Let's Roll!
Rolling Out or Deploying SEPG Assets

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KSC Software Engineering Process Group (SEPG)

Topics To Be Covered

- SQI General Approach
  - Target Audience
  - Customer Relationship Management (CRM)
  - Organizational Change Management (OCM)
  - Capability Maturity Model Integration (CMMI)
  - Process Asset Library (PAL)
- SQI Deployment Process
  - Infrastructure and Operations
  - Communication and Outreach
  - Education and Training
  - Project Support (Consulting)
- SQI Lessons Learned
  - Process Improvement
  - Creating Assets
  - Deploying Assets
- Backup Slides

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JPL’s Software Community

- JPL’s Software Community consists of approximately 1200 to 1300 people (out of 5500 lab-wide) including:
  - Practitioners in the Information Systems and Computer Science (IS&CS) Job Family
  - Software Managers categorized as either Line Management or Program/Project Management.
  - Personnel who are categorized as Engineering and Technical, provided at least 50% of their work is software-intensive.

- The initial focus of the Software Quality Improvement (SQI) Project is on mission-critical software for flight projects, their spacecraft and instrument systems, and their ground systems.

SQI Customers (Target Audience)

- SQI customers primarily include the following roles:
  - Project Element Managers (PEMs)
  - Software Line Managers
  - Cognizant Engineers (Cog Es)
  - Software Systems Engineers (SSEs)
  - Software Engineers, Software Test Engineers
  - Software Quality Assurance (SQA) engineers
  - Mission Assurance Managers (MAMs)

- Managers in JPL Program and Project offices including:
  (since usually these managers have come from a hardware background)
  - Program Managers and Project Managers
  - Systems Engineers
  - Any others whose decisions impact the way software is developed or acquired

- Members of the Software Quality Improvement (SQI) Project itself, i.e., members of the Software Engineering Process Group (SEPG) and Software Process Engineers
The SQI Project took a very proactive approach to Customer Relationship Management (CRM).

- An approach not traditionally invoked in an engineering environment.

CRM is a strategy used to "learn more about customer's needs and behaviors in order to develop stronger relationships with them." CRM helps ensure that all products and services truly provide value to the customer, and that the "real" customers are being targeted and reached.

CRM defines a customer acquisition life-cycle with six stages:

- Unaware, aware, interest, action, user, and evangelist.

CRM involves identifying and prioritizing customer target segments, creating customer profiles, and tailoring the communication messages and approach to their specific needs.

The SQI Project identified five customer segments and tailored their training and presentations to the unique needs of each segment:


Organizational Change Management (OCM) is "the methodology that integrates change and the ability to adapt into the organization."

OCM involves working with a target community to systematically introduce them to desired changes in such a way that those changes are eventually adopted and become commonplace.


The SQI Project has employed several of Rogers' strategies for diffusing innovations:

- Relevance, customer focus, user friendliness, education, likelihood, measurement and testimony.
The Capability Maturity Model Integration (CMMI®) is an evaluation and appraisal model used to evaluate the "maturity" of an organization's processes.
- CMMI was developed by the Software Engineering Institute (SEI) at Carnegie Mellon University.
- JPL is currently implementing the CMMI® in four pathfinder software-intensive sections.
- The process areas (PAs) JPL selected are those from CMMI® Maturity Level 2 plus one PA from CMMI® Maturity Level 3.
  - Requirements Management (REQM)
  - Project Planning (PP)
  - Project Monitoring and Control (PMC)
  - Supplier Agreement Management (SAM)
  - Measurement and Analysis (MA)
  - Process and Product Quality Assurance (PPQA)
  - Configuration Management (CM)
  - Risk Management (RSKM) (ML 3)
- The near-term goal is to demonstrate CMMI® Maturity Level 2 compliance for selected projects in these sections by the end of fiscal year 2005.
Categories of Assets in the JPL PAL:
- Institutional Requirements
- Compliance Matrices
- Engineering Models (Experimental, Institutional, Trends)
- Handbooks and Guides
- Checklists
- Templates
- Sample Documents
- Studies and Reports
- Training Materials
- CMMI-Related Materials

The SQI Project developed and is following a rigorous process for creating and deploying an asset that includes:
- Collect user requirements and/or CMMI® needs.
- Generate the process, product or artifact.
- Develop Infrastructure and Operations approach and tools to support it.
- Develop Communications and Outreach materials to support it.
- Develop Education and Training materials to support it.
- Perform Project Support to promulgate it.
- Collect process and customer metrics to track it.
- Capture and document Lessons Learned.
- Update the process, product or artifact based on feedback.
Infrastructure and Operations involves developing the necessary infrastructure and operations approach for the SQI Project as a whole, and also for each item to be deployed.

