

AD-A274 475



7

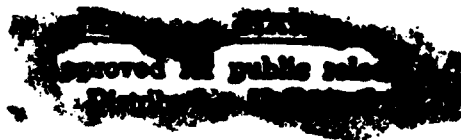
USING NEW TECHNOLOGIES A TECHNOLOGY TRANSFER GUIDEBOOK

SPC-92046-CMC

VERSION 02.00.08

DECEMBER 1993

DTIC
ELECTE
JAN 05 1994
S E D



168P/ 93-31609



REPORT DOCUMENTATION PAGEForm Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)

2. REPORT DATE

December 1993

3. REPORT TYPE AND DATES COVERED

Technical Report

4. TITLE AND SUBTITLE

Using New Technologies: A Technology Transfer Guidebook

5. FUNDING NUMBERS

G MDA972-92-J-1018

6. AUTHOR(S)

Produced by Software Productivity Consortium under contract to Virginia Center of Excellence

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Virginia Center of Excellence
SPC Building
2214 Rock Hill Road
Herndon, VA 220708. PERFORMING ORGANIZATION
REPORT NUMBERSPC-92046-CMC,
Version 02.00.08

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

ARPA/SISTO
Suite 400
801 N. Randolph Street
Arlington, VA 2220310. SPONSORING / MONITORING
AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

Supersedes the Using New Technologies: A Software Engineering Technology Transfer Guidebook, Version 01.00.03 (DTIC # ADA259406)

12a. DISTRIBUTION / AVAILABILITY STATEMENT

No Restrictions

12b. DISTRIBUTION CODE

1

13. ABSTRACT (Maximum 200 words)

This guidebook provides practical guidance on how to successfully transfer technology into your organization. Aimed at engineers and managers, the guidance is distilled from a broad base of experience and research and is illustrated by numerous examples. This guidebook defines activities for transferring technology and can be used in support of process improvement efforts and in support of individual technology transfer. This guidebook addresses improving your technology transfer process.

14. SUBJECT TERMS

Technology transfer, process improvement, change management, technology transition, technology insertion, transfer

15. NUMBER OF PAGES

185

16. PRICE CODE

17. SECURITY CLASSIFICATION
OF REPORT

Unclassified

18. SECURITY CLASSIFICATION
OF THIS PAGE

Unclassified

19. SECURITY CLASSIFICATION
OF ABSTRACT

Unclassified

20. LIMITATION OF ABSTRACT

UL

USING NEW TECHNOLOGIES

A TECHNOLOGY TRANSFER GUIDEBOOK

SPC-92046-CMC

VERSION 02.00.08

DECEMBER 1993

DTIC QUALITY INSPECTED 8

Accession For	
NTIS	CRA&I ☒
DTIC	TAB ☐
Unannounced	☐
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and / or Special
A-1	

Produced by the
SOFTWARE PRODUCTIVITY CONSORTIUM SERVICES CORPORATION
under contract to the
VIRGINIA CENTER OF EXCELLENCE
FOR SOFTWARE REUSE AND TECHNOLOGY TRANSFER

SPC Building
2214 Rock Hill Road
Herndon, Virginia 22070

Copyright © 1992, 1993, Software Productivity Consortium Services Corporation, Herndon, Virginia. Permission to use, copy, modify, and distribute this material for any purpose and without fee is hereby granted consistent with 48 CFR 227 and 252, and provided that the above copyright notice appears in all copies and that both this copyright notice and this permission notice appear in supporting documentation. This material is based in part upon work sponsored by the Defense Advanced Research Projects Agency under Grant #MDA972-92-J-1018. The content does not necessarily reflect the position or the policy of the U. S. Government, and no official endorsement should be inferred. The name Software Productivity Consortium shall not be used in advertising or publicity pertaining to this material or otherwise without the prior written permission of Software Productivity Consortium, Inc. SOFTWARE PRODUCTIVITY CONSORTIUM, INC. AND SOFTWARE PRODUCTIVITY CONSORTIUM SERVICES CORPORATION MAKE NO REPRESENTATIONS OR WARRANTIES ABOUT THE SUITABILITY OF THIS MATERIAL FOR ANY PURPOSE OR ABOUT ANY OTHER MATTER, AND THIS MATERIAL IS PROVIDED WITHOUT EXPRESS OR IMPLIED WARRANTY OF ANY KIND.

ADARTSSM is a service mark of the Software Productivity Consortium Limited Partnership.

Expert Choice is a registered trademark of Decision Support Software, Inc.

Sun Microsystems is a registered trademark of Sun Microsystems, Inc.

CONTENTS

ACKNOWLEDGMENTS	ix
PREFACE	xi
1. MOTIVATING TECHNOLOGY TRANSFER	1-1
1.1 Objectives	1-1
1.2 Why You Need to Be Concerned About Technology Transfer	1-1
1.3 Transfer's Critical Role in Process Improvement	1-3
1.4 Roadmap to This Guidebook	1-4
2. UNDERSTANDING THE TECHNOLOGY TRANSFER PROCESS	2-1
2.1 A Technology Transfer Process	2-1
2.2 Technology Transfer Scenario	2-2
2.3 Understanding Technology Transfer	2-5
2.4 Starting and Planning a Technology Transfer	2-8
2.5 Using the Technology Transfer Process	2-11
3. LOOK AT YOUR SITUATION: UNDERSTAND CONTEXT	3-1
3.1 Build/Reinforce Sponsorship and Foundation	3-2
3.2 Define/Update Transfer Strategies	3-13
3.3 Understand Process	3-27
3.4 Context Review	3-30
4. CHOOSE THE RIGHT PATH: ANALYZE RISKS AND SELECT STRATEGY ..	4-1
4.1 Analyze and Resolve Risks	4-2
4.2 Select Strategy	4-13
4.3 Commit to Strategy	4-17

5. FOCUS THE TRANSFER: PLAN TECHNOLOGY IMPLEMENTATION	5-1
5.1 Define Implementation Plan	5-2
5.2 Commit to Implementation Plan	5-11
6. GETTING IT DONE: IMPLEMENT TECHNOLOGY	6-1
6.1 Implement	6-2
6.2 Manage and Monitor	6-7
6.3 Review Technology Implementation	6-13
7. DETERMINE WHERE TO GO NEXT: REVIEW AND UPDATE TRANSFER PLAN	7-1
7.1 Review Progress	7-2
7.2 Define/Update Transfer Plan	7-10
7.3 Commit to Proceed	7-15
8. IMPROVING YOUR TECHNOLOGY TRANSFER PROCESS	8-1
8.1 The Big Picture	8-1
8.2 Justifying a Defined Technology Transfer Process	8-7
8.3 What Your Organization's Future Should Be	8-10
APPENDIX: CHECKLISTS FOR APPLYING THE TECHNOLOGY TRANSFER PROCESS	App-1
LIST OF ABBREVIATIONS AND ACRONYMS	Abb-1
GLOSSARY	Glo-1
REFERENCES	Ref-1
BIBLIOGRAPHY	Bib-1
INDEX	Ind-1

FIGURES

Figure P-1. Structure for Integrated Application of Consortium Technologies	xi
Figure 2-1. Technology Transfer Process	2-2
Figure 2-2. An Example of a Technology Transfer Process	2-3
Figure 2-3. Technology Transfer Producers and Consumers	2-6
Figure 2-4. Success Factors in Technology Transfer	2-8
Figure 2-5. Activity Format	2-14
Figure 3-1. Understand Context Activities	3-1
Figure 3-2. Role Relationships	3-10
Figure 4-1. Analyze Risks and Select Strategy Activities	4-1
Figure 4-2. Example Risk Rating Scale	4-4
Figure 5-1. Plan Technology Implementation Activities	5-1
Figure 5-2. High Risk Areas and Order of Activities	5-6
Figure 6-1. Implement Technology Activities	6-1
Figure 6-2. Positive Response to Change	6-4
Figure 6-3. Assessing Quantitative and Qualitative Progress	6-10
Figure 7-1. Review and Update Transfer Plan Activities	7-1
Figure 7-2. Different Implementation Outcomes	7-7
Figure 8-1. Organizational Relationships to Technology Transfer	8-2

TABLES

Table P-1. Consortium Guidebooks and Related Practices	xii
Table 1-2. Guidebook Audience	1-6
Table 2-1. Technology Transfer Responsibility Options	2-7
Table 6-1. Resistance to Change Responses and Mitigation Strategies	6-5
Table 8-1. Justification for Improving Your Technology Transfer Process	8-7
Table App-1. Cycle 1 Task Checklist	App-2
Table App-2. Cycle 2 Task Checklist	App-4
Table App-3. Cycle N Task Checklist	App-6

EXAMPLES

Example 2-1. A Case of Tailoring Technology Transfer Resources	2-10
Example 3-1. A Case of a Bottom-Up Influence Approach	3-11
Example 3-2. A Case of New Customer Impacts	3-15
Example 3-3. A Case of Government Impacts on Technology Directions	3-16
Example 3-4. A Case of Selecting a New Technology	3-21
Example 3-5. A Case of Piloting a Transfer	3-24
Example 4-1. A Case of Gathering Information From Research and Vendor Communities	4-8
Example 6-1. A Case of Not Getting User and Management Buy-In	6-6
Example 7-1. Summary of an Entire Transfer (Part 1 of 2)	7-3
Example 7-2. Summary of an Entire Transfer (Part 2 of 2)	7-4
Example 7-3. A Case of Multiple Outcomes	7-7
Example 7-4. A Case of an Incomplete Support Plan	7-13
Example 8-1. Technology Use Survey Findings	8-9
Example 8-2. Top Impediments to Technology Use	8-9
Example 8-3. Impact of Training on Technology Use	8-9

This page intentionally left blank.

ACKNOWLEDGMENTS

The manager and lead author for this version of the guidebook was Mary Eward. Hillary Davidson supported development of this version of the guidebook, especially in the area of process improvement and technology transfer integration and the use of the Evolutionary Spiral Process. John Christian, Ph. D., Mary Eward, Sam Redwine, and Louis Tornatzky, Ph. D., Southern Technology Council, were the authors of the first version of the guidebook.

Richard Bechtold, Jim Blake, and Roger Williams were Consortium reviewers and provided excellent comments and insights. Special thanks go to Dave Nettles for his support and to Wil Spencer and Kirsten Blakemore for their insights.

This version of the guidebook drew heavily on the first version of the guidebook; therefore, it is especially important to carry over the acknowledgments for those who participated in the first version.

- Bob Christopher was the project manager.
- Jim Babcock of Georgia Institute of Technology, and Mitchell Fleischer, Stan Przybylinski, and Jim Shearer of Industrial Technology Institute provided case studies and graphics.
- Special thanks go to Claude DelFosse and Art Pyster for their guidance. Kirsten Blakemore, Ted Davis, Kent Johnson, and Wil Spencer were gracious and thorough Consortium reviewers; Priscilla Fowler and Linda Levine of the Software Engineering Institute were most helpful external reviewers.
- Real world experience and guidance were received from Jim Blake, Norm Hunt, Randy Scott, and members of the Technology Transfer Technical Advisory Group (Dennis Vickery, The Boeing Company; Dan Polofsky, Grumman Corporation; Valerie Denny, Martin Marietta Aero & Naval Systems; James Kummer, Martin Marietta Astronautics; Richard Surma, Rockwell International; Jennifer McLaughlin, SYSCON Corporation; Charlotte Winnick, UTC Norden Systems; and Howard Kaplan, Vitro Corporation).

Finally, the ESS division of the Consortium offered extra assistance in getting both versions of this guidebook to look their best.

This page intentionally left blank.

PREFACE

The technology described in this guidebook is part of a broad approach to software productivity improvement. This preface provides an overview of that approach and identifies the series of guidebooks that support it. These guidebooks were developed by the Software Productivity Consortium under contract to the Virginia Center of Excellence for Software Reuse and Technology Transfer (VCOE). For a complete listing of VCOE guidebooks and products, call the Software Productivity Consortium's Technology Transfer Clearinghouse at (703) 742-7211.

Each technology has been packaged so it can be used without reference to the other technologies. However, it is also possible to combine these technologies into an integrated approach for product development. Figure P-1 shows how the guidebooks for these technologies relate to the practices of software development organizations.

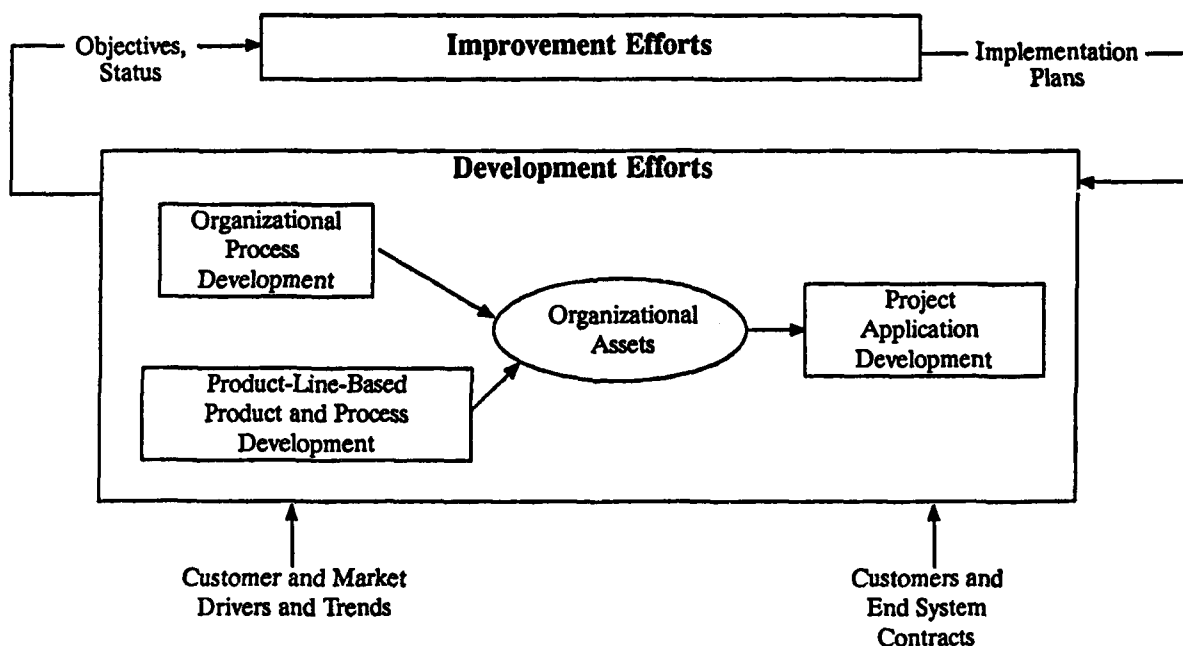


Figure P-1. Structure for Integrated Application of Consortium Technologies

These practices are composed of:

- **Improvement Efforts (IE).** Application of technology to improve software development efforts. These efforts require managed approaches to assessment of objectives and current capabilities, planning for the improvement, implementation of the plan, and measurement of success.

- The process model is based on the Evolutionary Spiral Process model. This change required moving guidance from the previous five-step process model to the correct activity in the ESP-based model. Guidance was added for the new management and risk analysis activities present in the ESP model.
- Key guidance from Appendix A Methods, was folded into the process guidance and the methods appendix was removed.
- Appendix B Sources of Software Engineering Technology Information, was removed because of maintenance issues.
- The guidebook is now positioned to be integrated with the *Managing Process Improvement: A Guidebook for Implementing Change* (Software Productivity Consortium 1993b). This required adding information about when and how this guidebook should be used in a process improvement effort.
- Guidance has been modified based on comments received from technology transfer courses, pilot projects, and consulting.

