The Software Process Part Two - CMMI Metrics

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Introduction

List of Metrics

Every organization we have ever assisted with process improvement efforts has always asked: "What metrics should we collect?" Well, once again, define your metrics to your business needs and the problems you face. Having said that, most executives and managers still want and need examples. So here they are.

List of Metrics

The metrics listed are arranged according to the Maturity Levels and Process Areas (PAs) in the CMMI. We have tried to present metrics that might be found more commonly, and used more effectively, at certain stages of organizational sophistication. However, just because a metric appears in a process area at Level 3, and you are just trying to reach Level 2, if that metric will help you, then use it. This list is arranged somewhat arbitrarily. Some readers will say, "Hey, that metric goes better in a different process area (process area X)." That is OK because this list is just to get you thinking about measurements that can be of help to you and your organization.

List of Metrics

These metrics are by no means the only measurements to collect in an organization. They are simply representative of those measures we have found collected the most frequently. We used the Directing Implementation Common Feature of the CMMI as the basis for these metrics, supplemented by metrics our clients have used in their own organizations. You should also note that most of the organizations we have assisted in their process improvement efforts and in their metrics programs began by reviewing the metrics documented in the CMM and CMMI, and then decided whether or not these metrics would work for them.

List of Metrics

For the most part, this list represents base measures to collect. Base measures are simple values of some attribute; for example, the size of a document in pages or the effort to produce a document in hours. To get value from your measurement, you will most likely want to compare actuals to planned, and to produce derived measures from your base measures. Derived measures are a function of two or more base measures; for example, productivity in hours per page to produce a document.

Level 2

Requirements Management

- Requirements volatility (percentage of requirements changes)
- Number of requirements by type or status (defined, reviewed, approved, and implemented)
- Cumulative number of changes to the allocated requirements, including total number of changes proposed, open , approved, and incorporated into the system baseline
- Number of change requests per month, compared to the original number of requirements for the project
- Amount of time spent, effort spent, cost of implementing change requests
- Number and size of change requests after the Requirements phase is completed
- Cost of implementing a change request
- Number of change requests versus the total number of change requests during the life of the project

- Completion of milestones for the project planning activities compared to the plan (estimates versus actuals)
- Work completed, effort and funds expended in the project planning activities compared to the plan
- Number of revisions to the project plans
- Cost, schedule, and effort variance per plan revision
- Replanning effort due to change requests
- Effort expended over time to manage the project compared to the plan
- Frequency, causes, and magnitude of the replanning effort

Project Monitoring and Control

- Effort and other resources expended in performing monitoring and oversight activities
- Change activity for the project plan, which includes changes to size estimates of the work products, cost/resource estimates, and schedule
- Number of open and closed corrective actions or action items
- Project milestone dates (planned versus actual)
- Number of project milestone dates made on time
- Number and types of reviews performed
- Schedule, budget, and size variance between planned and actual reviews
- Comparison of actuals versus estimates for all planning and tracking items

Measurement and Analysis

- Number of projects using progress and performance measures
- Number of measurement objectives addressed

Supplier Agreement Management

- Cost of the COTS (commercial off-the-shelf) products
- Cost and effort to incorporate the COTS products into the project
- Number of changes made to the supplier requirements
- Cost and schedule variance per supplier agreement
- Costs of the activities for managing the contract compared to the plan
- Actual delivery dates for contracted products compared to the plan
- Actual dates of prime contractor deliveries to the subcontractor compared to the plan
- Number of on-time deliveries from the vendor, compared with the contract
- Number and severity of errors found after delivery
- Number of exceptions to the contract to ensure schedule

- Number of change requests or change board requests processed per unit of time
- Completions of milestones for the CM activities compared to the plan
- Work completed, effort expended, and funds expended in the CM activities
- Number of changes to configuration items
- Number of configuration audits conducted
- Number of fixes returned as "Not Yet Fixed"
- Number of fixes returned as "Could Not Reproduce Error"
- Number of violations of CM procedures (noncompliance found in audits)
- Number of outstanding problem reports versus rate of repair
- Number of times changes are overwritten by someone else (or number of times people have the wrong initial version or baseline)

Level 3

Requirements Development

- Cost, schedule, and effort expended for rework
- Defect density of requirements specifications
- Number of requirements approved for build (versus the total number of requirements)
- Actual number of requirements documented (versus the total number of estimated requirements)
- Staff hours (total and by Requirements Development activity)
- Requirements status (percentage of defined specifications out of the total approved and proposed; number of requirements defined)
- Estimates of total requirements, total requirements definition effort, requirements analysis effort, and schedule
- Number and type of requirements changes

