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Three Process Improvement Examples; Two Successful, One Failure

Al Florence

The views expressed are those of the author and do not reflect the official policy or position of the MITRE Corporation

Overview

- Introduction
- Getting to Level 3
- Not Getting to Level 4
- Reasons for Getting to Level 3 and Not to Level 4
- Level 2 Example
- Suggested Reading
- Contact Information

Introduction

- The Level 3 and Level 4 examples are based on CMM®
  - ✓ On a contractor organization
  - ✓ Still relative to CMMI®
- The Level 2 example is based on CMMI®
  - ✓ On a DoD organization
- Getting to Level 3 can be quite different than getting to Level 4
- The reasons, commitments, dynamics and resources can be quite different for success at Level 3 vs. Level 4
  - ✓ This presentation is focused on those differences and provides valuable lessons learned gathered from an organization that had achieved Level 3 but failed to achieve Level 4
- Getting to Level 2 may be more difficult that getting to Level 3

Level 3 but not Level 4

- This author was the development manager and Software Engineering Process Group (SEPG) lead on one of the projects at the time Level 3 was achieved for the organization
- This portion of the presentation is mostly based on this project
  - ✓ When the word *"project"* is used it is only referring to this project
  - ✓ When the words *"projects"* and/or *"organization"* are used they are referring to all projects in the organization that were involved in the Level 3 and Level 4 efforts
- This author was later the SEPG lead at the next higher organizational level and defined Level 4 and Level 5 processes, installed them and supported their execution on the project

Corporation

- Many Level 3 organizations in the Corporation
- Corporation had no Level 4 organizations
  - At that time

Organization

- Organization’s projects existed at geographically dispersed locations
- Projects in the organization engaged in diversified software activities
- The organization had achieved Level 3 and was pursuing Level 4

Organizational Standard Process
Project's Defined Process

- Organizational Standard Process (OSP) exists at the Corporate level
  - ✓ Had process for Level 2 and Level 3
  - ✓ No Level 4 or Level 5 processes (at that time)
- OSP adapted on projects as Project's Defined Process (PDP)

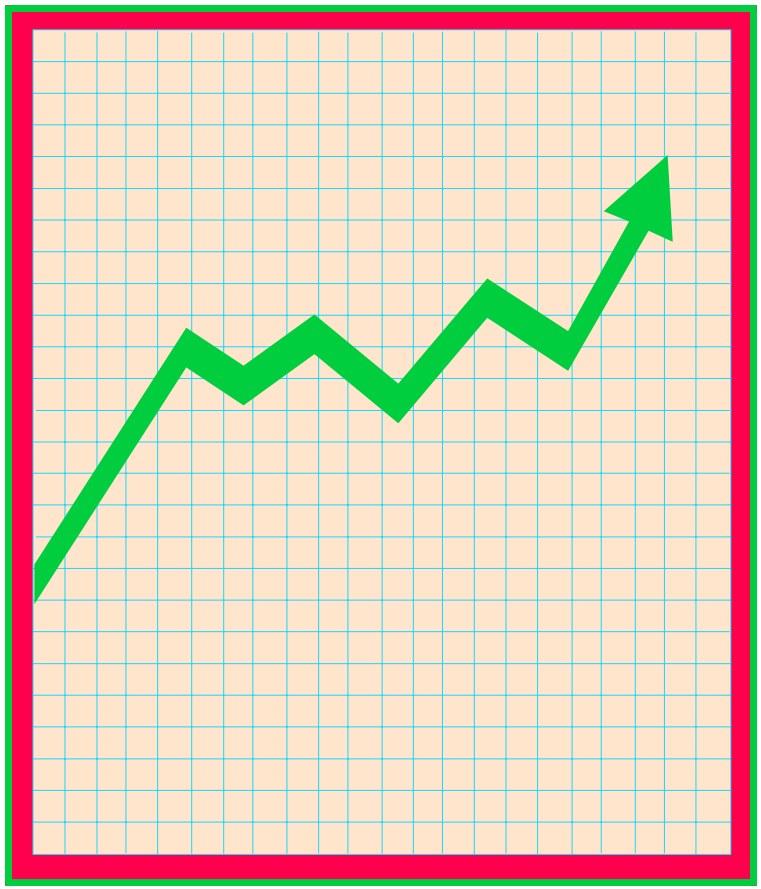
Software Engineering Process Groups (SEPG)

