

SW Process Improvement (Example)

CMMI and IDEAL

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1 Introduction

Miretne Incorporated is a company specializing in inventory software. The company was invited by the International Red Cross to participate in a bidding round for a global emergency inventory system. The bidding was only open for an 18-month period, to companies ranked at CMMI Level 3 or higher.

1.1 Problems

With the loss of one core staff member and the employment of 5 new people, the company needed to bring some structure to the development process. The last few versions of the product had been released with numerous bugs, and the employees were tied up in fixing them. This had seriously affected the company's ability to move forward and take on new projects. With the increased focus on software support the project management had also suffered. Customer demands had been neglected and final products failed to give the customers the desired process improvements. We were also behind in our projects schedules.

2 Effort Toward Resolution

Recognizing its serious problems, the company decided on an effort to not only improve internal processes but also bring its status to a CMMI Level 3 organization.

2.1 Initial Assessment of Organizational Status

To ensure our improvement efforts were focused on core business objectives, Miretne Incorporated's use of capability maturity model integration for software engineering (CMMI-SW), under a staged representation, was evaluated. A stage representation (instead of a continuous representation) was more appropriately used to focus on maturity level process areas, and eliminate the need to worry about cross-process dependencies. [Chrissis, Konrad, and Schrum 12]. Although future plans will address extending our model to include additional disciplines of Systems Engineering (SE), Integrated Product and Process Development (IPPD), and Supplier Sourcing (SS), only the process areas for creating our software were assessed for this report.

2.2 Approach

Using the IDEAL model for process improvement, a strategy was put in place to address those deficient process areas the company needed to expand in order to reach CMMI Level 3. The IDEAL model served as a roadmap. [<http://www.sei.cmu.edu/ideal/ideal.html>]. **Solutions** to our identified problems are discussed in sections 3.2 and 3.4 of the IDEAL model framework below.

3 Process Improvement Using the IDEAL Model

3.1 Initiating

3.1.1 Stimulus for Change

Recent contract opportunities made it necessary to achieve CMMI Level 3 due to hard-set contract requirements. Miretne Incorporated's fundamental objective became process improvement and it was instigated through identification of various problems. 1) **inconsistent implementation of the product lifecycle** stressing a need for a more formally defined system of capturing and reviewing various work products during development 2) **sweeping organizational change** resulting in a lack of understanding of company practices related to scheduling, peer reviews, and configuration management, 3) **not identifying/managing issues prior to release** due to poor scheduling and lack of adequate resources, and 4) **failure to properly communicate customer needs** resulting in lack of product improvement.

3.1.2 Setting Context

The addition of 5 new team members, and the loss of one core member, provided a good opportunity to strive for CMMI Level 3 having a generic goal (GG) focusing on a defined proactive organizational process [Ahern, Clouse, and Turner 91]. Reaching Level 3 was necessary not only to obtain the highly prized contract, but also to make the organization run more efficiently and service its existing product line with focus on the customers, project management, and defects.

3.1.3 Build Sponsorship

A management instantiated discovery team, led by the Sr. VP, was set up to start the Software Process Improvement (SPI) program moving. A high level SPI proposal was put together in order to ordain the management with the change process using the CMMI model as the basis for the SPI. As soon as consensus was reached on the goals and objectives with senior management it was communicated to the rest of the organization. The SPI proposal laid out, in high level terms, how to address issues with defects and project management by 1) setting up more integration teams to work the various areas of the projects (IPM-IPPD SG 4), 2) setting up environments that duplicate the customer's (Validation SP 1.2), 3) performing more peer reviews (Verification SG2), and 4) more extensive reviews of product requirements (Verification SG3) [CMU/SEI-96-HB-001].

