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Recommended Citation

Hefley, William E., "Where Does Team Building Fit As A Component of Mature Software Development Processes?" (1996). *AMCIS 1996 Proceedings*. 330.
<http://aisel.aisnet.org/amcis1996/330>

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Where Does Team Building Fit As A Component of Mature Software Development Processes?

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The Need for Software Process Improvement

Software development is large-scale, integrated, intellectual work (Humphrey, 1989). The skill of developing software is the skill of managing intellectual complexity. Performance ranges among professional software engineers routinely exceed twenty to one (Curtis, 1981; Sackman, 1968; Valett, 1989). Software engineers differ markedly in the level of complexity they can handle (Basili, 1983). The folklore of software engineering is replete with remarkable feats by heroes, wizards, and gurus. Although the presence of an extraordinary individual on a project can have dramatic impact, there are not enough of these individuals to staff more than a handful of the projects in most organizations (Curtis, 1988). Software organizations can lament these circumstances, or they can take actions to improve them.

The demand for higher quality systems has many organizations searching for ways to improve their software development processes. One approach to guiding software process assessment and improvement is embodied in the Capability Maturity ModelSM for Software (SWCMMSM) (Paulk, et al, 1995). The SW-CMM provides a means of evaluating capability and setting improvement goals within the organization's software process infrastructure.

With the help of the Capability Maturity Model for Software (SWCMM), many organizations have made improvements in their software processes and practices. These improvements have resulted in improved productivity, quality, and time to market (Herbsleb, 1994).

A Need for Addressing People Issues

Even in organizations with SWCMM-based improvement activities, many of these organizations have discovered that their continued improvement requires significant changes in the way they manage people, changes that are not fully accounted for in the CMM for Software. To date, most improvement programs for software organizations have emphasized process or technology, not people.

High process maturity organizations, such as the SWCMM Maturity Level 5 Space Shuttle Onboard Software operation (Paulk, 1995), exhibit a very different manner of addressing many people issues than do lower-maturity organizations. Organizations striving to reach higher levels of maturity are finding that the culture and workforce practices of their organizations must adapt to effectively implement a culture of software engineering excellence and continual improvement.

Team-Based Development

A set of concerns often dealt with in addressing these issues surround the peopleware issues, especially those surrounding the use of software development teams and team-based development processes. A major component of an organization's software processes are often executed by as a part of the organization's team-based processes. Team-based development is often instituted as a response to the complexity and size of today's systems.

What is needed to achieve higher levels of process maturity, is an understanding of how the SWCMM impacts team development efforts. This paper addresses these topics in light of the Software CMM and that of the People Capability Maturity ModelSM (PCMMSM) (Curtis, 1995).

While the SWCMM addresses issues such as intergroup coordination and training to accomplish standard organizational processes, it does not specifically address team-related issues. The Integrated Software Management key process area requires that software managers receive training needed to manage the "technical, administrative, and personnel aspects of the software project based on the project's defined software process" (Paulk, 1995, ISM AB3, pp. 225).

The People Capability Maturity Model (PCMM)

The People Capability Maturity Model (PCMM) adapts the maturity framework of the Capability Maturity Model for Software (SW-CMM), to managing and developing an organization's workforce. The PCMM is fashioned after the model of the SWCMM in both structure and format. Maturity on the PCMM represents an organization's ability to consistently improve the knowledge and skills of its staff and align their performance with the organization's objectives.

The motivation for the PCMM is to radically improve the ability of software organizations to attract, develop, motivate, organize, and retain the talent needed to continuously improve software development capability. The PCMM is designed to allow software organizations to integrate workforce improvement with software process improvement programs guided by the SWCMM. The PCMM can also be used by any organization as a guide for improving their people-related workforce practices.

Based on the best current practices in the fields such as human resources and organizational development, the PCMM provides organizations with guidance on how to gain control of their processes for managing and developing their workforce. The PCMM helps organizations to characterize the maturity of their workforce practices, guide a program of continuous workforce development, set priorities for immediate actions, integrate workforce development with process improvement, and establish a culture of software engineering excellence. It describes an evolutionary improvement path from ad hoc, inconsistently performed practices, to a mature, disciplined development of the knowledge, skills, and motivation of the workforce, just as the CMM describes an evolutionary improvement path for the software processes within an organization.

Five Maturity Levels of the P-CMM

The PCMM consists of five maturity levels that lay successive foundations for continuously improving talent, developing effective teams, and successfully managing the people assets of the organization. Each maturity level is a well-defined evolutionary plateau that institutionalizes a level of capability for developing the talent within the organization.