- **Development Efforts.** Development of products that meet the needs of customers and markets or products that make the organization more competitive in meeting expected future needs.
 - **Organizational Process Development (OPD).** Development of standardized organizational process assets (e.g., process and method descriptions, process enactment tools) tailored for a particular organization.
 - **Product-Line-Based Product and Process Development (PLD).** Development of integrated product and process assets (e.g., core products and processes for adapting them for particular customer needs) appropriate for a particular product line.
 - **Project Application Development (PAD).** The tailoring and application of organizational assets for a particular product development effort.

Table P-1 describes how existing products can be integrated to address your organizational practice.

Table P-1. Consortium Guidebooks and Related Practices

Guidebook	Part Number	Relationship to Software Practice
<i>Consortium Requirements Engineering Method Guidebook</i>	SPC-92060-CMC	Used for defining and analyzing requirements in PAD. Adaptable for use in PLD.
<i>Managing Process Improvement: A Guidebook for Implementing Change</i>	SPC-93105-CMC	Supports IE by providing a process and supporting guidance for initiating and maintaining an organizational process improvement program.
<i>Process Definition and Modeling Guidebook</i>	SPC-92041-CMC	Provides methods for defining and documenting processes so they can be analyzed, modified, and enacted. Supports IE and OPD.
<i>Process Engineering with the Evolutionary Spiral Process Model</i>	SPC-93098-CMC	Used to iteratively plan, manage, and control PAD and PLD. Used to construct organization-specific processes in PLD and tailor them in PAD.
<i>Reuse Adoption Guidebook</i>	SPC-92051-CMC	Supports IE by providing specific process improvement activities for incorporating reuse practices.
<i>Reuse-Driven Software Processes Guidebook</i>	SPC-92019-CMC	Provides development approaches for PLD (domain engineering) and PAD (application engineering) of reusable software assets.
<i>Software Measurement Guidebook</i>	SPC-91060-CMC	Supports IE by providing methods for quantitative assessment of project status.
<i>Using New Technologies: A Technology Transfer Guidebook</i>	SPC-92046-CMC	Supports IE by providing a process that addresses how to get an organization to use new technologies.

This guidebook is the second release of the Consortium's *Technology Transfer Guidebook*. The following list summarizes the changes made to the guidebook since the first version in December 1992:

This page intentionally left blank.

1. MOTIVATING TECHNOLOGY TRANSFER

For the past ten years, the data processing profession has been slowly learning that *technology transfer* is one of its biggest problems—if not *the* biggest problem.

Ed Yourdon, Forward, *Agents of Change*

Section Objectives

1. *Explain why you should be concerned about technology transfer*
2. *Explain the relationship between technology transfer and process improvement*
3. *Describe the guidebook's contents*

Using New Technologies provides practical guidance on how to successfully transfer technology into your organization. Aimed at engineers and managers, the guidance is distilled from a broad base of experience and research and is illustrated by numerous examples. This guidance can be used both as part of a process improvement effort and in support of individual technology transfers.

Section 1.1 lists the objectives of this guidebook. Section 1.2 motivates you to be concerned about technology transfer. Section 1.3 discusses the role of technology transfer in process improvement. Finally, Section 1.4 describes the guidebook's organization.

1.1 OBJECTIVES

This guidebook helps you, the technology consumer:

- Understand the importance of management support and user buy-in to the transfer and understand how to acquire them
- Ensure that the technology and transfer strategy are consistent with your organization's needs and culture
- Successfully plan and implement the technology transfer

This guidebook helps you address the challenges—technical, economical, human, and organizational—in making your organization willing and able to transfer and use new technology.

1.2 WHY YOU NEED TO BE CONCERNED ABOUT TECHNOLOGY TRANSFER

Rapidly changing markets, tighter budgets, increasingly critical roles for technology, and new government and standards' requirements are issues that engineers and managers contend with daily. These factors require organizations to successfully select, adapt, introduce, and use new

technologies. Because of these factors, all organizations transfer in new technology at one time or another; many do so frequently. However, most organizations follow an ad hoc technology transfer process. Just as developing software through an ad hoc process leads to spending more money than is needed on software development, transferring technology through an ad hoc process also leads to spending money on technology that is never recouped from using that technology.

In all transfers, regardless of the technology, you can follow a similar overall process for technology transfer. That is, the general principles of what you do during a technology transfer will differ little; how you do it may differ quite a bit. For example, in selecting a computer-aided software engineering (CASE) tool or in selecting a new network protocol, you should talk to potential users to understand their needs and requirements. How you get their input may differ, but the fact that you should get their input does not. You can take the same defined technology transfer process and adapt it to each situation. This guidebook provides a defined technology transfer process that you can adapt and use in all your transfer situations.

.....

SPEED OF TECHNOLOGY CHANGE AND TECHNOLOGY TRANSFER

Technologies are changing at a dramatically faster rate than the rate at which organizations transfer and use them. This section recounts and compares studies on these rates of change in the software industry.

"... technological change in the computer industry is continually accelerating."
Bill Joy, cofounder of Sun Microsystems, Inc.

- **Speed of Technology Change.** The rate at which new software engineering-based products come into industry is increasing. The CASE market alone experienced tremendous growth during the late 1980s and early 1990s with a forecasted growth of \$1 billion in 1989 to over \$5 billion in 1995 (Software Productivity Group 1991). Competition for the growing market resulted in hundreds of CASE vendors, with no one vendor having more than 7.8% of the market in 1990 (Software Productivity Group 1991). Another example of fast technological change is the workstation market. Sun Microsystems, Inc., takes only an average of 18 months to introduce a new product that doubles the performance of the previous product—at relatively the same price (Stalk and Hout 1990). Bill Joy, one of Sun's founders, said that Sun's strength is in the "... recognition of a central truth: technological change in the computer industry is continually accelerating" (Stalk and Hout 1990).

It takes between 4 and 8 years for an organization to institutionalize a new technology.
R. R. Willis, 1983

- **Speed of Technology Transfer.** The classic mid-1980's study of the maturation of 14 software technologies by Redwine and his associates showed that, on average, it took about 18 years to go from seminal paper or prototype to the beginning of popular, commercialized use (Redwine and Riddle 1985; Redwine et al. 1984). During the same time

frame, reporting from a consumer point-of-view, Willis (1983) concluded that it took 6, plus or minus 2, years to transfer a complex technology completely into an organization. Bayer and Melone (1989) surveyed over 75 firms in 1989 on their experiences in adopting 5 software engineering innovations. They reported a wide disparity in the time it took different firms to start effectively using the same innovation; for example, one firm started using software cost models 22 years before another firm. The shortest time differential of any of the technologies studied—in this case, use of Ada—was still 6 years.

One way to keep up with technological change is to reduce the time it takes to transfer in new technologies.

- **Comparing the Speeds.** A great disparity exists between the average rate at which an organization transfers in a new technology and the average rate at which technology changes. In fact, if a company started to transfer a CASE tool now, that CASE tool would likely be obsolete by the time it was institutionalized. Also, if a company were to buy new computers this year, they run the real risk of faster, smaller, and cheaper computers being available next year.

Given all of this, you might find it hard to justify the cost of transferring in a new technology when waiting a year would bring a faster, better technology. However, if you do wait, you must assess the impact of delay on your competitive advantage, market share, or other business priorities and on the potential difficulty of transferring in the second generation of a technology without having assembled the experience from the first generation. In any case, one way of keeping up with technology change is to reduce the time it takes you to transfer technology. A goal of this guidebook is to do just that: to define a process for technology transfer that you can adopt and improve, shortening the time it takes you to use new technologies.

1.3 TRANSFER'S CRITICAL ROLE IN PROCESS IMPROVEMENT

Improving your organization's development process requires you to be successful at technology transfer.

Efforts toward improving an organization's development process have been receiving much publicity and attention. The Software Engineering Institute (SEI), under contract to the Department of Defense (DoD), developed a model, the Capability Maturity Model (CMM) (Paulk et al. 1991), against which an organization can measure the maturity of its software development process and against which DoD is measuring companies' abilities to bid on DoD contracts. Similar efforts are under way for the systems engineering and government acquisition processes.

The Evolutionary Spiral Process (ESP) (Software Productivity Consortium 1993a), a process for product development, strives to improve your situation as you progress through the development life cycle by continuously analyzing and managing your risk. Further, process groups focused on improving an organization's development processes, such as a Software Engineering Process Group (SEPG), are showing up in DoD contracting organizations around the United States.

Improving your organization's development processes involves the use of new technologies. For example, measurement programs and quality assurance programs must be instituted to move up to higher CMM levels. To increase your organization's chances of improving its development processes, an organization needs to increase its chances of successfully using new technologies.

.....

RELATIONSHIP OF TECHNOLOGY TRANSFER TO PROCESS IMPROVEMENT

Process improvement and technology transfer have the same high-level goal: to improve your organization's practices by changing the way the staff works. What differs is the focus. Process improvement focuses on the improvement of an entire process; technology transfer focuses on the improvement of a particular process area through use of a new technology. In fact, a process improvement effort will invoke several technology transfer efforts as it finds areas in the organization that need to use a new technology.

To implement and support this relationship, this guidebook and the *Managing Process Improvement: A Guidebook for Implementing Change* (Software Productivity Consortium 1993b) are integrated and have the same organization and format. The integration uses the following guidelines:

- **Similar Processes.** Since the high-level goal of process improvement and technology transfer is similar, the processes in each guidebook, including the activities and the ordering of the activities, are similar. What is different is the focus and scope of those activities.
- **Similar Guidance.** Each guidebook contains general guidance that applies to both processes and specific guidance that is tailored to each process; this latter guidance is what makes the guidebook unique to the problem that it is helping you solve. The guidance that is similar to both processes is repeated in both guidebooks to support standalone use.
- **Similar Appearance.** The two guidebooks intentionally have a similar organization and look-and-feel so that you can easily transition from one guidebook to the other.

1.4 ROADMAP TO THIS GUIDEBOOK

This section highlights initial guidebook assumptions; changes since the last version; guidebook contents; and audience of this guidebook.

INITIAL ASSUMPTION: WHERE DOES THIS GUIDEBOOK START?

This guidebook assumes that you or your organization has identified an opportunity to use a specific technology or a need that can be met by the

use of a new technology. For example, your organization may want to improve current configuration management practices or use the latest object-oriented design method.

.....

GUIDEBOOK ORGANIZATION

This guidebook is organized as follows:

- Section 1, Motivating Technology Transfer, justifies the use of a technology transfer process and gives you a roadmap to the guidebook's contents.
 - Section 2, Understanding the Technology Transfer Process, introduces the technology transfer process, introduces technology transfer concepts, and gives you the information you need to start and use the process guidance.
 - Sections 3 through 7 contain guidance for the five steps of the technology transfer process as follows:
 - Section 3, Look at Your Situation: Understand Context, helps you understand your internal and external environment regarding the transfer and define objectives and strategies for how to proceed.
 - Section 4, Choose the Right Path: Analyze Risks and Select Strategy, helps you understand the risks associated with the transfer and select the right strategy to follow.
 - Section 5, Focus the Transfer: Plan Technology Implementation, helps you plan the next step of the technology implementation.
 - Section 6, Getting it Done: Implement Technology, helps you implement the transfer as defined in the plan.
 - Section 7, Determine Where to Go Next: Review and Update Transfer Plan, helps you understand the results of the transfer to date and how to proceed based on the results.
 - Section 8, Improving Your Technology Transfer Process, provides general guidelines for how to become proactive in technology transfer.
 - The Appendix, Checklists for Applying the Technology Transfer Process, provides checklists that summarize the tasks you would perform in a technology transfer.
-

AUDIENCE

To clarify what sections you should read, Table 1-2 identifies generic audience types and the sections of this guidebook that each should read.

Keep in mind that at any one time you may fit the description of more than one audience type; for example, you may control resources as well as be a user of new technology.

Table 1-2. Guidebook Audience

Audience Type	Section				
	1	2	3 - 7 (Process)	8	A
Person implementing transfer	✓	✓	✓		✓
Person controlling resources	✓		✓		
Person advocating use of a technology	✓	✓	✓		
Person using technologies	✓		✓		
Person improving an organization's transfer process	✓	✓	✓	✓	

2. UNDERSTANDING THE TECHNOLOGY TRANSFER PROCESS

A competitive world has two possibilities for you. You can lose. Or, if you want to win, you can change.

Lester C. Thurow, Dean, MIT Sloan School of Management

Section Objective

Introduce and explain the technology transfer process

This section introduces the technology transfer process and concepts described in this guidebook and then provides hints, suggestions, and advice that you will use throughout the process. Read this section before you start using the process.

2.1 A TECHNOLOGY TRANSFER PROCESS

When planning technology transfer, it is natural to envision implementing a series of activities performed one after another. The planner is tempted to lay out a scheme of such activities joined by arrows with planned start and finish dates for each. Unfortunately, successful technology transfer never follows such a well-structured plan. Planners are unable to accurately foresee all of the dynamics that will shape actual accomplishment of process steps. Experience has shown that straight line (often called "waterfall") plans are ineffective.

Technology transfer activities and their completion dates cannot be accurately predicted. However, a well-structured and implementable plan can be developed by considering a set of core activities, planned and executed in an iterative manner, that successfully identifies the specific transfer steps to be accomplished and projected dates for completion. Figure 2-1 presents the steps. They are:

- Step 1: Understand Context
- Step 2: Analyze Risks and Select Strategy
- Step 3: Plan Technology Implementation
- Step 4: Implement Technology
- Step 5: Review Update Transfer Plan

The steps are illustrated as a spiral to portray how you cycle through these steps (clockwise movement around the diagram center) continually as you

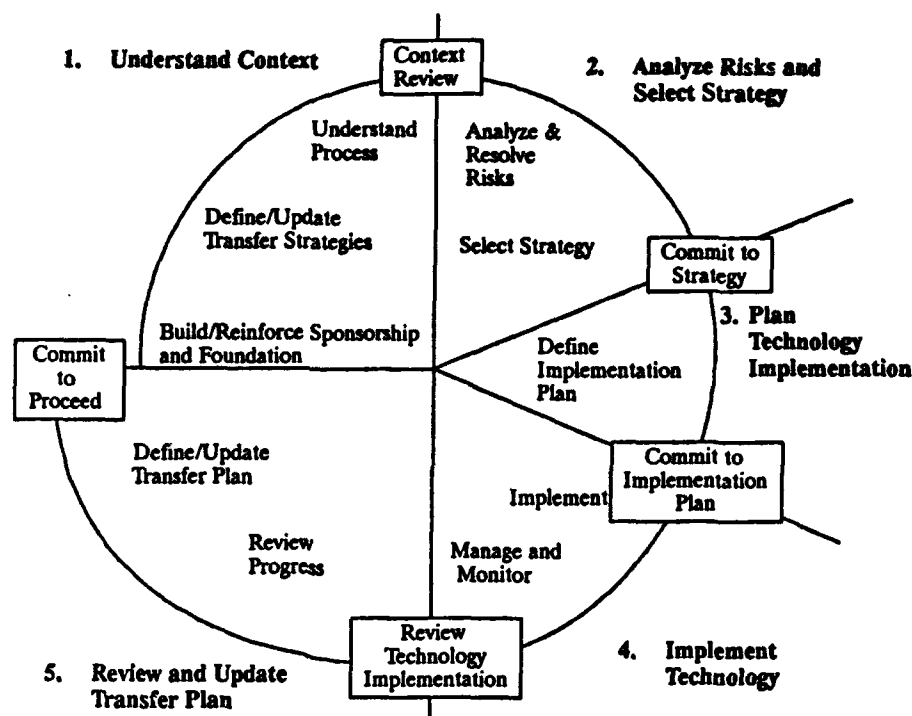


Figure 2-1. Technology Transfer Process

progress (moving away from the center of the diagram) toward your goal. In each cycle, you can accurately assess progress, identify alternative next steps, evaluate risks, and successfully plan the next increment. The plan recognizes that you may need to iterate (do two or more cycles) toward a given goal. For example, a pilot use of a technology may not have achieved all its objectives, and you may decide to devote another cycle to achieve a higher level of progress.