- Corporate SEPG
- Organizational SEPGs
- Project SEPGs

Process Training

- Corporate had a Level 2 and Level 3 training program
- All employees engaged in software development were required to take process training appropriate to their software tasks

Getting to Level 3



Commitment/Cooperation

- Executive/Senior management committed/cooperated
  - ✓ Mandated that Organization become Level 3
- Projects' management committed/cooperated
- Projects' personnel committed/cooperated
- Customers committed/cooperated

Resources

- Sufficient funding from the corporation, the organization and the projects
- Sufficient process staff
- Everyone on projects involved in Level 2 and Level 3 activities
- Corporate Organizational Standard Process provided process for Level 2 and Level 3 Processes
- Corporate Level 2 and Level 3 training material provided
- Much Level 2 and Level 3 industry publications and many examples available as reference material

Software Engineering Process Groups

- Corporate SEPG had membership from Organizations' SEPGs
- Organization's SEPG had membership from the Projects' SEPGs
  - ✓ Coordinated weekly
  - ✓ Level 2 and Level 3 coordination quite difficult between physically separate locations
  - ✓ Ensured that process applied in a repeatable fashion on the projects

Level 3 Assessment Preparation

- Installed and executed all Level 2 and Level 3 processes areas
- Collected extensive Level 2 and 3 artifacts
- Conducted extensive Level 2 and 3 training
- Conducted dry run assessments (supported with many Government Software Capability Evaluations)
- Everyone involved

Standards on Contract

MIL-STD and associated standards for the specific project which provide for:

- Management Plans
- System Engineering
- Software Development
- Risk Management
- Reviews and Audits
- Peer Reviews
- Testing
- Test Plans
- Earned Value Management
- Configuration Management
- Quality Assurance
- Metrics
- etc.

