

# The Managing Software Innovation and Technology Change Workshop

Eileen Forrester, SEI  
Priscilla Fowler, SEI  
Sharon Guenterberg, Litton PRC

*The Managing Software Innovation and Technology Change (MSITC) Workshop was held in June as a joint effort of the Software Engineering Institute (SEI) and Litton PRC. It was organized to determine what actions that leading organizations are taking to meet the challenges of integrating technological change strategically as well as operationally within their organizations.*

## **Background and Objectives**

The workshop convened representatives of organizations with experience in managing software-related innovation and technology change. The workshop objective was to share ideas, tested strategies, practical approaches, and analyses of lessons learned for adopting innovations and new technologies. Through working with their peers as well as invited experts, participants were to take away enhanced understanding of how to manage changes related to acquisition, adoption, and implementation of new information technologies for software-intensive products and systems.

We distributed an invitation to submit position statements for the workshop to several hundred experienced individuals. Acceptance was based on review of these position papers. All the workshop position statements are available as part of the final program. These are available online (<http://www.sei.cmu.edu/programs/te/tech-changewkshop.html>).

For the workshop's formal sections, 12 participants were asked to make short presentations for discussion during the workshop. In addition, we invited a panel of senior technical managers to address how technology change management (TCM) looks from their perspective, and asked a professor from the University of Pittsburgh, known for his expertise in managing innovation and technology, to provide input and commentary on the workshop findings. Other participants included those submitting position statements; members of the program committee; and management of the sponsoring organizations, Litton PRC and the SEI. There were 25 participants, each of whom had several years of diverse experience with TCM. The remaining time during the workshop—about half the total—was spent in working sessions. The remainder of this article gives highlights from the workshop formal program and working sessions and our plans to follow up.

---

## **Highlights from the Workshop**

The formal program consisted of a senior managers' panel, position paper presentations, and commentary from the invited expert.

### ***Senior Managers' Panel***

An invited panel of five senior managers from Litton PRC, Boeing, the SEI, and the Office for Science and Technology of the Spanish Presidency responded to the following two questions that addressed how the workshop looks from a senior technical manager's perspective:

- How do you strategically manage technology?

- How do you encourage and reward innovation?

Jude Franklin, Chief Technical Officer of Litton PRC, described the TCM program and development of the Strategic Technology Plan that advises senior management on where to invest their scarce overhead funding in terms of technology. This program includes tracking and evaluating new technologies, including those that emerge from within the organization, and developing tools that help technical personnel keep abreast of these technologies. Cora Carmody, General Manager of Internal Information Systems and Chief Information Officer at Litton PRC, spoke about the need for organizations to strategically manage Information Technology (IT) and to use that as the basis for identifying transformations and establishing an organizational structure that supports the identified goals. Goals include knowledge management, IT asset management, and electronic commerce.

Steve Cross, Director of the SEI, described SEI members of the technical staff as change agents, technology scouts, and “impact amplifiers.” SEI is organized into technical initiatives, the leaders of which are like commando unit leaders. Work is focused around expediting the technology maturation process; the model for that process is based on Geoffrey Moore’s notion of “crossing the chasm.” This includes addressing the specialized needs of early technology adopters and the broad needs of mainstream markets.

Gonzalo Leon, professor of the Universidad Politecnica de Madrid, and Director of the Office for Science and Technology, Presidency of the Spanish Government, represented an international, public-sector perspective. He reflected on the need to manage technology at the level of a country. His focus was on encouraging innovation and technology change in small- to medium-size enterprises (SMEs), which constitute 97 percent of Spain’s industrial base. He stressed that research and development must be funded and carried out in the context of technical and other innovation.

