A Corporate Approach to Technology Transition

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Abstract

This paper discusses the approach used by TRW for technology transfer, both internally and externally. The approach is based on the definition of Technology Change Management activities, as specified in the Software Engineering Institute’s Capability Maturity Model (CMM). The discussion will focus on TRW’s approach and techniques used, as well as lessons learned in implementation. This approach was found to be useful for lower maturity organizations, and provides a strong bond between corporate technologists and process improvement specialists.

1. Introduction

Part of any company’s competitiveness arises from its ability to transfer technology, both internally and externally. In the process of executing a task, the performer will discover, either directly or indirectly, ways in which the task can be performed better. The ability to capture this knowledge, to quantify it, and to communicate it to others is crucial in transferring these improvements to other performers.

TRW Inc. is a global technology, manufacturing, and service company, strategically focused on supplying advanced technology products and services to the automotive, space, and information systems markets. The critical dependence of our business on technology innovations, and the increasingly competitive nature of that business, provided the motivation for a sustained, proactive program of technology transfer.

2. Requirements

2.1. Capability Maturity Model for Software

The Capability Maturity Model™ for Software [1], [2] (CMM® or SW-CMM) is a model for judging the maturity of the software processes of an organization and for identifying the key practices that are required to increase the maturity of these processes. The CMM was developed by the Software Engineering Institute, a federally funded research and development center sponsored by the U.S. Department of Defense. The CMM is the defacto standard for organizational maturity in the software community, and is used by hundreds of defense and commercial software organization to measure and improve their practices.

The CMM describes the principles and practices underlying software process maturity and is intended to help software organizations improve the maturity of their software processes, at both project and organizational levels. The CMM is organized into five maturity levels, as shown in Figure 1:

1) Initial. The software process is characterized as ad hoc, and occasionally even chaotic. Few processes are defined, and success depends on individual effort and heroics.

2) Repeatable. 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.

3) Defined. The software process for both management and engineering activities is documented, standardized, and integrated into a standard software process for the organization. All projects use an approved, tailored version of the organization’s standard software process for developing and maintaining software.

4) Managed. Detailed measures of the software process and product quality are collected. Both the software process and products are quantitatively understood and controlled.

5) Optimizing. Continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies.
Although the majority of software organizations in the community can be characterized as Level 1, DOD generally seeks to do business with Level 3 or higher organizations, and some companies have achieved Levels 4 and 5.

Several organizations within TRW develop software for their specified markets. Because of the recognition of the CMM by the community and TRW’s customers, and the perceived value, TRW software organizations typically set improvement goals for specified CMM levels. Most TRW organizations are at Level 2, and key software organizations, such as the Data Technology Division (DTD), have progressed well beyond Level 3. The next section addresses CMM guidance for technology transfer.

2.2 Technology Change Management

One of the capabilities characterizing CMM Level 5 is a set of related practices termed “Technology Change Management”. The purpose of Technology Change Management is to identify new technologies (to include tools, methods, and processes), and track them into the organization in an orderly manner.

Technology Change Management involves identifying, selecting, and evaluating new technologies, and incorporating effective technologies into the organization. The CMM identifies eight typical activities performed by organizations which implement Technology Change Management (Figure 2).

To perform these practices, an organization typically establishes a group that works with the software projects to introduce and evaluate new technologies and manage changes to existing technologies. Particular emphasis is placed on technology changes that are likely to improve the capability of the organization's standard software process, a key element of Level 3.

1. The organization develops and maintains a plan for technology change management.
2. The group responsible for the organization's technology change management activities works with the software projects in identifying areas of technology change.
3. Software managers and technical staff are kept informed of new technologies.
4. The group responsible for the organization's technology change management systematically analyzes the organization's standard software process to identify areas that need or could benefit from new technology.
5. Technologies are selected and acquired for the organization and software projects according to a documented procedure.
6. Pilot efforts for improving technology are conducted, where appropriate, before a new technology is introduced into normal practice.
7. Appropriate new technologies are incorporated into the organization's standard software process according to a documented procedure.
8. Appropriate new technologies are incorporated into the projects' defined software processes according to a documented procedure.

In meeting the CMM requirements, it is not sufficient to simply perform these eight activities. The CMM also requires an organization to develop an infrastructure which
continually supports these practices. The infrastructure is characterized by four elements:

1. Commitment to Perform - Actions the organization must take to ensure that the process is established and will endure (e.g., establishing organizational policies and senior management sponsorship).

2. Ability to Perform - Preconditions that must exist in the project or organization to implement the software process competently (e.g., resources, organizational structures, and training).

3. Activities Performed - Roles and procedures necessary to implement a key process area (e.g., establishing plans and procedures, performing the work, tracking it, and taking corrective actions as necessary).

4. Measurement and Analysis - Measuring the process and analyzing the measurements, especially as needed to determine the status and effectiveness of the Activities Performed.

5. Verifying Implementation - The steps to ensure that the activities are performed in compliance with the process that has been established (e.g., reviews and audits by management, software quality assurance).