The remainder of this guidebook helps you structure your technology transfer process using this successful approach based on the ESP model (Software Productivity Consortium 1993a).

2.2 TECHNOLOGY TRANSFER SCENARIO

You perform a technology transfer by repeating the five steps, or one cycle, until the transfer is complete using the knowledge gained and lessons learned from previous cycles. Multiple cycles form a spiral: a spiral is one or more cycles that, when combined, accomplish a specific objective such as a complete technology transfer or other major milestone.

Figure 2-2 depicts a spiral (starting from the inside and growing out) that highlights the main activities of a typical technology transfer process using the process defined in this guidebook. Dotted and dashed lines are used to differentiate between the different cycles. This technology transfer process is based on the scenario that one or more staff members decide to pursue use of a new technology within their organization, starting without

management support. These staff members are the change agents. The rest of this section explains each cycle in the spiral.

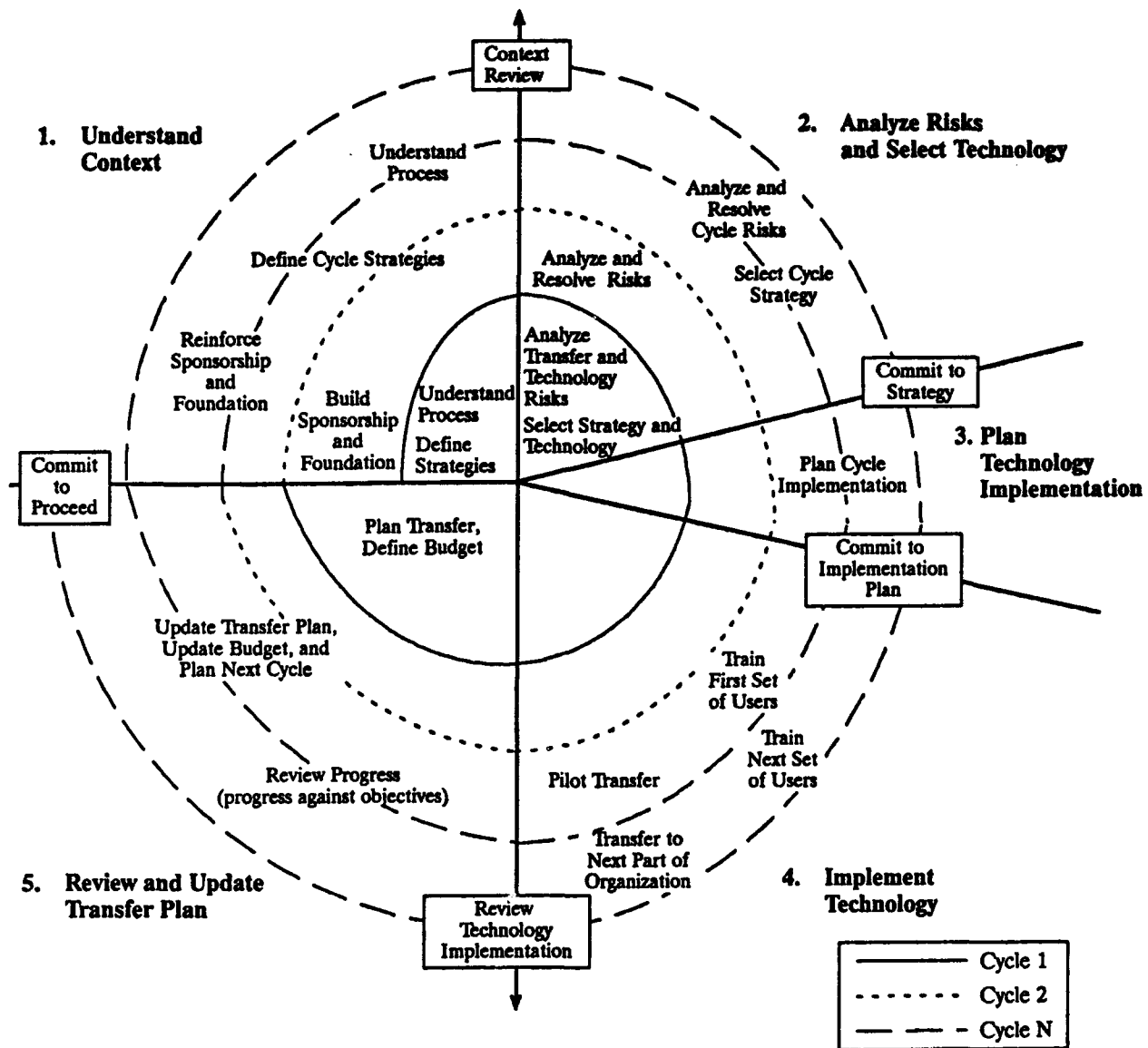
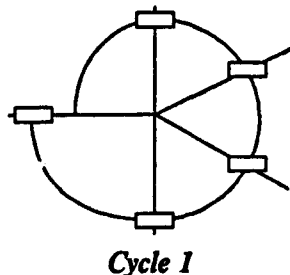


Figure 2-2. An Example of a Technology Transfer Process

CYCLE 1: PLAN TRANSFER



In Cycle 1, the goal of the change agents is to develop a plan for the transfer that they will use in Cycle 2 to get management support and funding. The activities in Cycle 1 are:

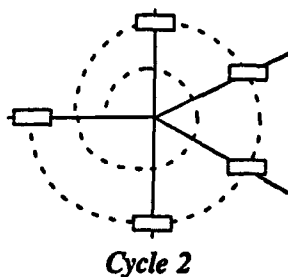
- Define alternative strategies based on an understanding of how the technology will affect the organization (Define Strategies and Understand Process in Step 1)

- Analyze risks and select a strategy to follow and a technology to transfer (Analyze Transfer and Technology Risks and Select Strategy and Technology in Step 2)
- Define a plan for how to proceed (Plan Transfer and Define Budget in Step 5)

Steps 3 and 4 are not performed in Cycle 1 because those steps focus on implementing the transfer, and the change agents are currently focused on developing an overall transfer plan.

At the commit activities (the activities in boxes at the end of each step) for Steps 1, 2, and 5 in Cycle 1, the change agents, along with any supporting champions, review and commit to proceed. At the end of Cycle 1, the change agents have a transfer plan detailing their strategy and plan for how to proceed.

CYCLE 2: BUILD SPONSORSHIP AND FOUNDATION



The change agent's goal in Cycle 2 is to get management support for the transfer based on the transfer plan and develop the necessary foundation to proceed with the transfer. The activities in Cycle 2 are:

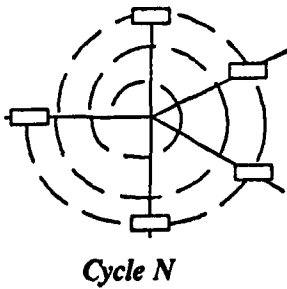
- Get explicit management support and funding, confirm or establish other roles for the transfer, and define alternative cycle strategies (Build Sponsorship and Foundation and Define Cycle Strategies in Step 1)
- Analyze and resolve risks based on the sponsorship and foundation built in the first step (Analyze and Resolve Risks in Step 2)
- Update plans and budget and plan the next cycle (Update Transfer Plan, Update Budget, and Plan Next Cycle in Step 5)

If, in Cycle 2, management wants changes to the transfer plan before they agree to support it, then the change agents may perform one or more cycles incorporating these changes and analyzing the risks of and getting buy-in to the modified plan. The change agents run a high risk of failure if they proceed without sponsorship.

Steps 3 and 4 are not performed in Cycle 2 because those steps focus on implementing the transfer and the change agents are currently focused on getting sponsorship and a foundation in place to support the transfer.

At the commit activities for Steps 1, 2, and 5 in Cycle 2, the supporting managers, the change agents, the end users, and the champions review and commit to proceed.

If the change agents had management support from the beginning, then they could have combined the guidance for Cycles 1 and 2.

CYCLE N: IMPLEMENT TRANSFER

From the third cycle on, the goal is to perform the actual transfer. By this time, the change agents have a plan for the transfer that everyone supports, and they have adequate management support and funding. In Figure 2-2, the third cycle is devoted to performing a pilot project of the transfer on a subset of the organization, and the fourth cycle expands use of the technology to more of the organization. The activities in these cycles are:

- Based on the results of the previous cycle, reinforce the sponsorship and supporting foundation, define alternative cycle strategies, and take another look at the process being changed by the technology to see whether any adjustments are needed (Reinforce Sponsorship and Foundation, Define Cycle Strategies, and Understand Process in Step 1)
- Analyze and resolve risks for the current cycle and select a cycle strategy (Analyze and Resolve Cycle Risks and Select Cycle Strategy in Step 2)
- Develop a detailed implementation plan for the part of the transfer to be performed in the current cycle (Plan Cycle Implementation in Step 3)
- Implement the transfer for the current cycle as defined in the cycle's implementation plan and monitor and manage the implementation (Train First Set of Users/Train Next Set of Users and Pilot Transfer/Transfer to Next Part of Organization in Step 4)
- Review the progress of the current cycle's implementation, update the transfer plan accordingly, and plan the next cycle (Review Progress, Update Transfer Plan, Update Budget, and Plan Next Cycle in Step 5)

At each commit activity in Cycle N, the supporting managers, the change agents, the end users, and the champions commit and review to proceed.

2.3 UNDERSTANDING TECHNOLOGY TRANSFER

Technology transfer can result in a positive change for the organization. People start using technologies that work better than what they had been using; productivity and morale increase; and, as people increase their skills base, they appreciate the organization's investment in them. New technology use also stimulates creativity as people see new ways of working and solving old problems. Though getting people to change can be difficult, once you establish a culture of change through successful technology transfers, people are eager for newer and better ways of working.

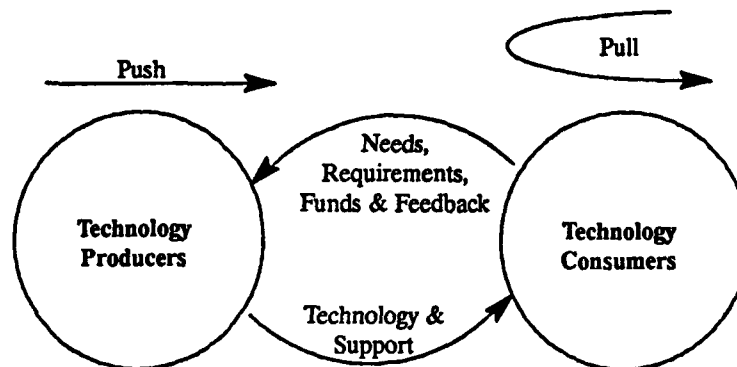
However, successful technology transfer depends on getting people to change the way they work. To do this, you need to understand and manage the change effort as it occurs, focusing on how the change affects each

person from their point of view. This section helps you understand technology transfer by describing the players involved, specific transfer influences, where you can put responsibility for technology transfer in your organization, and technology transfer success factors.

TECHNOLOGY TRANSFER PLAYERS: PRODUCERS AND CONSUMERS

Technology transfer typically involves many interactions among many organizations. Each of these organizations—whether a technology producer, a technology consumer, or other organization—pursues goals and forms relationships that affect the success of the transfer. Successful producers provide, evolve, and support technologies that match consumer needs, and successful consumers are willing and able to use new technologies. However, being successful at technology transfer usually presents difficult challenges (that are frequently not fully overcome). For most new technologies, central to overcoming these challenges is a cooperative, active relationship between the producer and consumer that involves an exchange of requirements, funds, products, services, and feedback.

In general, technology producers try to get consumers to use their products (technology push) while consumers look for a technology to solve their problem (requirements pull). These two kinds of actions, or goals, are depicted in Figure 2-3. For each player, the goal may be for either short- or long-term purposes.



Source: Adapted from Fowler and Przybylinski (1988).

Figure 2-3. Technology Transfer Producers and Consumers

TECHNOLOGY TRANSFER INFLUENCES

Technology transfer is affected and complicated by technological, human, and organizational influences.

- **Technological Influences.** The transfer of a technology is influenced by the technology's nature and maturity. The nature of the technology, which impacts the effort required for transfer, depends on the type of technology and its compatibility with the consumer's existing

environment. The maturity of a technology is reflected not only in the current stage of its life cycle (e.g., whether it is in research, initial use, or has been institutionalized within industry), but also in the producer's ability to provide adequate training and support and in industry's ability to provide related standards and integrated technologies.

- **Human Influences.** People problems are one of the most important areas in transfer and are typically least understood by engineers and managers. Producer personnel become enamored with technology and fail to understand what is really needed by the users. Consumer personnel frequently resist the change to a technology that they do not know or have strong ties to another technology (e.g., prefer one type of computer to another). Because of these influences, there will be strong champions and strong opponents in any transfer.
- **Organizational Influences.** Producers and consumers affect technology transfer by their organization's type, structure, culture, and politics. These influences affect the organization's ability to support the transfer, end users' willingness and ability to use the new technology, and management's willingness to take risks and try out new technologies.

PLACING RESPONSIBILITY FOR TECHNOLOGY TRANSFER IN YOUR ORGANIZATION

You can assign responsibility for technology transfer in several ways: on a case-by-case basis to an individual or temporary group (e.g., a grass-roots campaign), on a permanent basis to a technology transfer function, or on a permanent basis to an existing group. Table 2-1 highlights the advantages and disadvantages of each option.

Table 2-1. Technology Transfer Responsibility Options

Options	Advantages	Disadvantages
Case-by-Case Basis	Low to no overhead costs.	Process improvements, integration of strategy and approaches, and use of economies of scale and technology costs are all done on an ad hoc basis.
Technology Transfer Function	Lower technology costs due to economies of scale. Ensures integration of technology strategies and improvement of transfer process.	Higher overhead costs.
Assigned to Existing Group	Lower overhead costs. Allows for lower technology costs due to economies of scale, integration of technology strategies, and improvement of transfer process.	Group's existing responsibilities constrain their availability to focus on transfer issues.

WHAT MAKES TECHNOLOGY TRANSFER SUCCESSFUL?

Successful technology transfer depends on getting people to change the way they work. Usually, you can't be successful at getting people to change just by mandating it or by handing them a new technology and expecting them to use it. You have to show them, in detail, how the change will impact their work in the short- and long-term, ensure that they are motivated to change, and then support them throughout the transfer. Figure 2-4 lists factors that, if implemented, will improve your chances of successfully transferring technology.