John Vu, Boeing Technical Fellow and Chief Engineer of the Boeing Company, described their MSITC efforts. These include technology evaluation, based on tracking trends and forecasting in software engineering, for the entire Boeing Co. Evaluation also includes trying out the technologies in testbeds, followed by recommendations to the Software Council, and communications—making sure the organization knows that particular technologies are being investigated. Besides evaluation, Boeing uses the IDEAL<sup>SM</sup> model and the Capability Maturity Model® (CMM®) as the basis for action plans, which he said are “where the technology transition happens.” Regarding how Boeing rewards innovation, Vu noted that it is re-evaluating skill codes to better reflect the importance and range of skills Boeing needs in software engineering.

In the discussion among participants and panelists that followed, three key points were made:

- SMEs are “most of the world,” while workshop participants primarily represented large organizations and those who worked as consultants or provided other services to large organizations.
- While creating an infrastructure to support SMEs and others attempting to implement MSITC was important, it was even more important to create motivation and mindset so that organizations would take advantage of the infrastructure.
- The importance of identifying MSITC functionality, independent of the size of the group or organization performing it.

In summary, the panelists found the biggest challenge in the MSITC includes selling a common vision to management, addressing the compressed time cycle of change and new technology, making technology management an accepted role, communicating how MSITC

helps an organization accomplish its mission and business goals, and fostering a culture of change in the organization itself.

### ***Summary of Some Position Statements***

Three software tools for facilitating TCM were presented.

Linda Levine of SEI on “TCM: Integrating Knowledge and Processes in the Learning Organization.” This is the first of a two-part article, which can be found in the November issue of CrossTalk. She says that the interplay of technology, knowledge, and process is integral to innovation or change. She maintains that organizations doing TCM must be learning organizations, and describes an example tool, INTRo. INTRo, based on the IDEAL model and other SEI and LBMS work, attempts to join elements of technology, process, and knowledge management.

Ron Kohler and Stan Przybylinski (Center for Electronic Commerce, Environmental Research Institute of Michigan) contributed “Tools for Knowledge Management: Fieldwork in Evaluating RAPTR, An Intelligent Groupware System.” Readiness Assessment and Planning Tool Research (RAPTR) was described as a system to support change teams in planning and executing reengineering projects—or an electronic tutor for change agents. The paper also presented the results of using anthropological techniques to learn about intended users and operators of RAPTR.

Mike Lefler of Litton PRC presented a description of a third tool in his paper, “Tek\*Aware: A Litton PRC Project for Technology Monitoring.” Tek\*Aware, still in the experimental stages, is used by Litton PRC technical staff and engineers to monitor technology, gather and filter promising technologies, and help match technology information to known user needs.

Papers by Suzanne Garcia of aimware (“Managing Technology and Innovation”) and Sharon Guenterberg of Litton PRC (“Litton PRC’s TCM Program: The Continuing Quest for Aligning People, Technology and Strategy”) reflect the experiences of a very small and a very large organization in practicing what they preach. Both organizations have had success in using TCM methods with their customers that were originally developed for internal use. Both papers have lessons learned on techniques for fostering innovation and a learning environment.

Donald V. Dortenzo and Michele Nimerick submitted “Technology Innovation at Higher Levels of Process Maturity.” It reflects their work at the Software Productivity Consortium to help member organizations to be successful with TCM at higher CMM levels. They noted the need for quantifiable goals driven by business needs and reported on pilot efforts to test TCM guidance in an operational environment.

Stan Rifkin, Mark Paulk, Mac Patrick, and Lewis Gray challenged our assumptions about TCM. Rifkin (Master Systems) contributed “Discipline of Market Leaders and Other Impediments to Implementing Software Process Improvement.” He asserts that organizations need to determine their priority with respect to market strategy: are they focused on operational excellence, customer intimacy, or product innovation? He points out that TCM efforts must be aligned to the chosen market strategy, just as process improvement must align with business goals.

Paulk, of SEI, submitted “Analysis Tools for Different Perspectives on Process and Technology Change Management, which can be found in the November issue of CrossTalk. He offers three perspectives that may be of value when considering change management:

- internally driven change vs. externally driven change
- change directed at products and services vs. those directed at design and production processes, and

- incremental vs. revolutionary change. His paper highlighted work from Geoffrey Moore's *Crossing the Chasm*, Fichman and Kemerer's assimilation gap, and the Daghfous and White's innovation analysis model.