Technical Solution

- Cost, schedule, and effort expended for rework
- Number of requirements addressed in the product or product-component design
- Size and complexity of the product, product components , interfaces, and documentation
- Defect density of technical solutions work products (number of defects per page)
- Number of requirements by status or type throughout the life of the project (for example, number defined, approved, documented, implemented, tested , and signed-off by phase)
- Problem reports by severity and length of time they are open
- Number of requirements changed during implementation and test
- Effort to analyze proposed changes for each proposed change and cumulative totals

Product Integration

- Product-component integration profile (i.e., product-component assemblies planned and performed, and number of exceptions found)
- Integration evaluation problem report trends (e.g., number written and number closed)
- Integration evaluation problem report aging (i.e., how long each problem report has been open)

Verification

- Verification profile (e.g., the number of verifications planned and performed, and the defects found; perhaps categorized by verification method or type)
- Number of defects detected by defect category
- Verification problem report trends (e.g., number written and number closed)
- Verification problem report status (i.e., how long each problem report has been open)
- Number of peer reviews performed compared to the plan
- Overall effort expended on peer reviews compared to the plan
- Number of work products reviewed compared to the plan

Validation

- Number of validation activities completed (planned versus actual)
- Validation problem reports trends (e.g., number written and number closed)
- Validation problem report aging (i.e., how long each problem report has been open)

Organizational Process Focus

- Number of process improvement proposals submitted, accepted, or implemented
- CMMI maturity or capability level
- Work completed, effort and funds expended in the organization's activities for process assessment, development, and improvement compared to the plans for these activities
- Results of each process assessment, compared to the results and recommendations of previous assessments

Organizational Process Definition

- Percentage of projects using the process architectures and process elements of the organization's set of standard processes
- Defect density of each process element of the organization's set of standard processes
- Number of on-schedule milestones for process development and maintenance
- Costs for the process definition activities

Organizational Training

- Number of training courses delivered (e.g., planned versus actual)
- Post-training evaluation ratings
- Training program quality surveys
- Actual attendance at each training course compared to the projected attendance
- Progress in improving training courses compared to the organization's and projects' training plans
- Number of training waivers approved over time
- Integrated Project Management for IPPD
- Number of changes to the project's defined process
- Effort to tailor the organization's set of standard processes
- Interface coordination issue trends (e.g., number identified and closed)

Risk Management

- Number of risks identified, managed, tracked, and controlled
- Risk exposure and changes to the risk exposure for each assessed risk, and as a summary percentage of management reserve
- Change activity for the risk mitigation plans (e.g., processes, schedules, funding)
- Number of occurrences of unanticipated risks
- Risk categorization volatility
- Estimated versus actual risk mitigation effort
- Estimated versus actual risk impact

Level 4

Organizational Process Performance

- Trends in the organization's process performance with respect to changes in work products and task attributes (e.g., size growth, effort, schedule, and quality)
- Quantitative Project Management
- Time between failures

Critical resource utilization

- Number and severity of defects in the released product
- Number and severity of customer complaints concerning the provided service
- Number of defects removed by product verification activities (perhaps by type of verification, such as peer reviews and testing)
- Defect escape rates
- Number and density of defects by severity found during the first year following product delivery or start of service
- Amount of rework time
- Requirements volatility (i.e., number of requirements changes per phase)
- Ratios of estimated to measured values of the planning parameters (e.g., size, cost, and schedule)
- Coverage and efficiency of peer reviews (i.e., number/amount

Level 5

Organizational Innovation and Deployment

- Change in quality after improvements (e.g., number of reduced defects)
- Change in process performance after improvements (e.g., change in baselines)
- The overall technology change activity, including number, type, and size of changes
- The effect of implementing the technology change compared to the goals (e.g., actual cost saving to projected)
- The number of process improvement proposals submitted and implemented for each process area
- The number of process improvement proposals submitted by each project, group , and department
- The number and types of awards and recognitions received by each of the projects, groups, and departments
- The response time for handling process improvement proposals

Causal Analysis and Resolution

- Defect data (problem reports , defects reported by the customer, defects reported by the user , defects found in peer reviews, defects found in testing, process capability problems, time and cost for identifying the defect and fixing it, estimated cost of not fixing the problem)
- Number of root causes removed
- Change in quality or process performance per instance of the causal analysis and resolution process (e.g., number of defects and changes in baseline)
- The costs of defect prevention activities (e.g., holding causal analysis meetings and implementing action items), cumulatively
- The time and cost for identifying the defects and correcting them compared to the estimated cost of not correcting the defects

Conclusion

- The amount of effort and time spent on risk management activities versus the number of actual risks
- The cost of risk management versus the cost of actual risks
- For each identified risk, the realized adverse impact compared to the estimated impact

Questions to answer

- 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 and why not?
- How have you used the metrics?
- What problems do you see in entering, collecting, analyzing, and reporting the 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