

Interpreting the CMMI

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A Boatload of Metrics

- “What metrics should we collect?”
- The purpose of metrics is not to drive everybody crazy. It’s to look at the numbers as indicators of how your project is doing and how all of the projects are doing.

Selecting Metrics for Your Organization

- One place to begin looking for metrics to collect that will benefit your organization is the CMMI.
- So use the metrics mentioned in the CMMI only as a guideline when deciding which metrics would be appropriate for your organization.
- There is another way to determine which metrics would be the most beneficial for your organization. It is called the Goal–Question–Metric (GQM) technique.

The basic G–Q–M approach is to:

- Determine the Goal: What business goal are you trying to support? Why are you collecting these numbers? What will they do for you? Why is it important to collect metrics?
- Determine the Question that is most closely associated with achieving the goal.
- Determine the Measurements that help answer the question or metrics that would provide you with the response to the question.

Example of using the G–Q–M approach

- Goal: Reduce the time it takes for our requirements definition process (while maintaining quality)
- Question: Where is the most time spent?
- Metric(s): Refer to our list here. Some suggested metrics are:
 - Number of requirements changes proposed versus number approved and number implemented
 - Time it takes for the different phases of our requirements process
 - Number of users interviewed per job function and category
 - Number of errors traced back to the Requirements phase
 - Time it takes for requirements sign-off
 - Quality of the delivered product

Everyone should understand:

- Why the metrics are being collected
- How the metrics will be used
- What is expected from each person as to gathering, reporting, interpreting, and using the metrics

One more reminder:

- Metrics should not be collected and used to judge anyone's work on a personal basis.
- Metrics are used to determine how your project-level or organizational processes are working—not whether your people are “good” or “bad.”

List of Metrics

- “What metrics should we collect?”
- We used Generic Practice 2.8 Monitor and Control the Process of the CMMI as the basis for these metrics.
- For the most part, this list represents base measures to collect. *Base measures* are simple values of some attribute, for example, size of a document in pages or effort to produce a document in hours.
- To get value from your measurement, you will most likely want to compare actual performance (often referred to as “actuals”) to planned performance (often referred to as “planned”)
- *Derived measures* are a function of two or more base measures, for example, productivity in hours per page to produce a document.

Questions to Ask When Generating and Reviewing Metrics

- What metrics do you collect?
- How do they track to the cost–effort–schedule metrics needed by senior management or other corporate activities?
- Do you use and understand earned value?
- Do you track the time it takes to enter, track, and report metrics?
- Do you use any graphs or automated tools?
- Which metrics work for you and which ones do not work for you? Why/ why not?
- How have you used the metrics?
- What problems do you see in entering, collecting, analyzing, and reporting the metrics?

Questions to Ask When Generating and Reviewing Metrics

- How do you use the WBS? Does it tie back to the activities tracked by the metrics?
- How are the metrics you collect tied to business goals and the business problems in this organization?
- How do you analyze the metrics data?
- How do you verify that the data are correct and accurate?
- As for trends, what problems did/does your project have? Do the metrics reflect this finding? Did using the metrics help you identify this problem?
- In which phase of the life cycle did these problems occur?
- Do the metrics collected reflect or help you identify the phase of the life cycle where the problem occurred, or the cause of the problem?

Questions to Ask When Generating and Reviewing Metrics

- Selection of the metrics to be used on the projects should take into consideration the size of the project project classification and complexity of the system being built. In addition, metrics should reflect the needs of the projects that represent the main functional areas in your organization.

Planning the Metrics Process

Table 17.1 Measurement Plan Outline

I.	Introduction (Purpose, Scope)
II.	Organizational and Project Issues
III.	Overall Measurement Approach
IV.	Approach for Project Management Metrics
V.	Approach for Technical Metrics
VI.	Approach for Introducing Metrics into the Organization
VII.	How Metrics Will Be Collected and Used
VIII.	Roles and Responsibilities
IX.	Communication/Feedback Plan
X.	List of Measurements

Some Problems You May Encounter

- Metrics are collected but not used
- No mechanism exists to distribute project performance metrics for review, comparison, and use Project-level metrics do not appear to be used to help project managers manage their projects
- No understanding of the value of metrics or how to use them is found No formal feedback loop found on the quality of the metrics, questions about them, and so forth
- Metrics reports are hard to review for trends Metrics data are inconsistent
- Personnel collect and input data that they think are right but are unsure
- A standard work breakdown structure (WBS) (a basic building block for management activities) is not followed consistently, and metrics cannot be traced back to WBS activities

Some Problems You May Encounter

- No one reviews the metrics data in the various databases for data integrity
- Training and communication are not occurring throughout the organization
- Procedures need to be devised to document metrics generation, collection, review, and use
- Existing procedures need to be updated to reflect changes
- Automated tools are not used, or the wrong automated tool is used, or the automated tool is used incorrectly The metrics reports are hard to read and understand
- Procedures are not well defined or consistently followed (usage of "may ... if desired ... at PM's discretion")
- The time it takes to identify, track, collect, and report the metrics is not measured
- Redundant data entry is rampant

Recommendations to Improve the Metrics Identification and Collection Process Itself

- Automate the process and make it seamless and simple!
- Involve your project managers and process owners with designing the metrics to be collected.
- Collect metrics that the project managers need.
- Metrics should not be used punitively.
- Facilitate workshops to derive meaningful metrics.
- Provide feedback to the project managers and staff on the metrics collected

Recommendations to Improve Actual Performance on Projects

- Train the project managers and anyone else who generates, collects, reviews, or uses the metrics.
- Metrics must be used.
- The Standish Group, an organization devoted to collecting metrics summarizing performance of software organizations, has stated that up to 85 percent of all errors can be traced back to the Requirements phase.