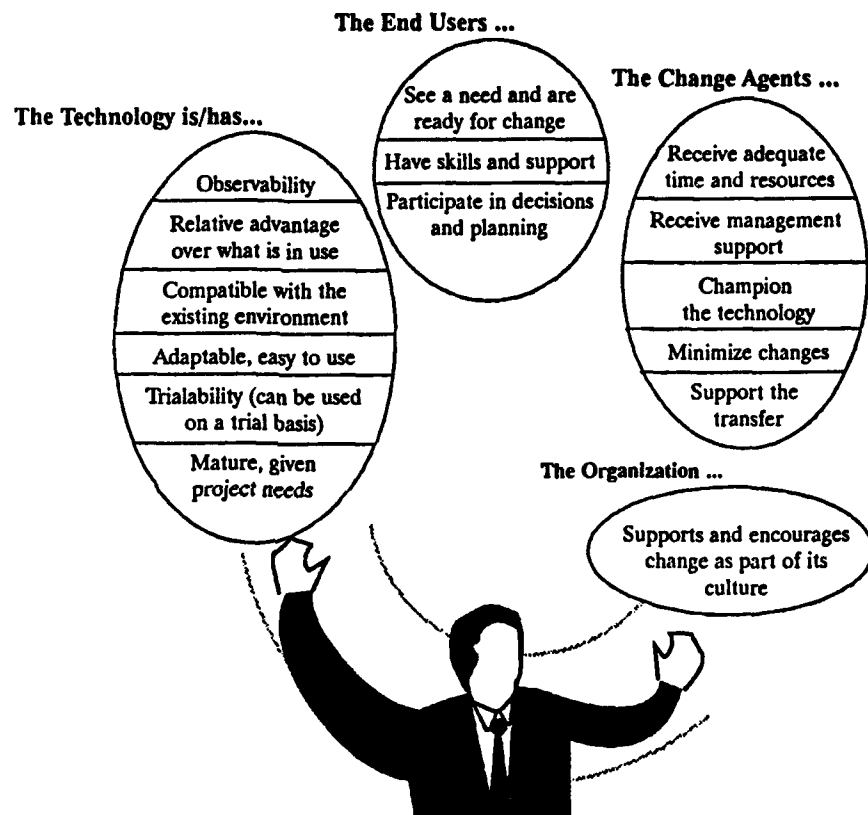


Figure 2-4. Success Factors in Technology Transfer

2.4 STARTING AND PLANNING A TECHNOLOGY TRANSFER

You should apply the following guidance when starting a technology transfer and during subsequent planning activities.

- **Needed Commitment.** Your sponsors need to understand that if they attempt a transfer and fail, they incur the following costs (adapted from Implementation Management Associates 1992):
 - **Short-Term Costs.** Direct costs include wasted resources and failure to achieve a stated business objective. Indirectly, staff morale suffers because they may have invested their own time and energy in a failed transfer.

- **Long-Term Costs.** If management commits to something that fails, then the staff will potentially have less confidence in management's leadership ability and will increase their resistance to the next transfer that they are asked to support.

To avoid these costs, your sponsors need to support the transfer throughout the entire process. They cannot give the transfer lip service only, expect it to succeed, and not expect any repercussions when it fails. If there is any doubt about whether you will receive ongoing support, then you should get new sponsors or delay the transfer until you receive support. Otherwise, the transfer may fail.

- **Cost and Schedule.** Most technology transfers are expensive. If you are tight on resources, then you can possibly make up for it in the beginning by stretching out your schedule, but there will come a time when management will have to provide adequate resources. If you are limited on time and resources (and cannot change the situation), the best guidance is to delay the transfer until your situation improves.
- **Timing.** Organizations perform work and for the most part can only perform work when they have a stable environment. If at all possible, time the transfer to occur at the beginning of an effort or at a major transition point when people are able to absorb technology changes better. It is nearly impossible to get an existing project to change, especially when it is in the middle of schedule and resource crunches.
- **Activity Duration.** Perform the transfer activities as rapidly as possible by performing activities and tasks concurrently. This might mean trading elegance and perfection for speed. For example, a market analysis completed in a week that is 65% correct provides more value than an 80% correct product done in a month.
- **Cycle Duration.** The length of a cycle will depend on your situation. However, you can use the following rules of thumb when planning a cycle:
 - The more people involved in the current cycle, the shorter the cycle should be because of the higher probability that risks will occur.
 - The more comfortable your organization is with the activities planned for the cycle (e.g., training), the longer the cycle can be because your organization already knows how to mitigate most of the risks.

One possibility is to time the cycles to correlate with your reporting cycle; for example, if management wants to see a progress report every 3 months, then you can time your cycles to be approximately 3 months in length.

- **Resources.** Variations in required resources are due to the increasing levels of impact on existing practices of each technology type. In general, the following are true:
 - Transferring in a tool alone will take the least amount of resources
 - Transferring in a method alone will take more resources
 - Transferring in a tool and associated method together will take even more resources
 - Transferring in a system or software development life-cycle process will take the most resources.

Example 2-1 describes how different transfers can be tailored.

Joe Dalton, System Manager for Apex Manufacturing, wants to implement three new technologies in the forthcoming year. One is a word processing program, the second a new electronic mail system (there is currently no E-mail system in the company), and the third a new method for doing software testing. Joe presents a proposal to his chief operating officer, Mr. Harry Hardnose, to provide 16 hours of training for all affected staff on each technology and a 1/2-time staff person for internal help for each technology.

Hardnose is clearly not pleased with this proposal. "You're going to introduce a new testing methodology with only 16 hours of training for the staff?," he sneers.

Joe tries to defend himself, "But we do testing now and this shouldn't be much different."

Hardnose can hardly contain his laughter. "And we're going to take the entire company off-line for 2 days to learn how to send recipes and memos faster?," Hardnose asks.

Joe replies, "Well, I didn't want anyone to feel left out." Hardnose tells Joe he'd better have a more appropriate implementation plan on his desk in the morning.

Upon reflection, Joe realizes that the new version word processor is a relatively minor implementation activity because there is already a previous version in place. Therefore, he plans a 1-hour training program and distribution of the latest documentation.

Implementation of the new E-mail system is somewhat larger, though still compatible with the existing cultural practices and organization of the company. This will require a 2-hour training program, supplemented by implementation assistance and an ongoing program for several months to work out bugs in operation.

The implementation of the new testing method can potentially cause major disruptions. Joe expects that he will need several days of off-site training for the technical staff and a consultant to redesign jobs and job descriptions of the technical and support staff. It is likely that some adjustments will need to be made in other software engineering methods and tools in use. In addition, project managers will need 4 to 6 hours of training. The whole implementation is expected to take several months.

Joe presents his new proposal to Mr. Hardnose who accepts it, but without a smile or other sign of pleasure. Some people just have to live up to their name!

Example 2-1. A Case of Tailoring Technology Transfer Resources

2.5 USING THE TECHNOLOGY TRANSFER PROCESS

This section explains how the technology transfer process is described in Sections 3 through 7 and provides guidelines on how to use the process.

.....

WHO SHOULD PERFORM THE ACTIVITIES?

Since staff at any level in an organization can play a role in technology transfer, this guidebook defines generic roles, with corresponding icons, for the activities. To use these role definitions, identify your role(s) and follow the guidance when the corresponding icon appears in the margin. Refer to *Managing Process Improvement: A Guidebook for Implementing Change* (Software Productivity Consortium 1993b) for clarification on Process Groups, Steering Committees, and Process Action Teams.



- **Sponsor.** This person possesses sufficient authority or influence to either initiate resource commitment (authorizing sponsor) or continually reinforce the transfer at the local level (reinforcing sponsor). The sponsor is usually at a senior management level. If the transfer is part of a process improvement effort, then this role is usually filled by a Process Group for technical issues and by a Steering Committee for budget and business-related issues.



- **Change Agent.** This person or team, empowered by the sponsor, performs the technology transfer activities. The change agent should have some technical experience, be respected for personal or technical leadership, and have insight into the technology and business strategy of the organization. If the transfer is part of a process improvement effort, then this role is usually filled by Process Action Teams.



- **Champion.** This person advocates and publicly supports use of the new technology in the organization, though lacks power to provide resources to support it. A champion can be present at any level of an organization; successful ones are usually respected for personal or technical leadership by the users. If the transfer is part of a process improvement effort, this role may include the Process Group.



- **End User.** This person or group uses the new technology. The end user can be present at all levels of an organization.

An individual's role may evolve and overlap during the transfer. For example, a middle manager may initially be the change agent and then become a reinforcing sponsor as additional staff are brought in to fill the change agent role.

In addition, the guidebook refers to the role stakeholders. Stakeholders are people who are involved with and affected by the change. Stakeholders include the sponsors, champions, end users, and change agents.

.....

KEY ASSUMPTION: PLACING YOU IN THE PROCESS

There are countless ways that you can perform a transfer using this process. Your role, the technology you want to transfer, and your organization's environment and culture all affect your focus and scope for the activities. Because of the wide range of possibilities, the guidance in the process, based on the scenario outlined in Section 2.2, uses the following strategy for each cycle:

- *Cycle 1.* Your objective in Cycle 1 is to develop a transfer plan that you can use to sell all stakeholders on the transfer.
- *Cycle 2.* Your objective in Cycle 2 is to get the necessary managers to sponsor the transfer and to get a foundation in place to support the transfer.
- *Cycle N.* For the remaining cycles, your objective is to transfer the technology.

Following this cyclic strategy approach gives you a baseline against which to understand the process guidance. If your situation is different from the baseline, then you can tailor the guidance appropriately. For each set of guidance, the corresponding cycle number is indicated in the lefthand column.

The only situation you may have that will greatly deviate from this cyclic strategy approach is having the necessary management support from the beginning. In this case, you can integrate the strategies and the guidance for Cycles 1 and 2. In the first cycle, then, you will develop a plan and get support from other stakeholders at the same time.

Though you will be performing the process a cycle at a time, the process is organized by activity and task. This was done to group related guidance together and to support tailoring. However, the Appendix provides a summary of the guidance ordered by cycle. The summary is in checklist format, allowing you to check off the tasks as you perform them.

.....

THINGS TO KNOW BEFORE USING THE PROCESS

Understand the following before you use this guidebook:

- The process guidance focuses on the group or individual performing the transfer activities (the change agents). Other roles in the process are included when they are involved in the task.

- You can perform each activity using various organizational structures and styles including formal team meetings, informal group meetings, or work by individuals. How you perform each activity depends on your own style and your organization's culture.
- You need to generate an electronic or paper trail on your analyses, decisions, rationales, and implementation efforts. Many activities do not prescribe a specific documentation type (e.g., a formal plan)—the type of document you create is up to you and your management.
- Use existing data and knowledge wherever possible. In technology areas that change rapidly, be careful of data over 2 to 3 years old.
- You may not perform each activity in each cycle. For example, in the first two cycles where you are focused on getting sponsorship and realistic plans in place, you will not perform the Implement activity.
- The list of stakeholders at each commit activity may change. This affects the amount of time and resources needed to get commitment.

.....

HOW ARE THE ACTIVITIES FORMATTED?

Figure 2-5 presents the format of activity descriptions. Each description contains a context diagram in the upper lefthand corner that serves as a pointer to the process diagram (see Figure 2-1). For each activity, the corresponding step in the process diagram is shaded.

Activities in Sections 3 through 7 may contain case studies, in the form of examples, that illustrate the guidance in the activity. They are based on real situations; however, specific names have been changed to protect proprietary information.

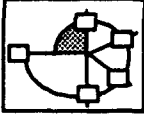
Name of Activity	
	A statement describing the step containing this activity.
Overview	Provides an overview of the activity.
Start Criteria	Provides criteria and inputs that must be met before the activity can start.
Tasks	Provides a detailed description of the tasks that should be performed in this activity.
	Who should perform each task is indicated by a role icon placed next to the first line of each task. There is an icon-to-role mapping at the bottom of each page.
<i>Cycle N</i>	The cycle in which you would follow this guidance is indicated in the left margin as needed.
Stop Criteria	Provides criteria and outputs that must be met before the activity can finish.
	

Figure 2-5. Activity Format

3. LOOK AT YOUR SITUATION: UNDERSTAND CONTEXT

Excellent firms don't believe in excellence—only in constant improvement and constant change.

Tom Peters

Section Objectives

1. *Provide guidance for understanding how your environment will impact the transfer*

2. *Provide guidance for defining an appropriate transfer strategy*

For any technology transfer to succeed you need to build sponsorship and a support structure, identify a strategy that all stakeholders buy in to, and understand the current process to be changed. Figure 3-1 shows the four activities described in this section:

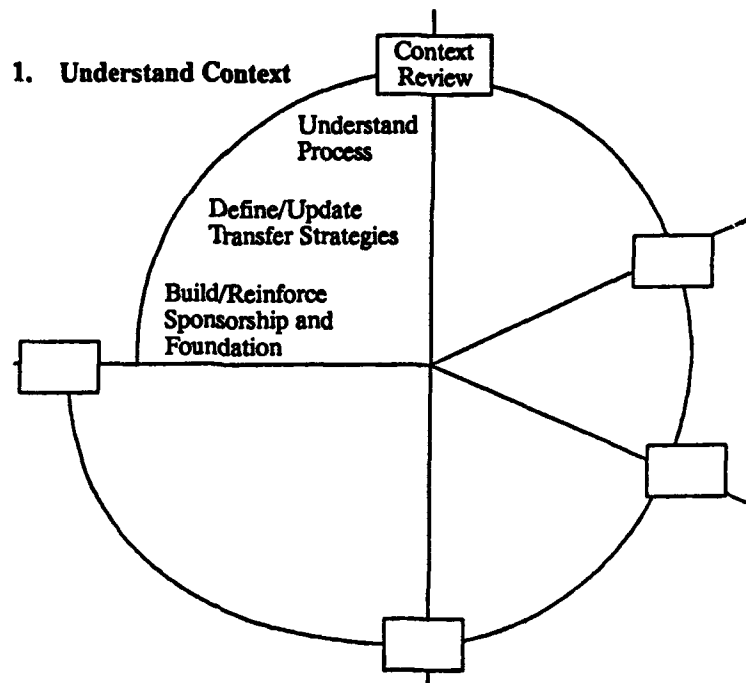
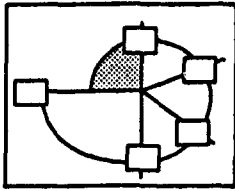


Figure 3-1. Understand Context Activities

You will not perform the activities within the circle linearly; rather they will share and depend on information from each other. You will not perform the Context Review activity until after you have completed the other activities.

3.1 BUILD/REINFORCE SPONSORSHIP AND FOUNDATION



OVERVIEW

This activity begins in Step 1, Understand Context.

.....

Your objective in this activity is twofold: ensure that you have a foundation in place and ready for the transfer and ensure that you have sponsorship for the transfer.

A foundation comprises champions, change agents, and end users ready to use the new technology. Champions are needed to advocate the transfer publicly and keep people supportive by constantly reinforcing the benefits of the technology. Change agents are needed to perform the day-to-day tasks of support, implementation, planning, managing, and review. The end users need to be ready for the transfer and be adequately trained and supported.

Sponsorship is a critical element in any effort that requires all or part of the organization to change and needs to be obtained as early in the transfer as possible.

.....

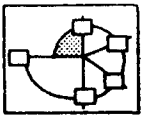
START CRITERIA

You should use information and/or working knowledge on the following items as inputs to this activity:

- Any related, supporting documents, including a process improvement action plan and any organizational strategic plans
 - If a continuing transfer, the transfer planning documents created and updated in previous cycles, including the transfer plan, risk management plan, implementation plan, and influence strategy
 - Any historical transfer information
-

TASKS

You will identify the change agents and the champions for the transfer; understand who the end users will be for the transfer and/or cycle and their readiness to change; identify sponsors and get their support for the transfer; and prepare/update and implement an influence strategy.



1. Build/Reinforce Transfer Support Staff (change agents and champions).

To start a new transfer or to continue an in-process transfer, you need to make sure that you have the support of change agents and champions.

Cycle 1

In Cycle 1, you will plan the support staff you need in the transfer plan. Guidance on planning for change agents and champions follows:

- **Change Agents.** An effective change agent will have project management experience, including excellent organizational, human relations, and communication skills. The change agent should be capable of standing up for the transfer in the face of adversity and have enough experience to understand the informal and formal workings of the organization. For example, the change agent should have a personal network to leverage in the transfer and understand how the different groups within the organization interact.