TRW DTD’s technology transfer program was designed to meet the CMM Level 5 practices of Technology Change Management.

2.3 Additional Corporate Goals

In addition to meeting the goals of the Software CMM, management wanted to ensure that the technology transfer program:

- Addresses non-software technologies;
- Focuses on competitive advantages;
- Works efficiently with other corporate improvement initiatives;
- Provides resources for less mature TRW organizations with similar technologies.

3. TRW’s Implementation

The TRW approach to technology transfer within DTD is shown in Figure 3. The DTD Technology IPT (Integrated Process Team) is assigned the responsibility for DTD technology change management, and uses a charter statement to define their roles and responsibilities.

The process starts by identifying potential changes in either the customers’ technology needs or in emerging competitor technologies. This is accomplished externally through university collaboration, standards committees, conferences, workshops, and customer input. Internally, DTD projects are surveyed annually to identify additional requirements and isolated project or customer concerns. Survey results identify both specific technologies in which innovation or improvements are desired, and desired communications mechanisms. For example, technology information is normally distributed over the corporate intranet. Compact disks are distributed monthly to projects without internet access.

Plans to meet the specified needs are addressed in an annual plan, which outlines specific tasks and success criteria. Given a limited budget, the plan prioritizes among potential actions.

Figure 3. DTD Technology Change Management Process
For each technology need identified, various actions may be taken by the Technology IPT, depending on severity of the need and in-house capabilities:

- Monitor technology changes and distribute key information;
- Sponsor internal symposia, provide training;
- Survey projects to determine key issues, impacts, and needs;
- Perform guided research to identify significant developments and distribute results;
- Conduct project pilots to evaluate a proposed technology;
- Incorporate selected technologies into projects.

Technology may also be acquired through the Internal Research and Development (IR&D) program. Needs are communicated to the staff, and anyone is free to submit a research proposal. Proposals are reviewed for technical soundness and affectivity, and on-going IR&D projects are monitored. Some projects may involved setting up collaborative efforts with universities, non-profit organizations, or commercial companies.

Although projects have the authority to implement technologies as their needs arise, some methods and tools are standardized across the organization. The System Development Office is responsible for coordinating overall changes to the infrastructure, and works with the Technology IPT to reflect technology changes in the standard process, procedures, and standards.

Technology changes may also drive a need for training, which is performed by the DTD Training Office. Training may deal with individual or project needs for specialized training (such as tool or method training), or organizational-wide training prompted by a change in policies or procedures. The Training Office produces an annual training plan, and maintains a matrix of required skill needs by job position.

Management oversight is provided by an Advanced Technology Council, with representatives from the functional organizations within the division. The Council reviews the identified needs, plans, and results, and provides feedback on available resources and rapidly changing needs.

Finally, there is a recognized need to make new technology available to other TRW organizations. Organizations are generally structured around customer communities and market segments. The underlying technology needs and solutions often cut across these markets, and sufficient benefits can be provided to other TRW organizations at little or no cost. The corporate intranet, internal conferences, and personal contacts have all proved effective.

4. Lessons Learned

Technology change management is a challenging task [3]-[8]. Key lessons we have learned include:

- The value of a proactive technology program may not be easily recognized. Sponsoring executives typically rely on their personal network to supply technology information upon request. The benefits of a proactive approach must be demonstrated.
- Prioritization must be used to scope the effort. Almost anything you do to identify and communicate technology will be of some value to someone. The key to planning a cost-effective program is to identify clear needs, and to prioritize the most effective ways of meeting them.
- Different levels of the organization need different kinds of data. Senior management needs concise information focussed on the decisions at hand. Staff members often desire broad awareness of technology options and sources of lower-level data.
- Different levels of the organization need different communication methods. Technologists are inclined to read email, search websites, and attend seminars to gather information. Senior management typically expects a briefing, and may not understand the value of other forms of communication.
- Technology dissemination must address both short-term and long-term needs. A more technologically-aware staff is advantageous in certain situations, but there will always be a need for response-on-demand, such as addressing a proposal requirement of project-generated issue.
- The return-on-investment from technology transfer is difficult to measure. Suppose a new technology is a factor in winning a proposal. How do you quantify the percentage of the total value? Can you be sure that the technology use is a result of the transfer program?
- Technologists may resist “pre-packaged” technology information because of the personal rewards of re-inventing. It may be perceived as more rewarding to create rather than reuse.
- The culture may resist broad dissemination of technology information. Knowledge is power, and there may be a perceived loss of personal power if information is widely available. This is best addressed by top management communicating and enforcing their desire for an open environment.
- Technology transfer is more efficient when performed within the overall context of the organizational change process [9]. Effective use of new technology often requires change in policies, procedures, organizational structures, training, etc.
5. Conclusions

TRW has implementing a proactive process for technology transfer, based on the guidance of the CMM. Although personal, organizational, and culture barriers exist, successful implementation had lead to distinct competitive advantages and better staff awareness.

References