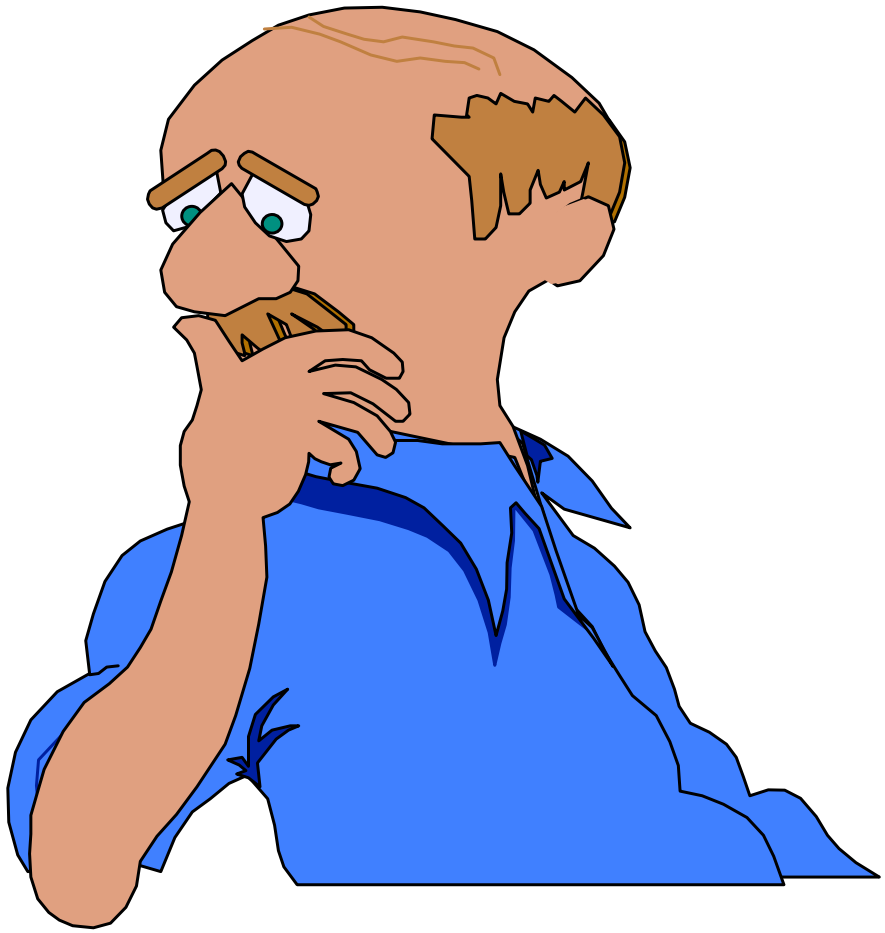
Processes and Artifacts

- The standards required many project plans and product deliverables
  - ✓ The execution of project plans provided all of the Level 2 and many Level 3 processes
  - ✓ Product deliverables provided all of the Level 2 and most of Level 3 artifacts

Achieved Level 3

- Organization achieved Level 3
  - ✓ 18 months after contract award for specific project
  - ✓ Project skipped Level 2 assessment
  - ✓ Lead assessor from an external vendor
  - ✓ Assessment team internal

Not Getting to Level 4



Commitment/Cooperation

- Executive/Senior management somewhat committed/cooperative
  - ✓ Mandated that Organization become Level 4
  - ✓ Did not apply the “carrot nor the stick”
  - ✓ Did not “walk the talk”
- Project management not committed/cooperative
  - ✓ Level 3 good enough
  - ✓ Did not sign up for Level 4
- Project personnel not committed/cooperative
  - ✓ Level 3 good enough
  - ✓ Except for Project SEPG lead and Project Software Quality Assurance Manager
  - ✓ Even fell back on some Level 3 processes
- Customer may not have even been aware of Level 4 efforts

Resources

- Insufficient funding from the Corporation, the Organization and the Projects
  - ✓ Maintained at same level as for Level 3
  - ✓ Should have been increased for Level 4
- Insufficient process staff
- Few staff on projects involved in Level 4 processes
- At that time
  - ✓ Corporate Organizational Standard Process did not support Level 4 or Level 5 Processes
  - ✓ Corporate Process Training did not support Level 4 or Level 5
  - ✓ Limited Level 4 and Level 5 industry literature and few examples to draw from

Software Engineering Process Groups

- Corporate SEPG not involved at Level 4 at the time
- The Organization SEPG had membership from the Project SEPGs
  - ✓ Coordinated weekly
  - ✓ Level 4 coordination becomes *very* difficult between physically separate locations
  - ✓ Level 4 *not* applied in a repeatable fashion across the organization

Level 4 Assessment Preparation

- Project instituted all Level 4 and Level 5 processes areas
- Other projects instituted only Level 4 process areas
- Project executed all processes areas
- Project collected extensive Level 2, Level 3 and Level 4 artifacts
- Projects conducted insufficient Level 4 training
  - ✓ Lack of cooperation
  - ✓ Lack of corporate training material at Level 4
- Organization conducted 1 dry run for Level 4 assessment

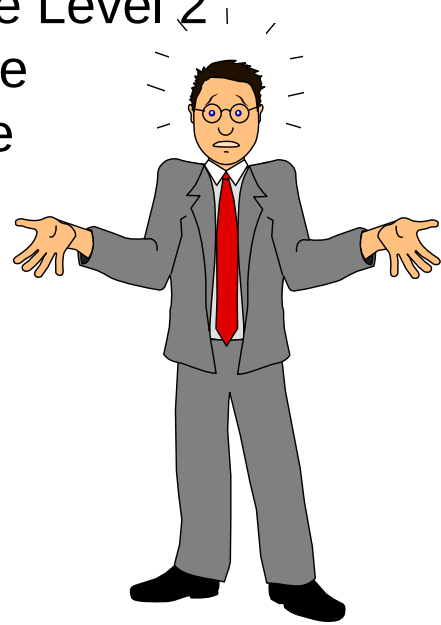
Standards on Contract

- Standards on contract provide for all Level 2 processes and artifacts and many for Level 3
- Standards on contract standards do not provide for processes or artifacts for Level 4 nor Level 5

