Management of Large-Scale, Software-Intensive System Development

Is Maturity Level 3 enough?

Kevin Richins

USAF Software Technology Support Center
Hill AFB, Utah
Content

- Does it really matter ML 3 - ML 4?
- State of Software Development
- Capability Maturity Model for Software (CMM-SW)
- Does CMM-I solve the problem?
- ACAT 1 demographics
- What’s the problem?
- What’s the real solution?
Why should it matter?
State of Software Development

- Corporate America spends more than $275 billion each year on approximately 200,000 application software projects.
  - 31.1% of projects will be canceled before they ever get completed.
  - 52.7% of projects will cost 189% of their original estimates.
  - 16.2% for software projects that are completed on-time and on-budget.
  - 9% of [large company] projects come in on-time and on-budget.
  - Projects completed by the largest American companies have only approximately 42% of the originally-proposed features and functions.

- “… most will fail for lack of skilled project management”

- ‘ I’m sick and tired of getting 60% functionality, on time, at twice the original cost! ’ Lt.Col. USAF

Standish Group Statistics - 1994
“When the team has achieved full coverage of the CMM ... the rating process may begin by rating each goal for each KPA within the assessment scope ... If the team decides that there are no significant weaknesses that have an impact on a goal, it is rated satisfied.”

“For a KPA to be rated satisfied, all goals for the KPA must be rated satisfied.”

“For a particular maturity level rating to be achieved, all KPA’s within and below a given maturity level must be satisfied.”

An organization must satisfy all the GOALS of Maturity Levels 2 & 3 to be considered a CMM Level 3 organization.
SW-CMM: What does it say?

Software Project Planning KPA
- Goal 1: Software estimates are documented for use in planning and tracking the software project.
- Goal 2: Software project activities and commitments are planned and documented.

Software Project Tracking and Oversight KPA
- Goal 1: Actual results and performances are tracked against the software plans.
- Goal 2: Corrective actions are taken and managed to closure when actual results and performance deviate significantly from the software plans.
- Goal 3: Changes to software commitments are agreed to by the affected groups and individuals.
Does CMMI Solve the challenge?

- A NEW MEASUREMENT PROCESS AREA
  - Measurement & Analysis Process Area (PA)

- “MONITORING” IS MORE PRO-ACTIVE THAN “TRACKING”
  - Project Monitoring & Control PA
SCAMPI Method Description

- “Goal ratings are a function of the extent to which the corresponding practices are present in the planned and implemented processes of the organization.”

- “In the SCAMPI method, a fundamental premise is that satisfaction of goals can be determined only upon detailed investigation of the extent to which each corresponding practice is implemented”

- Practice Implementation Indicators
Specific Goal 1: Measurement objectives and practices are aligned with identified information needs and objectives
- Specific Practice -1 Establish Measurement Objectives
- Specific Practice -2 Specify Measures
- Specific Practice -3 Specify Data Collection and Storage Procedures
- Specific Practice -4 Specify Analysis Procedures

Specific Goal 2: Measurement results that address identified information needs and objectives are provided
- Specific Practice -1 Collect Measurement Data
- Specific Practice -2 Analyze Measurement Data
- Specific Practice -3 Store Data and Results
- Specific Practice -4 Communicate Results
Specific Goal 1: Estimates of project planning parameters are established and maintained

- Specific Practice -2 Establish and document estimates of the attributes of the work products and tasks
  - Sub-Practice - 2 Use appropriate methods to determine the attributes of the work products and tasks that will be used to estimate the resource requirements
    - NOTE: Methods for determining size and complexity should be based on validated models or historical data
- Specific Practice - 4 Estimate the project effort and cost for the attributes of the work products and tasks based on estimation rationale
  - Sub-Practice - 3 Estimate the effort and cost using models and/or historical data
Specific Goal 2: A project plan is established and maintained as the basis for managing the project

- Specific Practice - 1 Establish and maintain the project's budget and schedule
- Specific Practice - 3 Plan for the management of project data
- Specific Practice - 7 Establish and maintain the overall project plan content

Generic Practice 2.8 Monitor and control the project planning process against the plan and take appropriate corrective action

- Examples of measures used in monitoring and controlling the activities of the Project Planning process area include the following
  - Number of revisions to the plan
  - Cost, schedule, and effort variance per revision
Specific Goal 1  Actual performance and progress of the project is monitored against the project plan

✓ Specific Practice -1 Monitor the actual values of the project planning parameters against the project plan
  • Sub-Practice - 1 Monitor progress against the schedule.
  • Sub-Practice - 2 Monitor the project's cost and expended effort.
  • Sub-Practice - 3 Monitor the attributes of the work products and tasks
  • Sub-Practice - 4 Monitor resources provided and used
  • Sub-Practice - 5 Monitor the knowledge and skills of project personnel

✓ NOTE: … monitoring … typically includes the following:
  • Periodically measuring the actual ...
  • Comparing actual ...
  • Identifying significant deviations from ...
Specific Goal 2  Corrective actions are managed to closure when the project's performance or results deviate significantly from the plan

Specific Practice - 1  Collect and analyze the issues and determine the corrective actions necessary to address the issues

- Sub-Practice - 1  Gather issues for analysis

  - Examples of issues to be gathered include:
    - Issues discovered through performing verification and validation activities
    - Significant deviations in the project planning parameters from the estimates in the project plan
    - Commitments (either internal or external) that have not been satisfied
    - Significant changes in risk status
    - Data access, collection, privacy, or security issues
    - Stakeholder representation or involvement issues
Some ACAT 1A Demographics

- Minimum Budget: $365,000,000
- Typical Budget: ~ $500,000,000 - $3,000,000,000 +
- Software Budget: ~ $200,000,000 - $1,000,000,000 +
- Incremental Development (Multiple releases)
  - ~ 5,000,000 - 20,000,000 SLOC
  - ~ 250 - 1250 Configuration Items
  - ~ 25,000 - 125,000 Modules
What’s the Problem?