The number of change agents you need depends on the level of impact the technology will have and the number of end users. You need change agents to perform the following functions:

- Plan the transfer and the implementation
 - Sell the transfer and implementation to all staff and management involved or impacted by the transfer (the stakeholders)
 - Train the end users in the new technology
 - Integrate the new technology into the organization's cultural and technical environment
 - Provide technical support to the end users
 - Manage and collect data on the implementation
 - Review the progress against the plan
- **Champions.** Champions are needed to advocate the transfer publicly and keep people supportive by constantly reinforcing the benefits of the technology. When identifying champions, quality is more important than quantity (though quantity does not hurt). To find champions, you should ask management and staff in the organization, especially the affected parts of the organization, to identify staff who are:
 - Well respected for personal and technical leadership
 - Technical experts in the particular technology area
 - Risk takers when it comes to trying new technology

\$ Sponsor



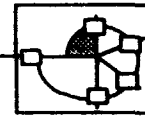
Change Agent



Champion



End User



Cycle 2 You need to get the change agents and champions identified in the transfer plan to buy in to the technology and the transfer. You need a support team that works well together. Good teamwork stems from each change agent and champion communicating equally, participating equally, and feeling they all provide equal value to the team.

You should use your influence strategy (see Task 4 in this activity) to sell the identified change agents and champions on the transfer and obtain their buy-in to support your efforts.

Cycle N For subsequent cycles, you need to reinforce continued support from all identified change agents and champions.



2. Identify End Users and Assess/Reinforce Their Readiness to Change. You need to identify alternatives for which organization unit(s) will use the new technology and then assess whether they are ready for the change.

Alternatives for which end-user group to choose will be heavily impacted by your sponsorship status. Those target units with managers that strongly support the transfer should be alternatives for the transfer early in the process; those with managers who are wavering or opposed to the transfer should be planned for later, after some success has been achieved. Because of this relationship, you will perform this task in parallel with Task 3, Build/Reinforce Sponsorship.

Cycle 1 Identify end users that are open to trying new technologies; have a need for the technology; are not in the middle of a busy period; and are at the beginning of a project or at a major milestone, giving them more freedom to change.

Get an initial understanding of whether the end users are ready for change by talking with managers and staff in the target unit to get their initial reaction to the transfer. You want to describe the area that you intend to improve with the new technology, their expected role in the transfer, how they will be impacted, the expected benefits of the transfer, and the expected transfer process. Clarify that all of this information is preliminary. In addition, get their input on technologies they would recommend and strategies for how to proceed. This should not be a full-scale assessment of their readiness; rather, the purpose of this is to initially understand whether the end-users are ready for the transfer and to start getting buy-in to the transfer.

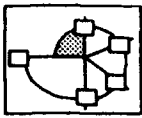
Cycle 2 In Cycle 1, you need to get buy-in from the end users as well as assess their readiness for change. To get buy-in, you can use the influence strategy developed in Task 4 of this activity.

\$ Sponsor

 Change Agent

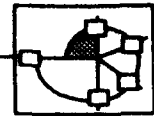
 Champion

 End User



To assess the end users' readiness for change, you must understand the atmosphere of the end users' organization, indicated by both the organization's history of change and the stress of individuals within the organization (Implementation Management Associates 1992). You will:

- Examine prior technology change efforts to help you understand end-user attitudes about change. Successful change experiences will increase receptiveness to the transfer, and you can proceed without worrying about this issue; in fact, you can possibly speed up the transfer schedule because you may have to spend less time gaining buy-in. Negative change experiences can greatly decrease your chances of success. Therefore, you should plan on spending at least one cycle describing the transfer and the resulting benefits to the end users, focusing on the expected immediate and long-term impact.
- Understand the make-up of the organizational unit and how that might affect the transfer. Are there political problems that might affect the transfer? For example, does the manager of the technical support group disagree with the transfer? If so, then that manager may not be willing to allocate the necessary resources to help integration and technical support for the end users and you need to spend time selling the transfer. Political problems that might affect the transfer should be captured either in the transfer constraints or categorized as a risk in the Analyze and Resolve Risks activity.
- Understand the level of stress in the organization due to other, parallel change efforts. Staff can only absorb so much change and stay productive; too much change will cause them to reject all change. If there are other changes going on at the same time, you should delay the transfer until the other changes have settled down. If you cannot delay the transfer, then you should include this issue as a high risk item in the Analyze and Resolve Risks activity and make management aware that too much change is occurring at the same time.
- Look at the expectations of the target unit that will use the new technology. Do they perceive a need for the change or is the change being forced on them? If the end users do not perceive a need for the change, then you should devote at least one cycle describing the change, the benefits, and the immediate and long-term impact on the end users.
- Determine whether the end users have the required resources to learn and use the technology. If they do not, then you need to solicit the end users' managers, your managers, and the sponsors for the transfer to get the required resources. You run a high risk of failure if the end users do not have the resources to learn and use the new technology—you will not get them to perform these tasks on their own time.



- Assess whether the end users have the required skills to benefit from available training. If not, then you will need to spend additional time training or you will need to bring in people from the outside to fill in the skill gaps.

A negative response to any one item in the bulleted list is enough to cause the transfer to fail. It is important to identify high risk areas now before a lot of effort is expended on the transfer. However, you have to determine whether to proceed based on your own situation. If you have no choice but to proceed, capture these items as risks in the Analyze and Resolve Risks activity and call management attention to them that way. Conversely, if you decide that the end users are not ready for the change and you have control over the transfer, you should delay the transfer until they are ready, find another set of end users, or discontinue the transfer.

As you assess the end users for their readiness to change, use the opportunity to inform them about the impending transfer and get their feedback and comments. This will start getting their buy-in to the transfer.

Cycle N In subsequent cycles, you will need to determine whether additional or different parts of the organization will use the technology in this cycle. Whether or not the end users have changed or expanded, you need to reassess their readiness for change because their environment or makeup may have changed. For example, other change efforts may have been invoked since the last cycle, or the staffing may have changed.



3. Build/Reinforce Sponsorship. You need to identify the sponsors for the transfer. Authorizing sponsors initiate resource commitment for technology transfer; reinforcing sponsors reinforce transfer efforts within their own organizational area. Sponsors provide funding and resources for the transfer and publicly support the transfer to the rest of the organization. Change agents and champions cannot substitute for the sponsor. You need to have a sponsor in each of the areas of the organization affected by the transfer. The following list contains guidance on sponsorship that applies to the entire transfer:

- Sponsors are most effective if they have excellent management and leadership skills to address both the technical and human aspects of change and to articulate the organization's vision and how this transfer supports that vision.
- If the transfer is part of a process improvement effort, then the authorizing sponsor is likely the Process Group or the Steering Committee.

\$ Sponsor



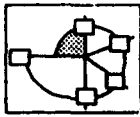
Change Agent



Champion



End User



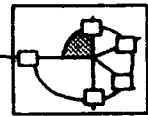
- Sponsors need to continually sanction the transfer publicly and demonstrate this commitment to everyone in their organization.
- Sponsors are most effective when they can understand the different perspectives all levels in the organization will have on the transfer. For example, the realities of the transfer in day-to-day life will be drastically different between the engineer and senior manager; sponsors need to understand this and be able to alleviate the concerns of all perspectives.

If there is any doubt about whether sponsorship can be sustained throughout the transfer, then you run a high risk of implementation failure, which incurs short-term costs (e.g., wasted resources) and long-term costs (e.g., reduced confidence in leadership and staff's lack of desire to support future changes). Your options at this time are to educate your sponsors to get strong support, get new sponsors, stop the transfer, or fail.

The approach you take to getting sponsorship will depend on how your organization makes decisions and on the technology's characteristics:

- Your organization may make decisions in many different ways:
 - A single, senior manager always uses the hammer approach to get others to comply. In this first scenario, you need to target the single, senior manager as your authorizing sponsor.
 - Managers make their own decision in a vacuum. In this scenario, you need to obtain sponsorship commitment from all involved managers individually.
 - There is cooperative involvement in the decision to support or not support the transfer. In this scenario, you can get input from all managers on the best way to sponsor and proceed with the transfer (e.g., which area will pilot the technology), ensuring cooperative buy-in to the transfer.
- The technology's characteristics may make one decision-making approach more appropriate than another. For example, a simple technology with minimal impact may be decided upon by a single manager and transferred through mandate; however, in practice, few technologies are this simple and an authoritarian approach often backfires. In contrast, a technology that involves extensive changes should be decided on in a much more participative, extensive manner and you should seek sponsors from all involved areas.

Cycle 1 In the first cycle, you need to identify an authorizing sponsor for the transfer. The authorizing sponsor can usually be identified by looking at the original impetus for the transfer (see Task 3 in the Define/Update Transfer Strategies activity), as follows:



- If the transfer is a management request, then the authorizing sponsor will either be the requesting manager or another manager designated by the requesting manager.
- If the transfer is a staff, or grass-roots, request, then you need to start identifying potential authorizing sponsors. The best place to start is the management of the staff members requesting the transfer, your managers, or the managers of internal technical groups (e.g., an internal research and development group).

After identifying an authorizing sponsor, you need to identify reinforcing sponsors. Reinforcing sponsors should include the managers of all of groups affected by the transfer. In addition, in case of reorganizations or shifts in responsibility, you should try to get as many managers to support the transfer as possible. It is important to get managers of all end users, champions, and change agents to support the transfer.

If you have management sponsorship at the beginning of the transfer, then you can combine the guidance for this cycle with the next.

Cycle 2 In the second cycle, you need to get the sponsors you identified in the first cycle to support the transfer based on your transfer plan. This means getting all yeses and no noes—even just one of the identified sponsors can throw a monkey wrench into the transfer if they do not support your efforts. You can use the influence strategy described in Task 4 of this activity to help get their sponsorship.

Cycle N For subsequent cycles, you need to reinforce continued sponsorship from all identified sponsors.



4. Prepare/Update and Implement Influence Strategy. There are winners and losers in any transfer. This fact makes transfers difficult and emotional and necessitates preparing a deliberate influence strategy. An influence strategy is a formal or informal, written or unwritten strategy for gaining buy-in from appropriate management and staff on the technology and its use within the organization. The influence strategy prepared in this activity will be used throughout the technology transfer process each time you need to get commitment and buy-in to the transfer from any stakeholder.

Technology transfer involves a series of decisions, starting with the change agents or authorizing sponsors as they decide to begin the transfer and continuing to each stakeholder as they decide to support or not support their role in the transfer. Deciding not to transfer is a decision that can be made by one person; if that person controls a key resource, then your transfer is put at a high risk. You need to realize that deciding to transfer

\$ Sponsor



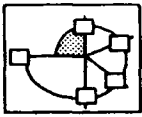
Change Agent



Champion



End User



involves getting many “yeses” and no “noes.” If you do get a “no,” talk to the person to understand their reasons for deciding against the transfer and diffuse their concerns. Another possible, yet less desirable, option is to continue with the transfer (though this may be impossible if the person is crucial to its success). In any case, you need to keep all of these factors in mind as you develop your influence strategies.

If the transfer is the direct result of an organizational process improvement effort, then you will likely be coming into the transfer with adequate management support. However, support will be for a process improvement effort and not necessarily for the use of a specific technology on a specific project. Therefore, you need to develop an influence strategy that focuses more on the benefits of the technology than on the need for the transfer itself and focuses more on the end users than on management.

Cycle 1

In Cycle 1, you will plan who should be your end users, sponsors, change agents, and champions (see the first three tasks in this activity). You should develop an influence strategy based on those plans, but realize that, as your plans change, your influence strategy might also need to change. To prepare an influence strategy, you will:

- **Identify stakeholders.** Identify all of the stakeholders. This information will come primarily from the results of performing the first three tasks in this activity; however, there are real and potential stakeholders that are not directly involved in the transfer. For example, if the technology directly affects a customer or supplier, then you should include them as a stakeholder. You may group the stakeholders together based on their position in the organization and/or their role in the transfer.
- **Identify stakeholder frame of reference.** For each stakeholder or stakeholder group, identify why they should support the transfer and what the change will mean to them. When you are identifying what will and will not change for each stakeholder, do so from their frame of reference, not from yours.
- **Understand stakeholder relationships.** Consider the organizational structure scenarios in Figure 3-2 and identify which one applies to your situation. The following list describes each scenario and how it may impact the transfer (Conner 1993).
 - **Scenario 1.** This is the typical hierarchical organization. The sponsor may successfully cascade some sponsorship duties to the change agent. The end users view the change agents as an extension of the sponsor.
 - **Scenario 2.** If the sponsor delegates sponsorship duties to the change agents, the end users are more likely to resist. For this structure to be successful, the sponsor needs to emphasize commitment to the transfer and introduce the change agents as the group chosen to lead

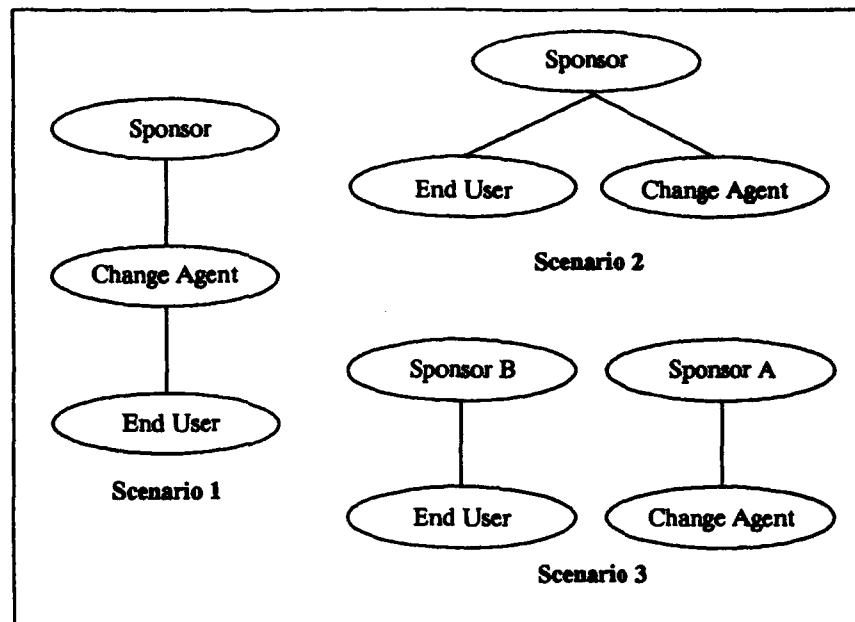
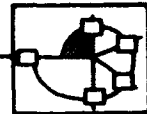
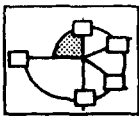


Figure 3-2. Role Relationships

the effort. This demonstrates sponsor commitment and will reduce the end users' resistance.

- **Scenario 3.** This structure poses a challenge. If Sponsor A and the change agent want any glimmer of success, they must convince the end users' sponsor, Sponsor B, that the transfer is imperative. Until this is accomplished, the end users will resist.
- **Develop an influence campaign.** Prepare a formal and/or informal influence campaign. The theme of the campaign should highlight how the transfer will satisfy the needs of the organization and how to get the organization to support the transfer. The campaign should:
 - Determine when each stakeholder should be approached to "talk up" the transfer, given the stakeholder's role in the transfer and the way decisions are made in your organization.
 - Explain why each stakeholder should use the new technology and what the impact is on them. Your arguments must include near-term as well as long-term implications of using the technology.
 - Describe the logistics approach, including who will deliver the message, how it will be delivered, frequency of the publicity, and in what order the stakeholders will be approached.
 - Be clear and honest about the technology and the transfer process, including training and support. Have satisfied users talk with new users to allay their concerns. Describe when the transfer will be taking place and when it will be affecting each stakeholder group.