3.1.4 Charter Infrastructure

The 5 new hires allowed for a shift in infrastructure. A Management Steering Group (MSG) was set up to create the Software Engineering Process Group (SEPG), advise the SEPG, allocate resources, approve the SPI Strategic Action Plan (SAP), and monitor the implementation. The SEPG began to facilitate the SPI program serving as the focus of propagating ongoing activities and providing a support network to the organization. Technical Working Groups (TWG) were approved, at a later stage, also by the MSG, to work on individual aspects of the SPI SAP that were developed in the Establishing phase. After the initial teams were developed, they were sent out for training in various Planning, Team Development, and Managing Technological Change areas. [SEI CMU/SEI-96-HB001]

3.2 Diagnosing

3.2.1 Characterize the Current and Desired state

A formal CMMI appraisal conducted previously certified that our company was operating at maturity Level 2. All Level 2 process areas - 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) and Configuration Management (CM), for two of

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our primary projects were analyzed and demonstrated results of a ‘managed process’. [Ahern, Clouse and Turner 90]. With a model for moving forward and specific key practices in place, a discovery analysis was performed. Procedures, practices, policies, and work products were analyzed for CMMI Level 3. All Level 3 process areas were assessed.

Requirements Development -The Purpose of Requirements Development (RD) is to produce and analyze customer, product, and product-component requirements. [Chrissis p.465]

Technical Solution-The purpose of Technical Solution (TS) is to design, develop and implement solutions to requirements. Solutions, designs and implementations encompass products, product components and product-related life-cycle processes either singly or in combinations as appropriate. [Chrissis p.533]

Product Integration-The purpose of Product Integration (PI) is to assemble the product from the product components, ensure that the product, as integrated, functions properly and deliver the product. [Chrissis p.371]

Verification-The purpose of Verification (VER) is to ensure that selected work products meet their specified requirements. [Chrissis p.575]

Validation-The purpose of Validation (VAL) is to demonstrate that a product or product component fulfills its intended use when placed in its intended environment. [Chrissis p.563]

Organizational Process Focus-The purpose of Organizational Process Focus (OPF) is to plan and implement organizational process improvement based on thorough understanding of the current strengths and weaknesses of the organization’s processes and process assets. [Chrissis p.323]

Organizational Process Definition-The Purpose of Organizational Process Definition (OPD) is to establish and maintain a usable set of organizational process assets. [Chrissis p. 307]

Organizational Training-The purpose of Organizational Training (OT) is to develop the skills and knowledge of people so they can perform their roles effectively and efficiently. [Chrissis p.355]

Integrated Project Management-The Purpose of Integrated Project Management (IPM) is to establish and manage the project and the involvement of the relevant stakeholders according to an integrated and defined process that is tailored from the organization’s set of standard processes. [Chrissis p.187]

Risk Management-The purpose of Risk Management (RSKM) is to identify potential problems before they occur so that risk-handling activities can be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives. [Chrissis p.497]

Integrated Teaming-The purpose of Integrated Teaming (IT) is to form and sustain an integrated team for the development of work products. [Chrissis p.231]

Integrated Supplier Management-The purpose of Integrated Supplier Management (ISM) is to proactively identify sources of products that may be used to satisfy the project's requirements and to manage selected suppliers while maintaining a cooperative project-supplier relationship. [Chrissis p.217]

Decision Analysis and Resolution-The Purpose of Decision Analysis and Resolution (DAR) is to analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria. [Chrissis p.173]

Organizational Environment for Integration-The purpose of Organizational Environment for Integration (OEI) is to provide an Integrated Product and Process Development (IPPD) infrastructure and manage people for integration. [Chrissis p.267]

3.2.2 Develop Recommendations

The discovery proved adequate performance for Level 3 practices, but uncovered deficiencies in three Level 3 PAs: Verification (VER), Validation (VAL) and Integrated Project Management (IPM). The baseline team set out to create a Final Findings and Recommendations Report (FFRR). [SEI CMU/SEI-96-HB001] This was used as the baseline for the SPI SAP that was developed by the MSG in the Establishing phase. [SEI CMU/SEI-96-HB001]The recommendations specific to Miretne Incorporated's identified problems related to the three troubled PA's (VAL, VER, and IPM) were to:

- a.) Put together a testing environment at the organizational level that closely resembles the one in which the customer is using. This satisfied Validation SG1 and its SP1.2. This also satisfied Validation SG2 SP2.1 and SP2.2.
- b.) Enhance the peer review process by setting up more formal guidelines on approving work products. Appropriately reviewed documents should be stored in a repository and made accessible to all team members. This satisfied Verification SG2 SP 2.2 and SP2.3 and also GG 3 with GP3.2 (DI 4).
- c.) Enhance the project by assessing what levels of expertise are needed from various software/management disciplines, and using that expertise on future projects; lack of expertise in some areas resulted in weeks of rework across projects. This recommendation more fully integrates the staff on the projects and should satisfy IPM SG4 SP4.1.
- d.) Develop a customer communication strategy to efficiently address customer feedback.