Patrick, of Visa International and Process Advantage Technology, said that "new technology alters our 'sensorium'—the ratio among our senses" and that people adopt technology "when they are ready and the technology is ready, or 'whole'—in their terms."

Gray, of Abelia Corp., suggests that we need requirements for technology change, and the free concurrence of the intended adopters of change, rather than simply setting criteria that allow us to declare success independent of the experience of intended users of technology.

Reed Augliere, of The Future Research Co., submitted a paper on using simulation technology to quantify the benefits and mitigate the risks of proposed technology changes. The technique was used to help a banking consortium evaluate and choose among alternative technologies to support a new electronic commerce system. It is a real-world example of the challenges associated with IT infrastructure planning and an example of one practical approach to TCM.

While there was collective breadth in the position statements, there were some obvious gaps in the total TCM picture they represented. Little on managing individuals or teams for innovation was presented, although it is implicit in the work of several participants. In addition, most of the contributions were strictly focused on the software-intensive industry and failed to take account of existing work in other disciplines and industries on managing innovation and TCM. A valuable exception was the participation of an anthropologist in the development of RAPTR.

Despite these omissions, the group of papers represents an attempt to wrestle with a complex set of factors, conditions, and inputs to change and innovation. No silver bullets were proposed; the working sessions and follow-on actions to the workshop were the participants' commitment to identifying and sharing good TCM practice.

#### ***Dr. George White's Role as Commentator***

Dr. George White, of the University of Pittsburgh, was served as an expert witness to the workshop activities. Based on his response to the presentations, working sessions, and other discussions, White offered commentary and informal critiques throughout the workshop and formal critiques during the closing session. He cited a position paper submitted by Rich Bland of Litton PRC when he stressed the importance of solving the problems associated with updating existing legacy systems that have been in place for the last 50 years with newer, more supportable technology. He also cautioned that the devil is in the details in terms of managing software innovation and technology change, as cited by Priscilla Fowler of the SEI in her position paper. Finally, he underscored the importance of learning as encapsulated in Levine's paper, and emphasized the value of having true social scientists, such as anthropologist Kohler, to give software practitioners fresh insight on TCM.

---

## **Highlights from the Working Group Sessions**

There were six working group sessions, some in small groups, some as plenary sessions.

#### ***Session Commenting on TCM-related CMMI Key Process Areas***

This working session reviewed key source materials related to TCM for CMMI project -- particularly, the SW-CMM V2 Draft C materials for Organization and Process Technology Innovation (OPTI) and Organizational Improvement Management (OIM). The goal was to apply

the insights of active researchers and practitioners in the area of managing technology and innovation to the expression of technology and innovation management concepts and practices in CMMs. Change requests based on this session have been forwarded to the CMMI architects. The findings focused on the distinctions between managing large, discontinuous innovations and incremental improvements, clarifying terminology, and considering the architecture of the process areas for greatest effectiveness in managing innovation and technology change.

### ***Session Drafting a TCM Position Statement***

This working group represented a diversity of disciplinary perspectives, including anthropology, rhetoric and communications, computer science, software engineering, telematics, marketing, and machine learning. Each individual had extensive experience in TCM work, and had approached it from his or her disciplinary perspective. This group created a position statement on TCM to begin to define the problem the workshop grappled with. The statement follows:

TCM is essential to the emerging world technological order, but planned technological change will fail if the people who have to live with it reject it. For TCM to succeed, TCM practitioners need to take a holistic—or “system of systems”—approach to TCM. In particular, they need to recognize that different usage domains produce different instantiations of TCM. It should be the business of the workshop to develop the domains of usage and domain-specific risks to the successful instantiation of TCM.

Participants indicated that by “domain” they meant a specific technical area, such as xerigraphy, and by “usage domain” they meant this technical area particularized for a common culture or similar set of users, such as those in the United States or Latin America.