In your campaign, use your informal network (the “grapevine”) as early and as often as it makes sense to build up awareness and support for the transfer. Be honest but upbeat about the impacts and benefits of the technology. Operate the campaign on both informal and formal fronts. For example, campaign in quiet meetings over lunch.

Cycle 2 Using the influence strategy you developed in Cycle 1, get buy-in from the stakeholders. You may need to modify the influence strategy based on the results of Cycle 1.

Cycle N Throughout the transfer, you need to continuously sell the transfer and influence others to buy in to the transfer. This will help the success of the transfer and will make your commitment milestones easier to achieve. As you obtain lessons learned throughout the transfer, or as your environment changes, you should update your influence strategy accordingly.

Example 3-1 describes how one manager had to initiate a bottom-up campaign to influence his managers to transfer a technology.

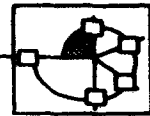
J. P. Heartless, the manager of the Advanced Technology Group (ATG) at Defenseless Systems has responsibility for the transfer of an advanced software system, known as SMAK-B. SMAK-B was developed at considerable company expense, and management would like to see some payback from internal transfer. The system is colloquially referred to as a “Super Macro-processor with a Knowledge Base.” These macros can access powerful pattern matching capabilities that make SMAK-B ideal for building specification languages that can automatically generate applications software and construct language-to-language translators.

After experiencing less than limited success explaining the system to senior management in various divisions, Heartless adopts a somewhat different approach to influencing transfer decisions. Using informal and social networking techniques, he identifies several engineers who have a problem that is amenable to a SMAK-B based solution. Heartless works with each engineer to develop a rapid prototype of a solution that demonstrates the capability of SMAK-B in a context that will be understandable by the engineer’s supervisors. For example, in just a few days one of his staff has worked with an application engineer (Mr. S. Northon Sniffle) to build a system that will automatically construct test programs for an advanced but highly minaturized missile system.

Once the prototype is functioning adequately, Heartless and Sniffle schedule a meeting with the boss (Edgar Wheeze). The intent is to win approval for widespread and permanent adoption of SMAK-B as the solution to the problem. This interaction is supported by results the rapid prototype and the testimonial support of the engineer. Wheeze agrees with Sniffles recommendation and the transfer proceeds.

This kind of “bottom-up” approach is replicated elsewhere and results in numerous and positive transfer decisions in various divisions in the company.

Example 3-1. A Case of a Bottom-Up Influence Approach

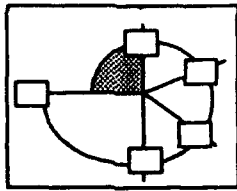


STOP CRITERIA

You will stop this activity when:

- You have identified sponsors, champions, change agents, and end users and understand their readiness and willingness to support the transfer
- You have prepared an influence strategy

3.2 DEFINE/UPDATE TRANSFER STRATEGIES



OVERVIEW

This activity begins in Step 1, Understand Context.

.....

Your objectives in this activity are to develop transfer and/or cycle objectives, alternative strategies, and constraints and identify alternative technologies that are consistent with the needs and current environment of your organization.

In this activity, you may provide retrospective validation for decisions that have already been made. It is also especially important that you document your progress in this activity, since your situation may change rapidly or be perceived differently by different people.

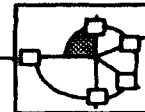
The first two tasks in this activity, together, represent an extensive examination of your environment. Given your current situation (e.g., the technology is already selected, limited resources to perform examination), you may want to prioritize these tasks and/or only briefly touch on some of them. However, each task discusses an area that can impact the transfer and should therefore not be completely skipped.

.....

START CRITERIA

You should try to use information that is already available and supplement it with information that you solicit from interactions with users, peers, producers, and the research and development community. You should use the following types of information and/or knowledge as inputs to this activity:

- Internal environment information, including any strategic plans, process improvement documents, descriptions of computing facilities, and analysis of your organization's work force (e.g., skills)
 - External environment information including existing organizational documents on technologies (e.g., trip reports, benchmark studies); market surveys; comparison data with peer organizations; competitor information; and relevant laws, regulations, or standards
 - If a continuing transfer, the transfer planning documents created and updated in previous cycles, including the transfer plan, risk management plan, implementation plan, and influence strategy
 - Any historical transfer information
-



TASKS

You will examine external and internal environments for potential influences on the transfer; understand the reason for the transfer; define the transfer and/or cycle objectives, alternative strategies, and constraints; when appropriate, identify technology alternatives; and identify a strategy for how to proceed with the transfer.



1. Examine External Environment. To define an effective transfer strategy, you need to examine your external environment to identify potential influences on the transfer.

This task provides guidance for an extensive examination of your environment. If you are limited on resources, then you may want to prioritize the areas you examine and/or only briefly touch on some of them. However, each area discussed can impact the transfer and should therefore not be completely skipped.

Cycle 1 In the first cycle, you need to examine your external environment to understand what can impact the transfer. You need to examine your customers, markets, suppliers, and related government policies and actions.

- **Customers.** Your customers are the most important factor in your external environment. You need to understand any impact the transfer will have on the customer. For example, you may be changing the way you send out engineering updates or the way you determine customer requirements. If the technology does change a customer interface, then you need to talk with the customer and inform them of the pending change, including the expected impact, benefits, and time frame. In this discussion, you should get your customer's feedback on the change.

If your customers have problems with the change, then you should consider changing your strategy or technology based on the customer requests or else identify their problems as risks and mitigate these risks by continuing to involve the customers in your decision-making and influence strategy activities.

- **Markets.** You need to understand how the transfer will affect or be affected by your organization's market base. For example, you may plan on bringing in a technology that represents a substantial investment in a single market that your senior management may not want to make (e.g., a tool that supports a standard soon to be obsolete).

To determine market impacts, you need to look at strategic and technical plans and talk to senior management to understand whether there are

\$ Sponsor



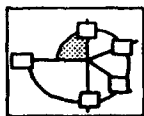
Change Agent



Champion



End User



any market changes that might affect the transfer. You should factor their comments in as technology requirements, transfer objectives, transfer constraints, and/or transfer risks.

Example 3-2 shows how a change in customer base affected the technology directions of one company.

Boss Systems is near the end of an organization-wide effort to implement a new software development process that is configured to meet the specifications of its DoD contracts, which account for almost 3/4 of Boss System's business. The process includes such mandatory items as risk management plans and lays the groundwork for integrating measurement and quality programs in order to move up to a Level 3 on the SEI's CMM within the next 3 years.

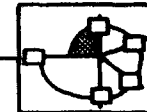
Because the process is new, management and staff are climbing learning curves that are (hopefully temporarily) causing overhead rates to spike. It is hoped that these initial costs will be paid for later in the software life cycle as development and maintenance costs decrease.

Unexpectedly, Boss lands a large commercial contract with General Motors that is scheduled to begin in 30 days. The proposal was bid before the full impact of the new software development process was understood; therefore, overhead rates and schedules were bid using data learned from the previous process. Strategically, the GM contract is crucial since it holds the prospect of making up for expected declines in DoD business over the next few years.

Top management decides that GM must be satisfied regardless of the cost implications for the company and the project decides to go back to the old process with hopes of integrating the concepts of the new process incrementally. Senior management sees this as a major step backwards in improving the company's software development process.

Example 3-2. A Case of New Customer Impacts

- **Suppliers.** Suppliers are those producers that provide technologies or services to your organization. They include consultants and hardware and software vendors. When you bring in a new technology, you are potentially forming new supplier relationships and/or impacting existing supplier relationships. For example, you may buy a technology from a new supplier that was available from an existing supplier. You need to understand whether your organization has any strategic alliances with existing suppliers that will impact the transfer or the technology you select for the transfer. You need to incorporate these factors into the technology requirements, transfer constraints, and/or transfer risks.
- **Government Policies and Actions.** Government policies and actions, both current and future, are important in many technologies. You need to examine the policies and actions related to the technology and the transfer and understand the risks associated with compliance or non-compliance to the policies. You need to discuss these issues with your sponsors and other senior managers to understand any organizational



compliance requirements. This is one area in which people who work in or have previous experience with the government can be very helpful. Example 3-3 shows how government actions significantly affected an organization's technology needs directions.

Tank Builders, Incorporated (TBI), a major DoD supplier, bases 40% of its business on building a major component for the M1/A1 tank. The company has been informed that the production rate of this vehicle will be cut in half within 18 months unless major international orders are received. TBI has also been informed by the Army Tank-Automotive Command that it will need to be CALS-compliant in all of its documentation within the next 12 months or be threatened with further loss of business.

As a component supplier, TBI was in no position to influence the purchase of tanks. Consequently, the decision was made to become CALS-compliant as an avenue to increasing business with the government in other areas.

Internally, organizational changes were made that were consistent with the introduction of CALS. For example, a supplier development function was created to provide assistance to suppliers to help them become CALS-compliant. This assistance included both financial help with technology purchases and direct technical help with training and consulting.

Since the assistance was low cost to the suppliers, the strategy was successful in bringing them up to full CALS-compliance in the necessary time period.

Example 3-3. A Case of Government Impacts on Technology Directions

Cycle 2...N

In subsequent cycles, you will need to update, as necessary, your external environment examination based on the results of previous cycles.



2. Examine Internal Environment. You need to look at your organizational culture and environment to understand those areas that will impact and be impacted by the transfer.

Cycle 1

In the first cycle, you need to examine your internal environment to understand your organizational culture and what organizational structures are in place that will support or hinder the transfer. Specific areas to examine include the following:

- **Organizational Culture.** Assess your organization's culture in relation to the transfer and the technology. Is the technology like other technologies used within the organization? Has the organization undertaken changes or transfers in the recent past that have failed? Does management request staff input and feedback on technological directions? If you answered no to even one of these questions, then you run a risk of failure because there are discrepancies between your organization's culture and the transfer you plan to make. In this situation, you need

\$ Sponsor



Change Agent



Champion



End User

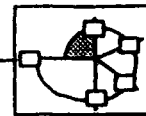


to devote at least one cycle to educating all levels within the organization on the transfer, including the justification, the process, the technology, and the impact on each stakeholder.

- **Organizational Strengths and Weaknesses.** You need to identify the strengths and weaknesses of the organization, especially in the unit that will be using the new technology. Is there strong technical knowledge? Is there strong leadership? Does management have good control over the organization? You should capitalize on the strengths and accommodate the weaknesses in your transfer strategy.
- **Business or Technology Strategies.** You need to identify whether there is a current business and/or technological strategy that supports the technological change. For example, your organization may have long-range, product-line plans that provide a business need for the change. If the transfer and/or technology you are proposing supports existing strategies or plans, then management is much more likely to approve the transfer. If it does not support existing plans, then you will have to plan extra time to make a cost/benefit case to upper management.
- **Policies and Procedures.** You need to identify the policies and procedures that support or constrain the transfer. For example, a policy or procedure may require the use of a specific technology that you plan on changing with the transfer. You should capitalize on those policies and procedures that support your transfer in your transfer and cycle strategies and plans. For those policies and procedures that constrain the transfer, you need to include time and effort to modify and get approval on the modifications in your transfer and cycle plans.
- **Existing Support and Training Resources.** You need to identify whether your organization has any existing training and support functions. You may not use them in the transfer, but you need to understand whether they impose any requirements or constraints on the transfer (see the Define Implementation Plan activity on when to use vendor-supplied versus internally-supplied training). Are you required to use internal resources first? Will they impose requirements on the technology? You need to factor your findings into your strategy, technology requirements, or risks.
- **Reward Programs.** A good reward or incentive program might induce people to try new technologies that improve current practices and should be capitalized on in your transfer strategy. If there is no program, then your options are to transfer without one, include a transfer-specific reward program in your plans, or lobby your management to institutionalize a reward program.

Cycle 2...N

In subsequent cycles, you need to update, as necessary, your internal environment examination based on the results of previous cycles.



3. Understand Reason and Expected Benefits for the Transfer. You need to understand the reason for the transfer (the problem) and the expected benefits before you can define the transfer (the solution). The following list explains some possible reasons why a transfer is needed along with how each reason might affect the transfer:

- **Strategic- or market-driven.** The reason for the transfer is to support a new corporate strategy or to respond to changes in the market. In this situation, you will probably have adequate resources, but will have a highly-visible transfer that needs to show early successes.
- **Internal process improvement action.** The reason for the transfer is to support an internal process change, such as a software process improvement effort. In this situation, you will likely have adequate management sponsorship but will have to fight against resource constraints and resistance to change due to other, simultaneous changes.
- **Technology opportunity or need, initiated by management.** The reason for the transfer is that management sees a need or opportunity (not strategic in nature) that can be met by a new technology. In this situation, you will have to spend time getting user buy-in to the transfer.
- **Technology opportunity or need, initiated by a grass-roots campaign.** The reason for the transfer is that staff members want to use a new technology. In this situation, you will have to spend time selling management on the benefits of the transfer, and you will have to be careful that management does not feel threatened by a grass-roots campaign.

Cycle 1

In the first cycle, you need to understand the original reason for and the expected benefits of the transfer before you can effectively and realistically define the objectives and constraints. You should document the reason for the transfer and use it when defining your objectives, constraints, alternative strategies, and alternative technologies. You should incorporate the expected benefits into the transfer success criteria (see Define/Update Transfer Plan activity).

Cycle 2...N

In subsequent cycles, you need to see whether the progress made in previous cycles will cause you to revisit your understanding of the reason or expected benefits of transfer. This should be reflected in the objectives, constraints, success criteria and alternative strategies for the current cycle and potentially for the entire transfer.



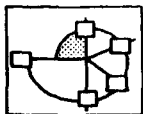
4. Define Objectives. Based on all of the information you have gathered on the transfer, you need to define transfer and cycle objectives. Transfer objectives are strategically oriented (e.g., institutionalize the technology

\$ Sponsor

 Change Agent

 Champion

 End User



throughout 1 division in 2 years and throughout the organization in 4 years). Cycle objectives are tactically oriented and focus on the objectives of the current cycle (e.g., train projects A, B, and C and integrate the technology into project D's technical environment by the end of the cycle).

An objective is the intended or desired result of a course of action. Use the following guidance when defining your objectives:

- Write several independent objectives instead of combining everything into one statement. Progress is more easily assessed when separated, and tradeoff analysis is easier to perform. A rule of thumb is that each objective may be met independently of the other objectives.
- Objectives should be measurable.
- Objectives should be clear, concise, controllable, and realistic.
- Objectives should create winning conditions for all stakeholders.

Cycle 1 In the first cycle, identify objectives for the entire transfer. The transfer objectives need to be consistent with why the transfer is taking place, result in the expected benefits of the transfer being achieved, and support the goals of the people initiating and sponsoring the transfer.

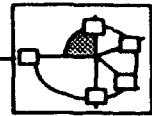
In addition, identify cycle objectives that focus on creating a technology transfer strategy and plan.

Cycle 2 Work with your sponsor to refine your transfer objectives based on the results of the previous cycle.

Identify cycle objectives that focus on getting sponsorship and stakeholder buy-in to the transfer effort.

Cycle N In later cycles, you will revisit the transfer objectives based on the results of previous cycles and define cycle objectives for the current cycle. Cycle objectives need to be consistent with the transfer objectives and result in progress being made against the transfer objectives. You will do the following:

- Compare the results of previous cycles to the overall transfer objectives to determine whether the expected progress was made. You may have to modify transfer objectives (e.g., expect institutionalization in 5 years instead of 4 because of an unexpected reorganization).
- If the previous cycle did not make the expected progress, then you need to define cycle objectives that make up for that lack of progress while making continued progress against the transfer objectives.