Level 4 Not Achieved

- Although all Level 4 processes were conducted and Level 4 artifacts collected, the organization failed to achieve Level 4
  - ✓ Lead assessor from an external vendor
  - ✓ Assessment team internal

- Note: Assessors at that time had conducted many more Level 2 and 3 assessments than Level 4 and some did not quite understand quantitative analysis, especially at that time
  - ✓ Interview, Interview, Interview
  - ✓ Be selective



Reasons for Achieving Level 3 but not Level 4

Reasons for Achieving Level 3 but not Level 4

Level 2 & Level 3	Level 4
Commitment, funding and cooperation existed	Commitment, funding and cooperation inadequate
Standards on contract provide for processes and artifacts	Standards on contract do not provide processes and artifacts
Many published examples	*Few published examples
Based on business goals	Done for process sake
Many experienced assessors	*Fewer experienced assessors

Also, the project fell back on some Level 3 processes
* At that time

Reasons for Achieving Level 3 but not Level 4

Level 4 is a drastic paradigm shift from Level 2 & Level 3 that isn't always recognized

Level 2 & Level 3	Level 4
Activities are common sense things to do in order to develop "*good*" products	Goes beyond these common sense things to do and is for organizations that really want to go the "*extra mile*"
Require existing skills *(software & management)*	Require new skills *(quantitative & statistical)*
Level 3 Focuses on the Organization	Focuses on the Projects
Requires that measurements be collected and actions taken on results	Requires that measurements be quantitatively analyzed statistically and immediate actions taken to remedy issues

Reasons for Achieving Level 3 but not Level 4

Level 4 is a drastic paradigm shift from Level 2 and Level 3 (continued)

Level 2 and Level 3	Level 4
Requires that process capability be institutionalized	Requires that process capability be understood and controlled quantitatively
Requires that quality assurance be institutionalized	Requires that plans for quality goals be established and that progress towards achieving these goals be quantitatively managed

Level 2 Example
A DoD Organization

Issues with Process Improvement

- When improving processes in organizations the following often occurs
  - ✓ Process Improvement (PI) is done for process sake
  - ✓ Management wants immediate feedback
  - ✓ Staff fails to “buy-in” to PI
  - ✓ Extraordinary process documentation is created
  - ✓ PI efforts linger forever, are ignored, fail, or are cancelled
  - ✓ Recidivism sets in

*Fas*Track* to Process Improvement

- The solution may be in Fas*Track* to Process Improvement
  - ✓ A process that is in need of time critical improvement is quickly implemented without much of the fanfare and tedious documentation that bogs down PI efforts
  - ✓ The process is quickly defined and executed immediately as a pilot
  - ✓ During the pilot's execution, the process is refined as necessary and the process documentation is enhanced as required.
  - ✓ Data and artifacts are collected on the pilot's execution which may be used as proof that the process is or is not successful and for continued process improvement

* Coined by Al Florence

DoD Organization

- A DoD organization that acquires and also develops products implemed both the CMMI® for development and the CMMI® Acquisition Constellation for acquisition
- This presentation focuses on CMMI of development
- Quickly Formed
  - ✓ Steering Committee (Senior Executive Management)
    - Approve, release, and enforce process policy
    - Approve process procedures
    - Oversee and approve Process Group's efforts
  - ✓ Process Group (MITRE staff and DoD personnel)
    - Provide status and recommendations to Steering Committee
    - Develop/acquire processes and guidelines
    - Develop/acquire and present process training
    - Select project pilot for Level 2 CMMI® Process Improvement

Process Group

- Developed Process Policy
- Selected pilot project
- Selected processes to pilot on pilot project
- Developed Schedule
  - ✓ Level 2 SCAMPI
  - ✓ Level 2 and Level 3 processes
- Developed draft processes
- Developed/acquired draft guidelines
- Developed/acquired training on processes
- Provided training

Steering Committee

- Signed Process Policy
- Reviewed and approved PI approach
- Reviewed PI status

Pilot Project

- Organization had no documented procedures
- Pilot project had followed undocumented methods and had some process artifacts
  - ✓ CCB Minutes
  - ✓ CM Plan
  - ✓ Baselined Requirements
  - ✓ etc.