The organization was also communicated with about the recommendations. A draft for the SPI SAP was initiated at this point.

3.3 Establishing

3.3.1 Set Priorities

The generic goal of Miretne Incorporated. was to institutionalize the company's software process from a managed process in CMMI Level 2 to a defined process in CMMI Level 3. According to the deficiencies that existed in the company, the software process improvement team focused most of the effort in the process areas IPM, VAL, and VER. The team also set the priorities to reflect the recommendations in Diagnosing phase and further pursued areas of the Verification PA with only GPs that apply to level 3 as follows:

Organize integration teams for IPPD (IPM SG4): The integration teams are identified, defined, structured, and tasked; then determine the integration team structure for the project.

Prepare for validation (VAL SG1): Conduct preparation for validation by establishing the validation environment.

Validate product or product components (VAL SG2): Perform the required validation with the product or product components, and analyze the results of the validation activities and identify issues.

Verification: Make certain that work and work products meet the requirements.

3.3.2 Develop Approach

In order to achieve the generic goals and identify resource availability, the SEPG developed a strategy that encompassed the scope of the work in the Diagnosing phase that also reflects the priorities. The following is the description of the strategy:

1. Obtain the sponsorship and management support.
2. Achieve a SPI proposal in high-level terms using the CMMI model as the basis of SPI.

3. After the SPI proposal is approved, ordain the teams involved in the Management Steering Group (MSG), the Software Engineering Process Group (SEPG), and The Technical Working Groups (TWG) and send them to the SEI courses in Planning, Team Development, and Managing Technological Change areas.
4. Utilize training for a pilot project.

3.3.3 Plan Actions

In alignment with the organization's 6 – 18 month business plan, milestones for the pilot project were set. The decision points were set every 6 months. The results of the pilot project were reviewed and measured after the first 6 months of the execution. The team decided to continue the pilot project. The choice of measurement tool was based on a decision matrix. The tracking mechanisms were based on the periodic evaluation reports from each team member. A detailed SPI Strategic Action Plan was setup and approved, details were played out in the Acting phase.

3.4 Acting

3.4.1 Create Solution

A solution was created as follows-

Organize integration teams for IPPD (IPM SG4): Organize the integration teams according to the levels of expertise that are needed from available staff that include software and management to work on the projects. A team structure with tasks was determined by TWG, and approved by SEPG. As the project evolves, integration team structures are reevaluated for continued applicability.

Validate product or product components (VAL SG2): Perform the required validation by testing the selected product in the established testing environment, and analyze the results of the validation activities and identify issues.

Verification

SG1-Preparation for Verification is Conducted. TWG set up methodologies and procedures for **SP1.1:**

Work products selected for verification along with the verification methods and are maintained in lists that

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call out each verification procedure for each work product. Types of methods include Acceptance tests, Performance tests and Functional tests. **SP1.2:** Set up and maintain the facilities needed for verification by establishing the proper environment including scenario generators based on customer input. **SP1.3:** Setup and maintain verification procedures for the work products selected by documenting test parameters and types, standards, and lists of criteria to be tested. [CMMI Distilled 244-245][CMMI Chrissis p 576-590]

SG2-Perform peer reviews: TWG set up a formal verification procedure that includes: **SP2.1 Preparing for peer reviews** by reading the necessary documentation for the project, setting up schedules for reviews, set up training for employees prior to peer reviews, and entry/exit criteria. **SP2.2 Conduct peer reviews** on selected work products and identify issues resulting from the review by using code inspection, automated code analysis, and putting out formal results, then, **SP2.3 analyzing data** about preparation, conduct, and results of the peer reviews by recording all data and storing in database and then running formal peer analysis. [CMMI Distilled 244-245] [CMMI Chrissis p 576-590]