5. Identify Alternative Technologies. You need to perform this task when you and your organization have not already chosen a specific technology. However, in many transfers, the transfer was initiated because your organization has identified a specific technology to transfer. In this situation, you should still follow the guidance in this task because: you want to make sure that the technology addresses end user requirements; there may be better technologies available of which you should be aware; and this guidance will help identify transfer risks due to the technology.

You will perform this task in parallel with the Understand Process activity because that activity will help you understand any constraints or requirements imposed by the current process.

In this task, you may define entire technology areas first (e.g., whether your organization, to improve productivity, should transfer in a CASE tool or adopt object-oriented design techniques) before you narrow down to a specific technology products (e.g., specific CASE tools or object-oriented design methods).

It is critical in this task to document your technology selection and rejection decisions, along with the rationales, because you may be asked to defend a decision at a later date.

Cycle 1

You need to define your technology requirements and identify one or more technologies that meet those requirements. Subtasks include:

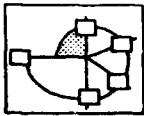
- **Define Technology Requirements.** You need to define a set of requirements for the technology. You should:
 - Talk to the end users to identify which technology functions and features are mandatory and which are optional. You may want to generate a questionnaire to help you in this task. This questionnaire should first communicate alternative transfer strategies and then ask the user to communicate the typical way in which they work in that technology area. How would they interact with the technology? How should the technology help them? Are there other technologies or people that will interact with the technology?
 - Define technology requirements based on the user discussions. The requirements need to support the transfer objectives.
 - Prioritize and weight your requirements so that they take into account the key shortcomings of current practices and/or the key integration areas. In other words, you need to define the rank order of technology needs and requirements. Prioritized requirements will also help as you search for available technologies.

\$ Sponsor

 Change Agent

 Champion

 End User



Benchmarking is a method that you can use to define technology requirements. One current description of benchmarking is how a company compares its "... performance on critical customer requirements against that of the best in the industry (direct competitors) or class (companies recognized for their superiority in performing certain functions) to determine what should be improved" (Vaziri 1992). You can use benchmarking results, or the results of what the best in the industry are using in this technology area, in your requirements. Additional sources on benchmarking are Camp (1989) and Tyson (1990).

Example 3-4 lists one company's requirements for a technology.

The Lockheed F-22 project management team had to select a system and software design methodology that would support an integrated product development team of over 800 software engineers from 17 major software companies on a system that had over 4 million lines of Ada code. Specifically, the design methodology had to:

- Create a supportable design
- Provide a uniform design method across the whole project
- Support the reuse of common avionics systems
- Provide a disciplined, repeatable approach
- Support design traceability to requirements
- Come from a third party in order to avoid individual company politics (the not-invented-here syndrome)

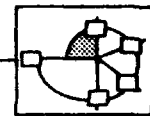
The producer's qualifications were of primary concern to the project management team—they had to deal with a producer that would provide adequate support and commit themselves to the continual improvement of the methodology. Specifically, the producer needed to:

- Make training available to all participating engineers
- Have ongoing consulting support available to resolve problems with applying the method to the design effort
- Continuously improve the methodology by fixing bugs and adding features
- Be committed to making the methodology work for the F-22 program

The Lockheed F-22 team chose the Software Productivity Consortium's Ada-based Design Approach for Real-Time Systems (ADARTS ) for the F-22 program because it fit all the requirements for the methodology.

Example 3-4. A Case of Selecting a New Technology

- **Identify Alternative Technologies.** You need to identify alternative technologies for the transfer. Because there are often numerous technologies available that would meet your requirements, your objective



in this subtask is to identify a small number of technology alternatives that you will analyze closely in the Analyze and Resolve Risks activity.

- Identify what technologies are available in the marketplace by reading reports, reviewing product evaluation reports, attending conferences, and talking directly to producers and researchers. You should look internationally. You should identify those technologies that address the technology requirements you defined earlier.
- Select a small number of technology alternatives to look at more closely in the Analyze and Resolve Risks activity. The alternatives you select should meet the technology requirements and best fit your organization's culture and current practices. The actual number of alternatives will depend on your situation; however, you should try to keep the number down to less than six, and ideally down to two or three.

Cycle 2 In Cycle 2, if your sponsors recommended changes to the technology selected in Cycle 1, you may need to identify other technology alternatives. If so, then refer to the guidance given in Cycle 1, changing your technology requirements to include the comments from the sponsors.

Cycle N In subsequent cycles, if the transfer has had problems related to the selected technology, you should refer to the guidance given for Cycle 1 to identify other alternative technologies (possibly including previously identified technologies that were not selected), modifying your technology requirements to address the problems in the implementation.

\$



6. Identify Alternative Strategies. Based on all of the information you gathered in this activity and the Build/Reinforce Sponsorship and Foundation activity, you need to identify alternative strategies for how to proceed with both the transfer and the cycle.

The sponsor needs to participate in identifying the alternative strategies. If the transfer is part of a process improvement effort, then the Process Group should participate since they have an understanding of what strategies will and will not support the overall improvement effort.

Cycle 1 You need to identify alternative strategies for how to proceed with the transfer. These strategies need to be consistent with the reason for the transfer and result in the transfer objectives. Your strategies should also ensure short-term successes to support growing impetus for the change. Each alternative strategy should address the following:

- **When to Transfer.** You can get your sponsor to commit to the transfer either when they currently have a technology need or when they anticipate

\$ Sponsor



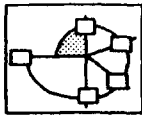
Change Agent



Champion



End User



that they will have a technology need. Conner (1993) calls this “current pain” versus “anticipated pain.” If the organization commits too early (early “anticipated pain”), then the transfer will be difficult to implement because it is difficult to convince managers to devote resources to the change. If they commit too late (late “current pain”), then the full benefits of the technology cannot be reaped because a window of opportunity was missed. You need to try to time the transfer so that the transfer will be supported and the maximum benefits of the technology can be achieved.

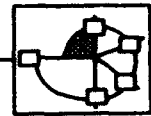
- **How to Transfer.** The primary input to how to implement the transfer strategy will be the original reason for the transfer identified in Task 3 of this activity. If the reason is coming from the top down, then you have a variety of options for where and how to start the transfer, several of which are listed later in this task. If the reason comes from the staff, then your strategy has to focus first on showing the viability of the transfer to management before performing it.

For most technologies, you should test the transfer before using the technology on a line project. Testing—whether through pilot projects, beta tests, or shadow projects—allows bumps and wrinkles to be smoothed out with minimum fuss and impact and gives you time to propagate success stories throughout the organization, leading to increased chances of success when transferring on a wider basis.

However, for technologies that require major cultural changes (e.g., a quality assurance program that spans multiple divisions), for technologies that are not easily tested on a trial use basis (e.g., a networking package that automatically affects everybody’s workstation), or in situations where management wants to see an immediate result on a specific line project, testing may not be possible. In these cases, the number of alternative strategies is reduced to one, or just a few, and you need to make sure you spend extra effort selling and planning the transfer because there will be many more stakeholders and risks involved.

If you do have the option of testing the technology transfer first, the following list gives you several options, along with the advantages and disadvantages of each, for where to start. You can identify your alternative strategies from this list and from other options unique to your organization and situation.

- **Start on a Proposal Effort.** Advantages include: the project is flexible in what technologies are used and how they are used. If the proposal is won, the company is committed to the technology. The major disadvantage is that no immediate benefits are reaped from the technology so you may lose enthusiasm from other projects.
- **Start on a New Project.** Advantages include: the project is flexible in what technologies are used and how they are used, and there is often



cash available for training and integration efforts. Disadvantages include: the project is undergoing other changes and may react negatively to a perceived, unnecessary change; and it may take a while for benefits of the new technology to be visible.

- ***Start on an In-Progress Project in Good Shape.*** Advantages include: a project in good shape often has the resources needed to transfer the technology and often has a good staff attitude. The biggest disadvantage is that the project has no reason to use the technology.
- ***Start on an In-Progress Project in Bad Shape.*** Advantages include: a project in bad shape is often looking for any help and would be willing to use the technology; and management is often willing to expend resources to help out projects in trouble. The major disadvantage is that if the technology does not help the project, even if it is not due to the technology, then enthusiasm and support for future use of the technology is at risk.
- ***Start on an Important Project.*** The advantage is that succeeding on an important project ensures strong management support for continued transfer. A disadvantage is that failure on an important project ensures strong management aversion against the transfer.

Example 3-5 shows how one company planned a pilot transfer before planning widespread transfer.

The Marshall Company decides to transfer a system of networked 486 PCs. Despite the fact that the task seemed easy, Marshall's in-house system group decides to pilot the chosen system with three experienced users within the company.

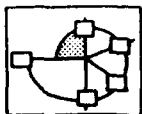
Numerous problems are unexpectedly encountered, particularly with the capacities and flexibilities of the networking features. Ultimately, it is discovered that the network card is inadequate for the intended use, and the system is reconfigured with vendor support. Following these changes, a successful, widespread transfer is achieved.

Example 3-5. A Case of Piloting a Transfer

- ***When to Publicize Transfer.*** You need to identify alternatives for when to start publicizing the use of the technology both inside and outside the organization. A strategy might be that an early announcement would jeopardize the plan, so you may delay publicity until the decision has been made. Conversely, to rally as much support as possible, you may publicize the transfer earlier.

You need to identify alternative cycle strategies in Cycle 1 that focus on working with the involved change agents and champions to develop a transfer plan.

Cycle 2 Based on input from your sponsors, you may need to identify new alternative transfer strategies or modify the transfer strategy selected in Cycle 1.



You need to identify alternative cycle strategies in Cycle 2 that focus on getting sponsorship and stakeholder buy-in to the transfer.

Cycle N

Based on the results of the previous cycle, you need to identify alternative strategies for how to proceed with the current cycle. In defining your alternative cycle strategies, you need to be concerned with progress made in previous cycles and current stakeholder support levels.

- **Progress Made in Previous Cycles.** Your current cycle strategy will be heavily based on the progress made in previous cycles. This information is documented in the transfer plan. If the expected progress was not made in previous cycles (e.g., the technology is not making the expected impact or the transfer is running behind schedule), then you need to make sure you define strategies that address or make up for lack of progress while showing continued progress against the overall transfer objectives. You will also want to include short-term successes in the strategy to help maintain stakeholder support.
- **Stakeholder Support Levels.** Your cycle strategies will be heavily impacted by the current support level of the sponsors, champions, change agents, and users. If they are upbeat and energetic about the transfer, then you can take higher risks and try proceeding faster. If they are in a lull and excitement over the transfer is low, then you should focus on reaping noticeable benefits from the transfer.

Alternatives for cycle strategies that you need to define include:

- Whether to stay focused on the current end user group or move on to other organizational units
- Whether to stay with the current technology or start looking at new technologies
- Whether to move toward institutionalization or keep the transfer on a more limited scale

Based on the results of the transfer to date, you may need to modify your transfer strategy. If so, then you should identify alternative transfer strategies that address the problems encountered in the implementation.



7. Identify Constraints. Constraints are unchangeable considerations that the alternative strategies and technologies must satisfy. Your constraints may come from:

- **External Influences.** Look at your examination of your external environment and identify those groups that impose expectations or

\$ Sponsor



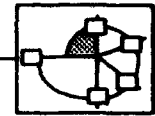
Change Agent



Champion



End User



constraints on either the transfer strategy or the technology. An example of an external constraint is that your key customer requests you use a specific design method on the software you provide to them.

- **Internal Influences.** Look at your examination of your internal environment and identify expectations or constraints on either the transfer strategy or the technology. An example of an internal constraint is that your company wants to bid on a proposal that requires use of a specific process modeling technique.
- **Existing Technologies.** Look at the understanding of the current process (see Understand Process activity) and identify any processes, hardware, or software technologies that you cannot change that impose a constraint on the transfer strategy or the technology.

Cycle 1 In Cycle 1, identify constraints on each of the alternative transfer and cycle strategies and on the alternative technologies.

Cycle 2 In Cycle 2, identify constraints on the alternative cycle strategies. If there were changes to the transfer strategy and/or to the selected technology and if alternatives were identified again in this cycle, then identify constraints on the new alternatives.

Cycle N In later cycles, identify constraints on the alternative cycle strategies and, if needed, on alternative transfer strategies and technologies. Identify these constraints by reviewing prior constraints and identifying: those constraints that are and are not still applicable; any new constraints that cropped up since the last cycle (e.g., your organization had a restructuring and you now have to deal with a potential loss of funding); and any new constraints due to new transfer tasks you will be performing (e.g., this is the first cycle that will include training so you will want to include any training-related constraints). In addition, realize that strategies and technologies selected in earlier cycles tend to impose constraints on later cycles.

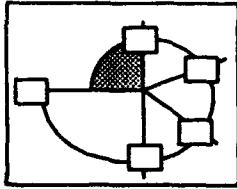
.....

STOP CRITERIA

You are done with this activity when:

- You understand your external and internal environments, including why the transfer was started and the expected benefits
- You have defined transfer and/or cycle objectives, alternative transfer and/or cycle strategies, and constraints on those alternatives
- If needed, you have identified alternative technologies, along with the constraints on them, that should be considered for the transfer

3.3 UNDERSTAND PROCESS



OVERVIEW

This activity begins in Step 1, Understand Context.

.....

Your objective in this activity is to understand the current process to be changed by the new technology. You need to understand how the new technology will interface with other technologies, with current policies and procedures, with the staff, and with other parts of the organization.

This activity will be conducted in parallel with Task 5, Identify Alternative Technologies, of the Define/Update Transfer Strategies activity.

.....

START CRITERIA

You should use information and/or working knowledge on the following items as inputs to this activity:

- Internal environment information, including organizational and project policies and procedures and descriptions of computing facilities
 - The technology requirements and list of alternative technologies
 - Transfer and cycle alternative strategies, objectives, and constraints
-

TASKS

You need to understand your current hardware and software environment and understand the current process, or practices, that will be changed by use of the new technology.



1. Understand Hardware and Software Environment. If the technology is hardware- or software-related, then you need to look at your current computing environment to understand issues associated with integrating the new technology into the environment.

Cycle 1

In Cycle 1, you need to understand in general terms current hardware and software support for the technology area you are proposing to change.

\$ Sponsor



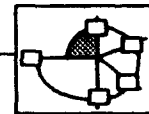
Change Agent



Champion



End User



Does your organization currently have automated support, or is this a new area? If there is currently support, what platform does the supporting tool run on and with what other hardware or software packages does the tool interface? Will this impact the new technology's interfaces?

If your organization currently does not have hardware or software support for the technology area, then you can use this as a selling point to management. If there is support, but the users feel it is inadequate, then you need to make sure that the inadequacies are reflected either in the technology requirements or in the transfer risks in the Analyze and Resolve Risks activity (depending on whether you can address the inadequacies). You can also use this finding as a selling point to management. If there is adequate support, then maintain that support with the new technology or include potential user resistance as a risk item because the users will not perceive a need for the change.

Cycle 2 You need to understand the integration issues associated with the technology selected in Cycle 1. Issues you need to address include:

- Will current hardware and software support use of the technology?
- Do you have adequate network capacity, disk size, computational power, or memory space to support the technology?
- Is there an interface incompatibility between current hardware and software and the technology?