Pilot Project

- Leveraged *CMMI® to develop draft procedures and training
  - ✓ Two or more processes developed and implemented per month
    - Developed draft procedure and guidelines
    - One to two procedure per process area *(3 to 4 pages)*
    - Developed and delivered process training (can be uses as guidelines)
    - Identified industry and government guidelines and standards
- Piloting procedures on project
  - Provide mentoring
  - Mature process
  - Collect artifacts

*Credit given to SEI

Project Plans

- Often project plans take much effort and resources to develop
  - ✓ Project Management Plans
  - ✓ Requirements Plans
  - ✓ Test Plans
  - ✓ Quality Assurance Plans
  - ✓ Configuration Management Plans
  - ✓ ect.
- Plans may take months and cost $100K to develop
- The following is a method of developing project plans quickly

Example of Tailoring a Plan

QA Plan Tailoring

1. Introduction
1.1 Purpose
1.2 Scope
1.3 Plan Organization
1.4 Related Documents
1.5 Tailoring this Plan
1.6 Plan Maintenance
2. Quality Goals and Objectives
3. Quality Assurance Program
3.1 Process Steering Committee
3.2 Process Group
3.3 Enterprise-Level Quality Assurance
3.4 QA Manager
3.5 QA Personnel
3.6 Program/Project Management
3.7 Programs/Projects Personnel
3.8 QA Measurement and Metrics
3.9 QA Risks
4. QA Resources
4.1 Facilities and Infrastructure
4.2 Tools
4.3 Costs
5. QA Training
5.1 Senior Management Orientation
5.2 Program/Project Staff
5.3 QA Staff
APPENDIX A QUALITY ASSURANCE TASKS - TAILORING TABLE

A QA plan is developed that is generic and should cover QA needs for most projects.

It has a tailoring mechanism built into an appendix where the QA activities are described.

Projects use the appendix to appropriately tailor the plan to the project's specific needs and to the scope of the application.

Projects can accomplish this tailoring with minimum resources and costs.

QA Plan Tailoring

Appendix A

Describes the activities to be executed to effectively administer the QA program. It provides a tailoring schema used to tailor this plan to be used on specific programs and projects.

Allows for quickly adapting plans to projects

QA Plan Tailoring

Appendix to QA Plan
QUALITY ASSURANCE TASKS
TAILORING TABLE

QA tasks are shown in the table along with task numbers. Responsible organizations are shown along with QA process areas. References to procedures are included for those tasks that require them. The table allows programs and projects to tailor the QA process to the scope of a specific application by indicating "Y" for "used" and "N" for "not used". Additional QA tasks can be added at the end of each section, if needed, for a specific application. The main body of this plan should not be tailored since all QA tasks are included in this appendix.

TAILORED FOR PROJECT/PROGRAM:_____
Program/Project Manager:_____
Date:_____
Process Group:_____
Date:_____
Quality Assurance:_____
Date:_____
Process Steering Committee_____
Date:_____

QA Plan Tailoring

Portion of Appendix	Y/N
3.4 QA Manager	
a. Primarily responsible for overseeing QA task assigned to programs/projects and to QA personnel	
b. Works closely with the Process Group and serves on the group whiled developing QA process artifacts and QA orientation and training	
c. Provides QA orientation and training	
d. Works with Program/Project Management in tailoring and applying QA.	
e. Attempts to resolve QA non-compliance with program/project management	
f. Escalates QA non-compliance to Steering Committee	
3.5 QA Personnel	
a. Support the development/acquisition of QA processes and best practices	
b. Support the development and tailoring QA plans	
c. Conduct product reviews on external products delivered by contractors and suppliers 1. QA Product Review Procedure	
d. Conduct product reviews at the enterprise level and on programs/projects 1. QA Product Review Procedure	
e. Conduct process audits at the enterprise level and on programs/projects 1. QA Process Audit Procedure	