SG3-Selected work products are verified against their requirements. The TWG has set up procedures and methodologies to **SP3.1: Perform verification** on work products against the specs and coming up with action items in reports and **SP3.2: Analyze the results and come up with corrective actions.** By running analysis on the verification report, putting in change methods for verification if necessary, and comparing actual with expected results [CMMI Distilled 245] [CMMI Chrissis p 584]

GG3: The process is institutionalized as a defined process. The TWG has set out to institutionalize several key areas of the Verification process by setting standards and periodically reinforcing the standards with training and with self audits. These areas are **GP3.1 (AB1) Establish and maintain** a description of a defined verification process by setting up a Sharepoint portal to store the process assets in and **GP3.2 (DI4) Collect work products,** measures, measurement results, and improvement information derived from planning and performing the verification process to support the future use and improvement

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of the organization's processes and process assets. All work products, no matter how insignificant are
gathered up and stored in Sharepoint for future use. [CMMI Chrissis p 589]

3.4.2 Pilot/Test Solution

Considering the available projects at hand, the SEPG decided to pick one project called the "Tool Management System" for testing the new process. The following actions were performed:

Organize integration teams for IPPD (IPM SG4): TWG selected five members to form this team; three were from the original staff and had been involved in this project for some time. The other two members were new to the company; they also had years of professional experience in software development. Two of the senior software developers were ordained as the team leaders; tasks and responsibilities were assigned to each member respectively.

Prepare for validation (VAL SG1): The integration team established a testing environment that closely resembles the customer's environment.

Validate product or product components (VAL SG2): The integration team performed the required validation by testing the Tool Management System in the established testing environment, and analyzes the results of the validation activities and identified issues.

3.4.3 Refine Solution

1. TWG selected five members to form the integration team; three of the members were from the original staff. The other two members were new to the company.
2. Establishing a testing environment took the integration team more than two weeks in dealing with equipment purchases at a reasonable cost. To address this, the solution was modified to add the administrative support in purchasing equipment. The integration team just needed to give sufficient information about the equipment and to inspect equipment quality and functionality.
3. During the validation by testing the Tool Management System in the established testing environment, we modified the solution to have the system developer do the unit test, to debug and remove the

simple defects that are found during that stage and then a testing specialist perform the more thorough testing steps.

4. The peer reviews were conducted, but it revealed that no acute time limitation of peer reviews were required. Half of the reviewers complained that the lack of structure and documentation rules made the documents difficult to understand. To address these problems, a revision of Verification procedure was made to list deadline of peer reviews with a formal document template. The procedures could be checked in to the procedures and documents database.

3.4.4 Implement Solution

After the newly developed process was applied on the pilot project, the signs showed “Acceptance”. The MSG decided to implement the new processes across the company. For a better performance in the management and implementation, the top-down approach was applied with the new process. The details of the new processes were introduced to the President, CEO, and managers. Thereby, the highest authorities in the organization were able to give the appropriate support to their subordinates. The solution was implemented as planned.

3.5 Learning

The goal for the SPI was to get the project to a CMMI level 3, another iteration with the goal of reaching level 4 using the IDEAL model is currently not planned. The analyze phase will be used to review the process; collect data for future IDEAL based SPIs.

3.5.1 Analyze

After analyzing the lessons learned documents the following was pointed out as being areas of potential improvement:

- Changes to customer’s production environment were not discovered in a timely manner and validation was performed in an environment that closely but not perfectly resembled the production environment.

- Lessons learned documentation was not considered an important artifact.
- Peer reviews were not welcome. Employees disliked being evaluated.
- In the beginning everyone followed the guidelines of the processes, but after a while some employees stopped using them. According to the observation from one integration team leader, this was due to time pressure and lack of control experiences.

3.5.2 Proposed Future Actions

The company has no way of controlling the customer's production environment so customers should be more involved in the process. Before the next iteration a deeper review of potential stakeholders should be conducted.

Stakeholder orientations should be held before a new iteration and between phases. A review of the completed phase goals and lessons learned should be discussed and documented. Goals for the new phase should be presented and discussed. Also the process itself should be discussed not only the process artifacts.

The reason for the opposition to the peer review process is mostly linked to the fact that peers had little understanding of the process and experience. MSG also acknowledges that, in general, there is a learning curve coupled with new processes, and will make some adjustments with the process controls and conduct basic training of employees at all levels to better institutionalize the processes.

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