Organizations at the PCMM Repeatable maturity level find that although they are performing basic workforce practices, there is inconsistency in how these practices are performed across units. The organization is not capitalizing on opportunities to standardize its best workforce practices, because it has not identified the common knowledge and skills needed across its units and the best practices to be used for developing them. The organization is motivated to achieve the Defined level in order to gain a strategic competitive advantage from its core competencies.

At the Defined level, the organization begins to adapt its workforce practices to the specific nature of its business. By analyzing the skills required by its workforce and the business functions they perform, the organization identifies the core competencies required to perform its business. The organization then adapts its workforce practices to develop the specific knowledge and skills that compose these core competencies.

A common organizational culture can develop at the Defined level, because the organization becomes focused on developing and rewarding a set of core competencies. This culture places importance on growing the organization's capability in its core competencies, and the entire workforce begins sharing responsibility for this growth. This culture can be enhanced by establishing a participatory environment where individuals and groups are involved in decisions regarding their work.

At the Managed level, the organization takes the first steps in capitalizing on managing its core competencies as a strategic advantage. Further, it seeks to maximize the effectiveness of applying these competencies by developing teams that integrate complementary knowledge and skills.

Mentoring activities support the growth of individual competencies in the core knowledge and skills required by the business. High-performance teams, composed of people with complementary knowledge and skills, are developed where conditions support their functioning. These teams are built around complementary knowledge and skill sets, and team building activities are employed wherever possible to improve the effectiveness of these teams. When applied to teams, workforce practices are tailored to support team development and performance.

The workforce capability of Level 4 organizations is predictable because the current capability of the workforce is known quantitatively. The organization has also developed a mechanism for deploying its competencies effectively through high-performance, competency-based teams.

At the Optimizing level, individuals and coaches, as well as the entire organization, are focused on continually improving the competencies of the individuals and the organization. The culture created in an optimizing organization is one in which every member of the staff is striving to improve their own, their team's, their unit's, and the organization's knowledge, skills, and motivation in order to improve the organization's overall performance. The people-related system is honed to create a culture of performance excellence.

Of a number of key process areas in the PCMM focused on developing an effective organizational culture, two key process areas specifically address team building and team-based practices.

Team Building Key Process Area

The purpose of Team Building is to capitalize on opportunities to create teams that maximize the integration of diverse knowledge and skills to perform business functions.

Team Building involves matching potential team members to the knowledge and skill requirements of the team, training all new members in team skills, defining objectives for team performance, tailoring standard processes for use by the team, and periodically reviewing team performance.

Opportunities to form teams are identified within the organization's or unit's work process. The organization or unit identifies the knowledge and skills required for the team. Team members are selected to provide a mix of complementary knowledge and skills that satisfy the requirements of the various tasks and roles involved in the team's work. Where appropriate, this will involve a mix of the core competencies of the organization. Team members are trained in team skills, some of which are identified as core competencies of the organization. Objectives are established for team performance. The team adopts and tailors for its use any standard team or relevant work processes defined for use by the organization. The team defines processes as necessary to perform its assigned responsibilities and a set of performance criteria that are approved by management. The team assesses its own performance and periodically reports results.

Team-Based Practices Key Process Area

The purpose of Team-Based Practices is to tailor the organization's workforce practices to support the development, motivation, and functioning of teams.

Team-Based Practices involves ensuring that the work environment supports team functions, setting performance criteria and reviewing team performance, involving team members in performing workforce activities, and reflecting team criteria in individual compensation decisions.

Team-Based Practices begin with shaping the work environment to foster team-based activities. Objective performance criteria are established for the team. The individuals or groups to which the team is accountable maintain ongoing communication about performance with the team. Team members are involved in the performance of team-based practices such as team recruiting, selection, performance management, reward, training, development, and compensation activities as appropriate based on the structure and function of the team. Team data are used to identify needs for team development. Team-based criteria are factored into compensation decisions. Rewards are provided based in part on team criteria.

Building a Foundation for Effective Team Use

Developing and institutionalizing these capabilities across the organization will provide a means for the organization to better make use of its software talent, deploy teams to meet complex system needs, and further develop and motivate individuals to contribute to complex team-based activities. These team-based organizational structures can begin to be effectively used when the organization has developed a participatory culture (Curtis, et al, 1995) that supports lateral communication and appropriate participation in decision making (Mohrman, et al, 1995).

Notes

CMM and Capability Maturity Model are service marks of Carnegie Mellon University

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