IMPLEMENTING MEASUREMENT AND ANALYSIS

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Introduction

The Measurement and Analysis (MA) Process Area in the Capability Maturity Model Integration (CMMI)* provides a solid infrastructure for implementing a measurement program. In this article we will describe the practices of MA and give some examples of practice implementations.

MA Purpose

From the CMMI text, the purpose of Measurement and Analysis is to develop and sustain a measurement capability that is used to support management information needs.

The Specific Goals (SGs) and Specific Practices (SPs) in **Figure 1** describe the PA.

SG 1	**Measurement objectives and activities are aligned with identified information needs and objectives.**	
	SP 1.1	Establish and maintain measurement objectives that are derived from identified information needs and objectives.
	SP 1.2	Specify measures to address the measurement objectives.
	SP 1.3	Specify how measurement data will be obtained and stored.
	SP 1.4	Specify how measurement data will be analyzed and reported.
SG 2	**Measurement results, which address identified information needs and objectives, are provided.**	
	SP 2.1	Obtain specified measurement data.
	SP 2.2	Analyze and interpret measurement data.
	SP 2.3	Manage and store measurement data, measurement specifications, and analysis results.
	SP 2.4	Report results of measurement and analysis activities to all relevant stakeholders.

Figure 1 MA Specific Goals and Practices

When MA is implemented, objectives and measures are established. Measurement results are then used to determine progress towards these objectives. Typical symptoms that occur when MA is not performed well include: few clear objectives; numerous measures defined but not used; or objectives are defined by rumor.

Next is a brief explanation of the Specific Practices.

SP 1.1: Establish and maintain measurement objectives that are derived from identified information needs and objectives.

Objectives may cover a broad range of issues such as budget, deadline, quality and product performance. A few items that are considered important for the business should be selected.

Objectives can either be qualitative or numeric. Usually, objectives start out as ambiguous or qualitative phrases, (e.g., "Improve quality") and over time are refined as numeric targets, (e.g., "Improve quality from 10 major defects per release to no more than 5 major defects per release.")

The CMMI text provides examples such as:

- Reduce time to delivery
- Reduce total lifecycle cost
- Deliver specified functionality completely
- Improve prior levels of quality
- Improve prior customer satisfaction ratings
- Maintain and improve the acquirer/supplier relationships

SP 1.2: Specify measures to address the measurement objectives.

Specify measures means that the measures are written down and made crystal clear. You can determine how well this practice is implemented by performing a simple test. Ask five colleagues to define "quality." If they provide multiple, conflicting or ambiguous responses, you know that this measure needs to be clarified. When the practice is performed correctly, all five people will refer to the same written definition.

SP 1.3: Specify how measurement data will be obtained and stored.

This practice simply asks for a definition of how and where data are collected. An example would be: "Every Monday, each project manager collects actual effort hours expended on project

tasks and stores in work-breakdown-effort.xls." The frequency, method of collection and storage location do not necessarily have to be the same for each measure.

SP 1.4: Specify how measurement data will be analyzed and reported.

This practice helps clarify what to look for in the data. For example, should the measurement results lie within a range? Should the trend be up, down or flat? Is there a threshold that, when exceeded, triggers further investigation or corrective actions?

Example metric for product integration

The last entry in **Figure 2** shows an example from one of our clients that measures the number of issues found when developers release components to the integration team.

In this example, the organization instituted a simple measure into the day-to-day flow of the project to detect problems being passed from the developers to the integrators. The measure allows problems to be detected early and acts as an ongoing feedback mechanism for the developers.

Objective	Stakeholder(s)	Metric(s)	Data Storage and Collection	Analysis	Reporting
Meet all commitments	Jennifer Jim Mary	# Days early or late	Collected every Monday. Recorded in milestone-report.doc	1. If > 5 days late: Report to program manager Examine critical path Adjust resources? Delegate work? Simplify solution? Slip deadline?	Weekly staff meeting Monthly program review
100% known defects resolved	Jennifer Jim Mary Kurt	# Major with open status	Collected weekly via script run on bugtrack system database. Defect counts are recorded in bugtrack.xls	1. Open rate (new defects open per week) <= close rate (defects closed per week) 2. # Major defects open = 0	Weekly staff meeting Monthly program review
Reduce problems entering integration by 10%	Jennifer Jim Mary Kurt	Product-component handoff scorecard rating (defined in scorecard spreadsheet)	For each product version, store in: <productname>-integration-scorecard.xls	1. Score should be > 80/100 for all handoffs	Monthly program review

Figure 2 Examples of objectives and measures

Figure 2 provides some examples of objectives and measures. These are defined in table form to keep the measurement documentation concise. This table could be imbedded in a project plan for project-level measures or created as a separate document for organizational measures. The analysis in the example is rudimentary and will likely become more advanced over time.