- Why do we have an 18 month schedule slips 6 months before delivery?

- How did we ever get to the point of overrunning our budgets by 189%?

- Why do 80% + of our software projects either exceed budget, schedule, or BOTH?

- You can’t manage that which you do not measure

- “Thou shalt not fool thyself”
Have we made progress?

- **1993**: First Maturity Profile developed
  - CMM Level 1: 72.1 %
  - CMM Level 2: 18.6 %
  - CMM Level 3+: 9.3 %

- **1999**: SW-CMM Level 3 Policy (Gansler Letter) developed
  - CMM Level 1: 39.3 %
  - CMM Level 2: 36.3 % (75.6 %)
  - CMM Level 3+: 24.4 %

- **2001**
  - CMM Level 1: 24.8 %
  - CMM Level 2: 39.9 % (64.7 %)
  - CMM Level 3+: 35.3 %
We’re progressing TOO SLOW!

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What am I really proposing?

- **QUANTITATIVE PROJECT MANAGEMENT**

- Capability Maturity Model Integrated (CMMI)
  - Staged Representation Maturity Level 4
  - Continuous Representation w/ QPM / OPP as required PA’s

- My DoD policy proposal
  - Require PM’s to perform a thorough program risk analysis
  - Select PA’s based upon risk results
  - Make QPM / OPP required PA’s
Quantitative Project Management

- Specific Goal 1: The project is quantitatively managed using quality and process-performance objectives
  - Specific Practice 1: Establish and maintain the project's quality and process-performance objectives
  - Specific Practice 2: Select the sub-processes ... based on historical stability and capability data
  - Specific Practice 3: Select the sub-processes ... that will be statistically managed
  - Specific Practice 4: Monitor the project to determine whether the project's objectives for quality and process performance will be satisfied, and identify corrective action as appropriate
  - Specific Practice 5: The performance of selected sub-processes ... is statistically managed
Quantitative Project Management

- Specific Goal 2: The performance of selected sub-processes within the project's defined process is statistically managed
  - Specific Practice 1: Select the measures and analytic techniques to be used in statistically managing the selected sub-processes
  - Specific Practice 2: Establish and maintain an understanding of the variation of the selected sub-processes using the selected measures and analytic techniques
  - Specific Practice 3: Monitor the performance of the selected sub-processes to determine their capability to satisfy their quality and process-performance objectives, and identify corrective action as necessary
  - Specific Practice 4: Record statistical and quality management data in the organization's measurement repository
Organizational Process Performance

- Specific Goal 1: Baselines and models that characterize the expected process performance of the organization's set of standard processes are established and maintained
  - Specific Practice 1: Select the processes or process elements in the organization's set of standard processes that are to be included in the organization's process performance analyses
  - Specific Practice 2: Establish and maintain definitions of the measures that are to be included in the organization's process performance analyses
  - Specific Practice 3: Establish and maintain quantitative objectives for quality and process performance for the organization
  - Specific Practice 4: Establish and maintain the organization's process performance baselines
  - Specific Practice 5: Establish and maintain the process performance models for the organization's set of standard processes
Conclusion?

- If we are ever really going to get this software gorilla off our backs, we need to get serious about management (measurement and control)

- If the Department of Defense really wants quality, high-performance software delivered on-time and within budget, it needs to require software producers to live in the world of objective, quantitative management.

- It won’t be easy but … somebody has to step up and LEAD!
SW-CMM: What does it say?

- **Key Process Area: Requirements Management**
  - **Goal 1:** System requirements allocated to software are controlled to establish a baseline for software engineering and management use.
  - **Goal 2:** Software plans, products, and activities are kept consistent with the system requirements allocated to software.

- **Measurement 1:** Measurements are made and used to determine the **status of the activities** for managing the allocated requirements.
**SW-CMM: What does it say?**

- **Key Process Area:** Software Project Tracking and Oversight
  - **Goal 1:** Actual results and performances are tracked against the software plans.
  - **Goal 2:** Corrective actions are taken and managed to closure when actual results and performance deviate significantly from the software plans.
  - **Goal 3:** Changes to software commitments are agreed to by the affected groups and individuals.

- **Measurement 1:** Measurements are made and used to determine the **status of the software tracking and oversight activities.**
SW-CMM: What does it say?

- Key Process Area: Software Project Planning
  - Goal 1: Software estimates are documented for use in planning and tracking the software project.
  - Goal 2: Software project activities and commitments are planned and documented.
  - Goal 3: Affected groups and individuals agree to their commitments related to the software project.

- Measurement 1: Measurements are made and used to determine the status of the software planning activities.