### ***Session Drafting a High-Level Procedural Approach to TCM***

This group’s goal was to identify factors to consider in implementing a new technology. The factors they identified were placed in a quasi-procedural framework. Key factors identified were:

1. noting the existence of triggers for consideration of new technologies, such as senior management special interests or customer requirements
2. assigning ownership for implementation, so that the leader and the sponsor of the effort is clearly identified and initial resources are provided
3. identifying the stakeholders for the new technology, and the need for using a defined methodology to accomplish this, such as simulation of the outcome, quality function deployment, or an anthropological approach
4. scoping and validating the assumptions behind the technology implementation, to be sure that the technology should be implemented, and if so where and how broadly within the organization
5. performing a detailed analysis prior to implementing the technology in specific situations, attending to the maturity of the technology, trade studies, and results from piloting
6. selecting a TCM model for implementing the technology, such as IDEAL, simulation, piloting, or evolutionary spiral process
7. developing a deployment plan, based on considerations of “whole product” issues, and deployment and transition mechanisms such as training and education, intraorganizational communications, and web material
8. getting senior management approval of the specific deployment plan and allocation of resources needed. Note that this is different from obtaining initial sponsorship, which supports and encourages work preparatory to deployment.
9. deploying the technology according to the plan developed, and revising the plan as results and feedback require

10. closing out the deployment, including “acceptance testing” of the new technology—  
determining the success of the implementation (the TCM process) and the technology

***Session Considering Requirements, Next Steps  
to Improve Understanding and Practice of TCM***

As with many such workshops, workshop participants were concerned that both the enthusiasm and findings would be carried beyond the workshop. They brainstormed ideas for how to accomplish this and move progress in TCM forward. Their ideas were classified into five categories:

1. Building a community of practice extending TCM  
Examples: use of a collaborative work site, panel and birds-of-a-feather sessions at upcoming events, active information sharing, and email dialogue
2. Short-term action items  
Examples: document results of workshop, draft a case study of good TCM practice such as Litton PRC
3. Basic research (information gathering such as from the library)  
Examples: catalogue competing models and relative merits, articulation of TCM assumptions
4. Applied research and development (field work, with results analyzed quantitatively)  
Examples: develop and pilot application criteria for TCM models, develop domains of use
5. CMM-related  
Examples: describe TCM actions for lower levels of maturity, develop metrics for TCM effectiveness

***Session Creating a “Mind Map” for TCM***

A session was conducted to identify, graphically document, and begin to categorize the many activities involved in successful TCM practice.

***Session Creating a Graphical Metaphor (Mural) for TCM***

Many metaphors surfaced during the “mind map” session on what it was like to implement software innovation or technology change within an organization. These metaphors were captured and depicted in a TCM mural.

---

## **Followup to the Workshop**

***Ongoing Participation***

Participants agreed that further dialogue was important. In the closing session, the suggestions of the “next steps” working group were endorsed. One immediate task -- already completed -- was establishing an online, web-based working group using the shareware tool Basic Support for Cooperative Work (BSCW). All workshop participants have been incorporated as members under BSCW, and can contribute articles and bibliographies, start and participate in discussion threads, and invite nonworkshop participants as members to expand the group.

***Plans to Publicize the Workshop Results,  
Recruit Broader Participation***

Immediate plans for publicizing the MSITC workshop findings more broadly include organizing a panel discussion at the SEPG 2000 Conference. An SEI technical report will expand on this

paper and include all the position statements as well as more details of working group findings. This technical report also will be created as a web site, with additional materials and the opportunity for broader dialogue with others interested in TCM related to software and IT. More workshops will be scheduled once this initial work is well under way. Meanwhile, we solicit your feedback on this paper, on the findings it reports, and on general or specific TCM issues. Write to [ecf@sei.cmu.edu](mailto:ecf@sei.cmu.edu), [pjf@sei.cmu.edu](mailto:pjf@sei.cmu.edu), or [guenterberg\\_sharon@prc.com](mailto:guenterberg_sharon@prc.com); also let us know if you are interested in participating as this work progresses.