It includes the following items:
- Contact management system, problem management system (action item tracking, problem/failure reporting), configuration management system, electronic library, metrics collection, customer e-mail lists, customer tracking database for CRM, project calendar, target audience definition and strategy, intellectual property approach, and Operations Plan.

This infrastructure is the foundation upon which all other aspects of deployment are built.
Communication and Outreach

- Communication and Outreach involves communicating with, and systematically reaching out to, the user community so that they know and understand what is available to assist them.
  - It includes a website, presentations, seminars, brochure, OCM and CRM approaches, surveys, forums, interest groups, etc.
- The SQI Project generated CRM and OCM approaches that inform all aspects of their communication and outreach activities.
  - This provides a well-integrated approach to their customers.
- SQI Software Seminar Series – Shares information about the practices and methodologies for improving software quality
  - One-hour noon-time presentations by internal JPL speakers on various topics concerned with software processes, practices, methodologies, and project experiences.
- SQI Software Tool Service (STS) Seminar Series – Highlights software engineering tools available from industry and academia
  - Seminars and tutorials offered by various vendors on their commercial-off-the-shelf (COTS) tools for use in the software development process, including CASE tools, operating systems, languages, debugging tools, and test tools, etc.
- JPL Software Test Guild – Provides a forum for JPL Test Engineers to network, learn and share knowledge
  - One-hour special interest group (SIG) meetings of software test engineers covering topics ranging from test tools to test methodologies to lessons learned about testing in various application domains and test environments.

Education and Training

- Education and Training involves providing educational materials and classroom training in the desired processes, products and tools.
  - Computer-based training in the future.
- A JPL Software Training Plan defines the target customers, required skills sets, and training goals, and describes the training process to be utilized.
- Courses are offered on topics such as software management, software engineering, and process improvement.
- A biannual training survey is conducted in order to gauge the impact of, and satisfaction with, the software training program.
- The four-part Kirkpatrick Model is used to evaluate training effectiveness.
  - Reactions, learning, behavior, results

Cumulative SQI Software Training

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Project Support involves providing consulting support to projects across a broad range of relevant topics so that they can use the products in their own environment and for their specific purposes. It includes consulting in the areas of:

- Cost estimation, software project planning, software project tracking, earned value management (EVM), metrics definition and implementation, defects and reliability, software acquisition, software tools, use of templates, software testing, software quality assurance, CMMI®,

Extensive consulting support is provided to the four target sections and also to projects in the early phases of the system life-cycle.

- Additional ad hoc consulting is provided as requested to other projects and tasks.

Lessons Learned
Lessons Learned – Process Improvement (1)

- **Start with a proven framework.** - The CMMI® framework offered a proven process improvement approach and appraisal benchmark. It facilitated the measurement of progress against that benchmark.
- **Get outside help if necessary.** - Consulting support on CMMI® provided by appraisers from the Center for Systems Management (CSM) proved to be very helpful in understanding the model and in generating evidence for appraisals.
  - The advice of the Lead Appraiser to “start small, start slow, and start simple” helped in setting realistic goals and objectives, and establishing an appropriate horizon for change acceptance.
- **Build on previous efforts.** - The SQI Project was able to build on previous reengineering efforts, especially the major reengineering activities associated with Process-Based Management (PBM) and ISO 9000 in the late 1990’s.

Lessons Learned – Process Improvement (2)

- **Reach the “front line” managers too.** - Senior management support is important, however, so is the support of “front line” managers (supervisors).
  - That support needs to be painstakingly earned, one meeting or presentation at a time.
- **Other concurrent major changes can be a mixed blessing, i.e., sources of distraction or opportunity.** - The recent reorganization of the Engineering and Science Directorate (ESD) at JPL means many new players, but also provides some additional opportunities.
Lessons Learned – Creating Assets (1)

- **Start by documenting the current processes.** – Documenting the current processes provides a necessary baseline and a basis for future improvement.
- **Provide tools to support requirements and facilitate process compliance.** – When you begin with specific process requirements and then develop tools to actually implement them, then users are much more likely to comply and to perceive the process as “user friendly.”
  - e.g., handbooks, templates, and models
- **Utilize many reviewers to promote ownership.** – When many reviewers who are representative of different domains and perspectives provide comments on new or revised products, it promotes ownership or “buy-in” of the final result.

Lessons Learned – Creating Assets (2)

- **Strive for consistency amongst products** – When many products and guidelines are generated over time by several different individuals, there can be issues with consistency amongst those products.
  - At some point, it is necessary to step back and review the entire product suite to ensure that they are consistent with the standards and frameworks being utilized, and that they are consistent with each other.
  - Standards, handbooks, templates and training about a particular topic all need to convey the same message.
- **Allocate sufficient time for curriculum development.** – Curriculum development and defining course content is very time consuming.
  - On average, it takes approximately four months to develop a new course.
- **Update courses regularly.** – When processes and products are changing and the environment is dynamic, courses need to be updated regularly to reflect the latest information.
Use OCM and CRM to facilitate change. – There are several advantages to proactively using OCM and CRM.
  - It helps to maintain a customer focus and to create motivation for reaching out to customers.
  - Also, when setting priorities, it helps to know who your primary target audience is vs. your secondary or tertiary audience.
    • For example, some "eager beavers" or early adopters may not be part of your primary customer group.