Process for MA

The process to implement MA will vary. If there are many organizations or projects participating in the measurement program and numerous objectives to clarify, the process might be larger and more complicated than if you are applying MA to one small group of 15 people.

In the beginning, the process might be as simple as completing the table in **Figure 2** with the appropriate stakeholders. For more complex organizations, there might be alignment steps with other groups, more advanced analysis and more comprehensive reporting.

Component Handoff Criteria	Coefficient	Rule Used to Generate Score
Component must build (Comp-build)	2	If one build breaks: 0, otherwise 100
Component must not break the release (Rel-Build)	2	If one component breaks the release: 0 for all related components, otherwise 100
Component handoff must meet deadline (On-time)	3	If a handoff arrives after the deadline: 0, otherwise 100
Component must not introduce failures in sanity checks (Sanity Tests)	4	If one sanity check fails, as described in the Test Plan: 0, otherwise 100
Component handoff document content must be complete, as per current template (Handoff Doc)	1	If some information is missing or inaccurate: 0, otherwise 100
Component label is correct - correct versions, correct elements (Label)	2	If the label is applied to the wrong elements, or is missing elements, or is the wrong version: 0, otherwise 100
Component changes correspond to the release plan (In Plan)	2	If the list of functions identified in the change request does not match the list of functions planned for this release in the release plan: 0. If the list matches: 100

Figure 3 Scorecard Criteria

During development, software components and files are completed and handed to the integrators. The integrators check each component against the criteria listed in **Figure 3** and derive a score.

The scores are then charted and communicated back to the developers (see **Figure 4** and the corresponding graph in **Figure 5**). The well-defined criteria helps the developers avoid repeating many of the previously experienced problems. The developers also know that the average scores over time are reported to the senior managers. This provides an extra incentive to deliver quality components.

The criteria are well maintained to avoid the integration check becoming academic. If the criteria are incorrect or add no value to the project, a lessons-learned session is conducted and the criteria are refined.

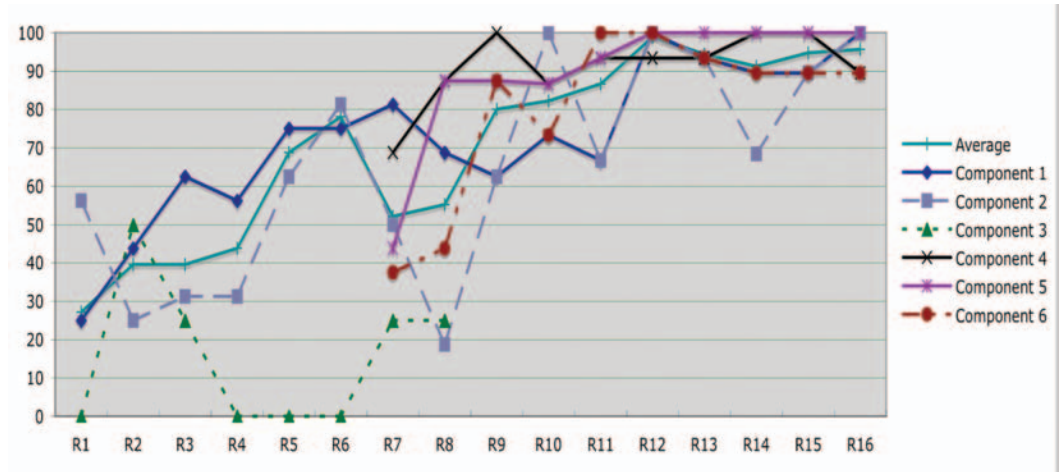|		Release: R1							
		Comp-Build	Rel-Build	On-time	Sanity Tests	Handoff Doc	Label	In Plan	Score
Component	Coefficient	2	2	3	4	1	2	2	
	Component 1	100	100	0	0	0	0	0	25
	Component 2	100	100	0	0	100	100	100	56
	Component 3	0	0	0	0	0	0	0	0
	Component 4								
	Component 5								
	Component 6								
	Component 7								
	Average								27

Figure 4 Score examples for 3 components

Example Scorecard

Examples of three components being scored in Release R1 are shown in **Figure 4**.

The objective – "Reduce problems entering integration by 10%" – was made very visible by the Scorecard measure. The measure provided an effective way to monitor the quality of components entering the integration phase of a project. The criteria and corresponding scores helped pinpoint corrective actions needed.

Summary

The Measurement and Analysis PA provides guidance on establishing a working measurement program. It emphasizes the need for clear objectives and defined measures. Measurement results are then collected and used to assess progress towards these objectives.

Figure 5 The scores of 6 components over 16 releases

The best implementations of MA focus on what is most important to a business. Time is spent refining meaningful objectives and measures that provide timely insight so that corrective actions can be taken.

Footnote:
*The full CMMI source is at: http://www.sei.cmu.edu/publications/documents/06.reports/06tr008.html

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