be able to complete planned scope on time given scope and effort reduction.

MEASURE	RATING
Development Schedule	GREEN
Development Effort	GREEN
Staffing	No data suggests neither a risk nor lack of risk.
Project Scope	YELLOW
Progress	YELLOW
Scope Stability	YELLOW
Defects	YELLOW
Computer Resource Utilization	GREEN

Conclusions and Recommendations

When government and contractor management and software teams understand the value of the data, they will support collection and analysis.

- Use contractual language to support early data negotiation/agreements and provide solidification.
- Be the PM's best advocate with contractor teams; be the contractor's best advocate at the PM.
- Make earliest visibility your best friend (to avoid later surprises)
- Use opportunities to dispel inaccurate perceptions, raise awareness, and toot horns.

In addition to enabling better risk mitigation, software health assessments are improving the way contracts are managed.

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