Passed Level 2 SCAMPI in April 07 on CMMI® v1.2

Level 2 Level 3 Level 4
Level 5 AM Unique

Category	Process Area [Level]	CMMI®	CMMI®-AM	Timeline
Project Management 	Project Planning [2]	YES	YES	May 06
	Project Monitoring and Control [2]	YES	YES	May 06
	Supplier Agreement Management [2]	YES	NO	Sep 06
	Integrated Project Management (IPPD) [3]	YES	YES	Oct 06
	Integrated Supplier Management (SS) [3]	YES	NO	Oct 06
	Integrated Teaming (IPPD) [3]	YES	YES	Dec 06
	Risk Management [3]	YES	YES	July 06
	Quantitative Project Management [4]	YES	NO	N/A
	Solicitation and Contract Monitoring [AM]	NO	YES	Sep 06
Support 	Configuration Management [2]	YES	YES	Feb 06
	Process and Product Quality Assurance [2]	YES	NO	Mar 06
	Measurement and Analysis [2]	YES	YES	June 06
	Decision Analysis and Resolution [3]	YES	YES	Jan 07
	Organizational Environment for Integration (IPPD) [3]	YES	Imbedded	
	Causal Analysis and Resolution [5]	YES	NO	N/A
Engineering 	Requirements Management [2]	YES	YES	**Jan 06**
	Requirements Development [3]	YES	YES	**Jan 06**
	Technical Solution [3]	YES	NO	Aug 06
	Product Integration [3]	YES	NO	Jan 07
	Verification [3]	YES	YES	Aug 06
	Validation [3]	YES	YES	Aug 06
	Transition to Operations and Support [AM]	NO	YES	Dec 07
Process Management 	Organizational Process Focus [3]	YES	NO	Feb 07
	Organizational Process Definition [3]	YES	NO	Feb 07
	Organizational Training [3]	YES	NO	July 06
	Organizational Process Performance [4]	YES	NO	N/A
	Organizational Innovation and Deployment [5]	YES	NO	N/A

Conclusions

Getting to Level 2 may be more difficult than getting to Level 3

- At Level 2 no process infrastructure is in place
  - ✓ Have to develop from scratch
- At Level 3 process infrastructure is in place from Level 2
  - ✓ Continue from where Level 2 left off
- At Level 2 have to “sell” process to staff and management
  - ✓ At Level 3 hopefully this has been accomplished
- Usually at Level 2 some Level 3 processes are in place
  - ✓ Provide deltas for Level 3
- Level 2 processes are management processes
  - ✓ This is the area where most organizations are usually lacking
- Level 3 has many engineering processes
  - ✓ Most organizations have good engineering practices
- And, if successful at Level 2 much enthusiasm at Level 3

Conclusions

- Getting to Level 3 can be quite different than getting to Level 4
- The reasons, commitments, dynamics and resources can be quite different, meaning success at Level 3 and failure at Level 4
- Process commitment has to be maintained at all Levels
- Standards may provide for Level 2 and Level 3 processes and artifacts but don't for Level 4 nor Level 5
- Level 4 is a drastic paradigm shift from Level 3
  - ✓ New and additional skills are required at Level 4 *(quantitative & statistical)*
  - ✓ Level 4 requires that process capability and quality goals be understood and managed quantitatively

Conclusions

- Very difficult to coordinate when the organization has diversified projects and is physically in separate locations
- Process improvement is not the sole responsibility of the SEPG and a selected few, everyone has responsibilities
- Process improvement will only work if:
  - ✓ Everyone is committed and cooperates
  - ✓ Proper resources are available
  - ✓ Improvement is based on business goals

Suggested Reading

- *Capability Maturity Model Integration (CMMI®), Version 1.2.* Software Engineering Institute
- Jeff Perdue, November 2000, *Why is Level 4 so Hard?,* Washington D.C. Software Process Improvement Network

Contact Information

Alfred (Al) W. Florence

florence@mitre.org

(703) 983-7476