Pair Process Engineers with "Shepherds". – Process Engineers from each of the target sections were paired with a representative or "shepherd" from the SQI Project who worked with them to understand CMMI® and its implications for their organization.

Address "culture issues" head on. – The SQI Project needed to address some culture issues it encountered when deploying assets.
  - The major difference between how software is developed for Flight Software applications and how it is developed for Ground Software applications, especially software that is developed for multi-mission purposes.
  - Factors that engendered resistance to change, such as the perception of insufficient time and resources to try something new, program and project constraints, and the difficulty of change itself.
  - "Baggage" from previous process improvement efforts and the false perception of "just another unfunded mandate."

Conduct internal appraisals periodically. – When periodic internal appraisals are conducted, it reveals progress and helps to show what additional effort is required to meet the stated goals.

Collect metrics and measure regularly. – Collect metrics, and conduct regular surveys and user forums to determine the level of infusion into the organization and to uncover any barriers to acceptance. Measure infusion, effectiveness, customer satisfaction, progress, etc. Remember that "without measurement, you’re just guessing!" [14]

Track customer contacts. – It is helpful to track customer contacts so that there are no duplications, and customers don’t feel pestered by many representatives covering the same territory. It is also useful for reporting outreach efforts to management.
Lessons Learned – Deploying Assets (3)

- Use an electronic library. – Use of an electronic library promotes information sharing and collaboration among various team members and projects.
- Communicate via multiple avenues and promote shamelessly. It never helps a change effort if it remains a “well kept secret.” No matter how many times a message is communicated, there still may be some who haven’t gotten the message.
  - Some people prefer e-mail, while others prefer fliers, posters, presentations or seminars.
  - It helps to think of novel ways to attract attention such as bookmarks, cubicle pins, cafeteria monitors, brochures, websites, etc.
- Address frequently asked questions about products and about who to contact. Create a set of frequently asked questions (FAQs) to reflect recent enquiries and to anticipate the types of concerns customers may have.
  - Make available a list of Points of Contact (POCs) for various types of issues and subject matter experts for each area.

Summary

- Changes in how software is managed, developed and acquired do not come quickly or easily.
- The improvement process needs to be approached with many of the same deliberate methods and practices that are used in actual system development.
- It helps to proactively reach out to customers instead of merely waiting for them to come to you.
- Lastly, it is important to maintain the proper balance between defining processes and generating assets vs. actually deploying them and supporting customers.
  - If this balance is not achieved, all the products generated just become “shelfware.”
Continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies. Detailed measures of process and product quality are collected. Both the process and products are quantitatively understood and controlled.

The processes for both management and engineering activities are documented, standardized, and integrated into a standard process for the organization. All projects use an approved, tailored version of the organization's standard process for developing and maintaining systems and software. Basic project management processes are established to track cost, schedule, and functionality. The necessary process discipline is in place to repeat earlier successes on projects with similar applications.

Processes are characterized as ad hoc and occasionally even chaotic. Few processes are defined, and success depends on individual effort. Usually involves "heroics."

CMMI was developed by the Software Engineering Institute (SEI), Carnegie Mellon University (CMU).

Organizational Innovation & Deployment
Causal Analysis & Resolution
Staged Representation
Level 5
"Optimizing"
Level 4
"Quantitatively Managed"
Level 3
"Defined"
Level 2
"Managed"
Level 1
"Initial"

Requirements Development
Project Planning
Technical Solution
Product Integration
Validation
Risk Management

Organizational Process Performance
Organizational Process Focus
Organizational Process Definition
Organizational Training
Decision Analysis & Resolution
Integrated Project Management

Process & Product Quality Assurance
Configuration Management
Measurement & Analysis

Few processes defined
Usually involves "heroics."

Organizational Training
Decision Analysis & Resolution
Integrated Project Management
## Capability Maturity Model Integration (CMMI)

### JPL CMMI Profile -- Process Area by FY

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**Key:**
- 2 = Capability Level 2
- 3 = Capability Level 3
- 4 = Capability Level 4
- 5 = Maturity Level 2 PAs
- 6 = Maturity Level 3 PAs

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### KSC Software Engineering Process Group (SEPG)

#### Capability Maturity Model Integration (CMMI) Process Areas

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KSC Software Engineering Process Group (SEPG)

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KSC Software Engineering Process Group (SEPG)

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