High-Maturity Perspective

- The high-maturity measurement concepts that we are going to cover are Process Performance Baselines, Process Performance Models, and Event Level Measurement.

Event Level Measurement

- An *event level measure* is a measure taken at the completion of an event, for example, definition of a requirement, implementation of an interface, performance of an inspection, or execution of a test.

Table 19.1 Example Event Level Measures

Objective	Event	Measures
Productivity	Requirement (defined)	Hours, Complexity
	Requirement (designed)	Hours, Complexity
	Interface Implemented	Hours
	Object Coded	Hours
	Subsystem Integrated	Hours
	Test Scenario Executed	Hours
Product Quality	Design Review (completed)	Defects, Pages, Hours
	Inspection (completed)	Defects, Lines, Hours
	Test Scenario Executed	Defects, Hours, Coverage
Schedule	Task Completion	Days (no. late or early)

Process Performance Baseline

A process performance baseline (PPB) documents the historical results achieved by following a process.

Table 19.2 Process Performance Baseline (PPB) for New Development Productivity

PPB Elements	Upper Limit	Mean	Lower Limit	Unit of Measure
Requirements Definition	50.8	35	19.2	Hours/Complex Requirement
	29.2	21	12.8	Hours/Nominal Requirement
	13.4	8.6	3.8	Hours/Simple Requirement
Design	81.4	49.8	18.2	Hours/Complex Requirement
	44.4	31.7	19.0	Hours/Nominal Requirement
	18.6	13.3	8.0	Hours/Simple Requirement
Implementation	13.4	8.6	3.8	Hours/Interface
	35.4	21.0	6.6	Hours/Design Page
	6.54	4.3	2.1	Hours/Object
Integration	301.5	175.5	49.5	Hours/Subsystem
	32.5	23.5	14.5	Hours/Component
Systems Test	18.5	12.4	6.3	Hours/Test Scenario

So How Do You Use a PPB with Your Projects?

- New projects could use the example PPB for estimating their effort based on estimates of the number of requirements, number of interfaces, number of design pages, and so on.
- After planning, the PPB can also be used to monitor and control the project's work by comparing the actual number of hours to perform the work against expected range of values for the PPB element.

Process Performance Model

- The PPM describes the relationships among attributes of a process and its work products, and is used to estimate or predict a critical value that cannot be measured until later in the project's life—for example, predicting the number of delivered defects or predicting the total effort.
- Attributes of a *process* include productivity, effort, defects produced, defects detected, and rework.
- Attributes of a *product* include size, stability, defects contained, response time, and mean time between failures.

Table 19.3 Process Performance Model (PPM)—Effort for New Development

Line Number		Est'd Number of Elements	Req. Phase	Design Phase	Implement Phase	Integration Phase	System Test Phase	Total Effort
1	PPB Elements		mean	mean	mean	mean	mean	
2	Number of Complex Reqs	75	25	49.8				
3	Number of Nominal Reqs	100	21	31.7				
4	Number of Simple Reqs	200	8.6	13.3				
5	Number of Interfaces	TBD			8.6			
6	Number of Design Pages	TBD			21.0			
7	Number of Objects	TBD			4.3			
8	Number of Subsystems	TBD				175.5		
9	Number of Components	TBD				23.5		
10	Number of Test Scenarios	TBD					12.4	
11								
12	Historical Effort Distribution		20%	30%	20%	15%	15%	100%
13								
14	Estimates							
15	Based on PPB Elements		6,445	9,565	0	0	0	
16	Based on Effort Distribution		6,445	9,668	6,445	4,834	4,834	32,225
17								
18	Actuals by Phase		6,752	0	0	0	0	0
19								
20	Prediction Based on Actual When Available or Best Estimate		6,752	9,565	6,445	4,834	4,834	32,430

Transitioning to Level 4

- Select the Measures That Will Be the Basis for Your PPBs and PPMs
- *Select the Measures That Will Be the Basis for Your PPBs and PPMs*
- *Collect the Measures Identified from the Projects*
- *Analyze the Data from the Projects*
- *Establish Organizational PPBs and PPMs from the Project Data*
- *Derive Project Goals*
- *Select the Measures That Will Be the Basis for Your PPBs and PPMs*
- *Collect the Measures Identified from the Projects*

Transitioning to Level 4

- *Analyze the Data from the Projects*
- *Establish Organizational PPBs and PPMs from the Project Data*
- *Derive Project Goals*
- *Select Critical Subprocesses to Be Managed by the Project*
- *Select the Process Performance Baselines to Be Used by the Project*
- *Select the Process Performance Model(s) to be Used by the Project*
- *Manage the Project Quantitatively*
- *Start Early to Level 4*

Transitioning to Level 5

- *Create an Organizational Group Responsible for the Collection of Improvement Suggestions*
- *for Both Process and Technology*
- *Establish a Well-Defined Process for Improvement Proposals*
- *Establish Process Improvement Goals*
- *Clearly Communicate Process Improvement Activities and Goals to the Staff*