If you answer no to any of the above questions, then you need to include these items as risk items in the Analyze and Resolve Risks activity. Potential risk aversion strategies would be to modify or upgrade the incompatible hardware and software to support the new technology or modify the hardware, software, or interface requirements for the technology (e.g., transfer the technology in standalone as opposed to integrated mode).

Cycle N In subsequent cycles, if the transfer had problems related to the selected technology, you should refer to the task guidance for Cycles 1 and 2 to support a possible decision, in the next step, on whether a new technology should be selected.



2. Understand the Current Process. You need to understand how the new technology will fit into the staff's everyday work routine, including the effect on organizational policies and procedures.

Defining and modeling your process is a useful method for understanding the current process. Defining and modeling allow you to analyze and compare the existing process to the proposed process, as well as help you facilitate any

\$ Sponsor



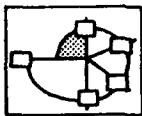
Change Agent



Champion



End User



training on the technology and its integration into the process. Refer to the *Process Definition and Modeling Guidebook* (Software Productivity Consortium 1992a) for help on defining and modeling your processes.

Cycle 1 In the first cycle, you need to understand how users currently work in the technology area you are proposing to change. Specifically, you need to:

- Understand whether the technology area is consistent with your organization's current culture and practices. Is the technology area a major deviation from the way the organization currently works (e.g., transferring in a new quality assurance program with supporting tools when none was previously in place) or is it only a minor deviation (e.g., a new quality assurance tool in an existing quality assurance program)? If the technology is inconsistent with current practices, then you will need to allocate time getting management and staff to understand the technology so that they will buy in to it.
- Understand whether the technology area requires a major or minor change in daily work loads for the end users. If the way the end users will perform work is going to change drastically, then you need to expect high selling and training costs.
- Understand whether existing technologies, practices, or policies and procedures, which you may not be able to change, place constraints on what new technologies may be adopted.

If you generate any findings that can negatively impact the transfer, then you should capture the findings as risks in the Analyze and Resolve Risks activity and invest at least one cycle in the process to selling the users on the benefits of the technology. See the task Prepare and Implement Influence Strategy in the Build/Reinforce Sponsorship and Foundation activity for help on how to get others to buy in to the transfer.

Cycle 2 You need to understand the process issues associated with the technology selected in Cycle 1. Answer the same questions that you did for the first cycle in this task, focusing this time on the selected technology and how it specifically impacts end user work practices.

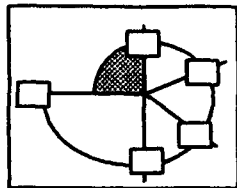
Cycle N In subsequent cycles, if the transfer had problems related to the selected technology, you should refer to the task guidance for understanding the current process to support a possible decision in the next step on whether a new technology should be selected.

.....

STOP CRITERIA

You are done with this activity when you have an understanding of how your technical and organizational environments will change because of the technology you are proposing to transfer.

3.4 CONTEXT REVIEW



This activity begins at the end of Step 1, Understand Context.

.....

OVERVIEW

Your objective in this activity is to get consensus from all stakeholders on the objectives, alternative strategies, and constraints defined for the transfer and/or for the current cycle; alternative technologies; and your understanding of the current process.

.....

START CRITERIA

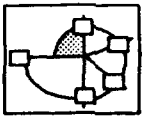
You should start this activity when you have defined the context for the transfer and cycle based on the results of the activities in Step 1, Understand Context. You need to have:

- Transfer and cycle objectives, alternative strategies, and constraints
 - Alternative technologies, if applicable
 - An understanding of the current process to be changed
 - If a continuing transfer, the transfer plan
-

TASKS

You need to get consensus from the stakeholders on the objectives, alternative strategies, and constraints defined for the transfer and/or for the current cycle; alternative technologies; and your understanding of the current process. In this activity, you need to get stakeholder input on your findings from the Step 1 activities, which should factor into your risk analysis and selection activities in Step 2. Through performing this activity, you will increase stakeholder buy-in to the transfer since they will be involved in the decision-making and analysis activities.

If this transfer is part of a process improvement effort, then you need to get review and approval from the Process Group. Depending on your particular situation, the Process Group will either be the sponsors or the champions for this transfer.

**1. Obtain Agreement From Champions, Change Agents, and End Users.**

The focus of this task is on getting agreement from the champions, change agents, and end users on the results of the activities in Step 1, Understand Context. This will help ensure sponsor support. You may need to go through several iterations of reviews before they agree.

Cycle 1 In the first cycle, you will be getting agreement on the objectives, alternative strategies, and constraints for the transfer and the current cycle; alternative technologies; and the results of the Understand Process activity. You need to get agreement from the change agents and champions involved in developing the transfer plan.

Cycle 2 In the second cycle, you need to get agreement on any modifications to the transfer plan and the cycle objectives, alternative strategies, and constraints. You need to get agreement from the change agents, champions, and end users identified in the Build/Reinforce Sponsorship and Foundation activity.

Cycle N In later cycles, you will be getting agreement on the cycle objectives, alternatives, and constraints and any modifications to the transfer plan based on the results of previous cycles. You need to get agreement from the change agents, champions, and end users identified in the Build/Reinforce Sponsorship and Foundation activity.



2. Obtain Commitment From Sponsors. After you have agreement from champions, change agents, and end users, you need to get the commitment of the sponsors. You will usually do this through a series of presentations to the different sponsors. Depending on your situation, you may decide to stagger the presentations, targeting first those sponsors who are more supportive to build up a stronger case for those sponsors who are less supportive.

You may have several iterations in your presentation to management before you get a final decision to go ahead with the implementation. If so, return, as necessary, to any task in this activity or in the other activities in this step to get the decision to proceed.

Cycle 1 In the first cycle, you will not perform this task since you do not yet have a sponsor.

Cycle 2 In the second cycle, you will get commitment on the transfer plan, including the objectives, selected strategy, and constraints; the selected technology; and the cycle objectives, alternative strategies, and constraints. You need commitment from the authorizing and reinforcing sponsors identified in the Build/Reinforce Sponsorship and Foundation activity.

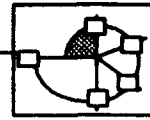
Cycle N In later cycles, you will get commitment on the cycle objectives, alternatives, and constraints and any modifications to the transfer plan based on the

\$ Sponsor

 Change Agent

 Champion

 End User



results of previous cycles. You will need commitment from the authorizing and reinforcing sponsors identified in the Build/Reinforce Sponsorship and Foundation activity.



3. Publicize Commitment. The sponsors need to publicize their support and commitment throughout their organization to keep everybody informed, to ensure the end users that the transfer is important, and to help prepare everybody for the changes ahead. To publicize their support and commitment to the transfer, the sponsors may send a memorandum or electronic mail, hold an organization-wide meeting, or hold a series of briefings across the organization.

You can use the influence strategy developed in the Build/Reinforce Sponsorship and Foundation activity in planning and implementing this task.

Cycle 1 In Cycle 1, you will not perform this task because you do not yet want to publicize any strategies or technologies until you have commitment from all stakeholders.

Cycle 2...N In later cycles, you should work with the sponsor needs to publicize support and commitment to the transfer to help prepare everybody for the changes ahead.

.....

STOP CRITERIA

You should stop this activity when you have buy-in on the transfer context from the stakeholders, and the sponsors have publicized their support and commitment to the organization.

\$ Sponsor



Change Agent



Champion



End User

4. CHOOSE THE RIGHT PATH: ANALYZE RISKS AND SELECT STRATEGY

Every business and every product has risks. You can't get around it.

Lee Iacocca, Chairman, Chrysler Corporation

Section Objectives

1. Provide guidance for analyzing and resolving the risks associated with the transfer
2. Provide guidance for selecting the best strategy and technology for the transfer

After you have identified the context in which you are performing the transfer, you need to understand the risks associated with the transfer and cycle, including how to mitigate the risks, and identify the right technology to transfer. Figure 4-1 shows the three activities described in this section.

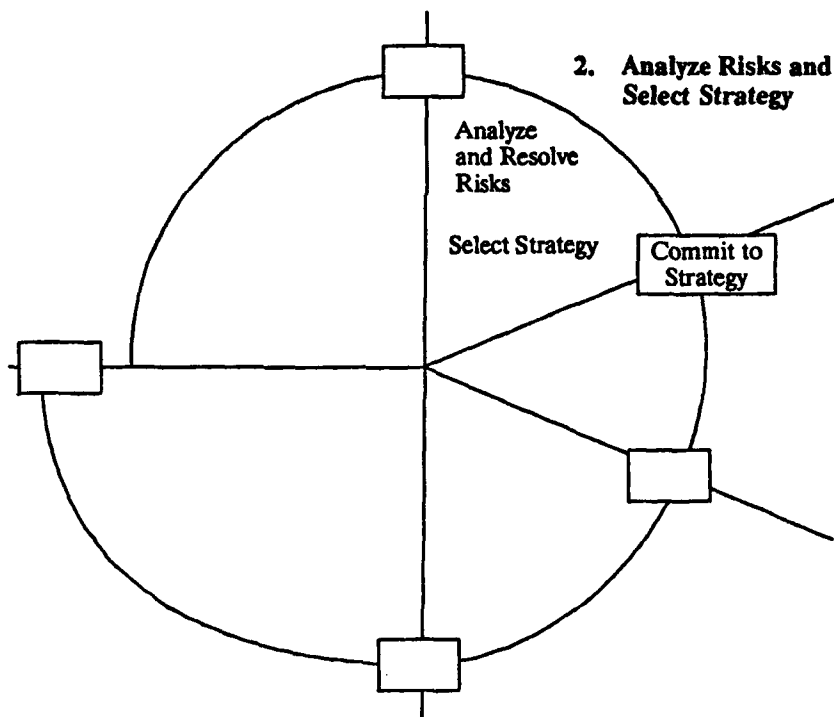
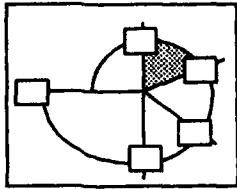


Figure 4-1. Analyze Risks and Select Strategy Activities

You will perform the Analyze and Resolve Risks activity first, the Select Strategy activity second, and the Commit to Strategy activity last.

4.1 ANALYZE AND RESOLVE RISKS



This activity begins in Step 2, Analyze Risks and Select Strategy.

.....

OVERVIEW

Your objective in this activity is to analyze and resolve the risks associated with the identified alternatives for the transfer strategy, the cycle strategy, and the technology to be transferred. **Transfer risks** are at the strategic level and will be analyzed in the first cycle and then reviewed in subsequent cycles. **Cycle risks** are at the tactical, or implementation, level and will be analyzed in each cycle. Analyzing technology alternatives will be performed in the first cycle and will only be performed again if there was a problem in the transfer related to the technology and all stakeholders agree that the issue of which technology to transfer needs to be revisited.

In this activity, you will concentrate on the factors, or risks, that may oppose transfer or cycle success. You will first identify and analyze risks; the primary result of this analysis is a quantified list of risks for the transfer and/or the current cycle. After identifying and quantifying risks, you evaluate possible risk aversion strategies and commit, plan, and execute one of those strategies.

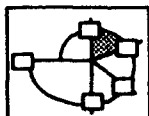
Additional guidance on risk analysis can be found in Charette (1989) and the U.S. Air Force (1988).

.....

START CRITERIA

You should start this activity when you have:

- Defined and approved objectives and constraints for the transfer and the cycle that all stakeholders support
- Alternative transfer and/or cycle strategies that need to be analyzed
- Alternative technologies that need to be analyzed, when appropriate
- If this transfer is part of a process improvement effort, then any process improvement documents, including implementation plans and risk management plans
- An understanding of the current process and computing environment related to the technology area being changed



- Supporting documents, including any organizational policies and procedures, and organizational and project planning documents
 - Any historical technology transfer data
-

TASKS

You will perform a risk analysis on the alternative transfer strategies, alternative cycle strategies, and alternative technologies to help you in the next activity to make a decision on which strategy and which technology to use for the transfer. You should document the results of your risk analysis and risk aversion plans and activities in a risk management plan.

Your risk management plan should be a living document. You should not just concern yourself with risks once in a cycle and then have the risk management plan sit on the shelf until the next cycle. Rather, you should keep on top of known risks and keep your eyes open for new risks. For example, during implementation, a key player may leave the organization or you might be faced with a restructuring—both of which will open the transfer up to new risks. Also, keep in mind that most serious risks are people risks (those risks related to people's reactions to the transfer) not technical risks.

If this transfer is part of a process improvement effort, then you must take into account the objectives, constraints, risks, and action plan defined and identified for the larger improvement effort when you are identifying, analyzing, and averting risks. For example, if there are multiple transfers occurring in parallel, then there might be a risk of inadequate technical support because support personnel are spread too thinly.



1. Identify and Analyze Risks. You need to identify the risks associated with the alternatives you are currently looking at, estimate the potential chance and cost of each risk occurring, and then evaluate each risk. Each of these risk analysis areas (identification, estimation, and evaluation) is summarized in the following list before guidance is given on specific risk areas for technology transfer. References are provided if you need more information.

- **Risk Identification.** Risk identification uncovers and categorizes risks. You can use the following methods to help identify risks:
 - **Risk Source Checklists.** These checklists remind you where to look for generic and project- or transfer-specific items, how they can manifest, and strategies for dealing with them. Examples are provided in Boehm (1989), U.S. Air Force (1988), and Charette (1990).

\$ Sponsor



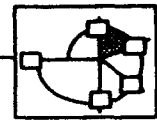
Change
Agent



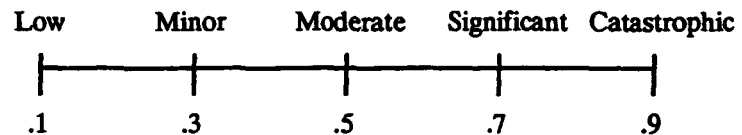
Champion



End User



- **Assumption Analysis.** Boehm (1989) offers a sample checklist that helps identify optimistic assumptions about the ability to achieve some result.
- **Decomposition.** Poorly defined descriptions of what has to be done and how it has to be done reveal poor understanding of tasks. Boehm (1989) offers a sample checklist to help identify these risks.
- **Risk Estimation.** Risk estimation calculates the probability of a risk item occurring and the cost of it occurring.
 - **Probability of Occurrence.** Establish the risk rating scales, and then, for each risk item, estimate the probability of occurrence in terms of its maturity, complexity, and dependency. Charette (1989) describes an example of a quantitative risk rating shown in Figure 4-2. The U.S. Air Force (1988) uses another rating scale.



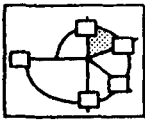
Source: Charette (1989)

Figure 4-2. Example Risk Rating Scale

- **Cost of Occurrence.** Estimate the cost of each risk item occurring in terms of budget, schedule, and product quality.
- **Risk Evaluation.** Risk evaluation helps you adequately understand and measure the risks to actively control them. Charette (1989) provides further guidance on how to perform the following tasks:
 - **Establish Referent Risk Levels.** Predefine, for each risk item and for the transfer, upper limits of acceptable risk for each time phase of the transfer. Overall, transfer risk should decrease as the transfer advances.
 - **Determine Project's Risk.** Calculate each item's risk by multiplying the probability of occurrence and the cost of occurrence; do this for each time phase of the transfer. Calculate the transfer's average risk by averaging together each item's risk.

Understand and address the effect of risk coupling or risk compounding. Coupling occurs when an alternative to a risk causes another risk to be introduced or increased. Compounding occurs when the risk in one area is amplified by a risk in another.

- **Compare Risks to Referent Levels.** Identify risk items that exceed the upper limits of acceptable risk. Identify risk items with a significant probability or a significant cost of occurring. Compare the transfer's average risk against the predefined referent.



Cycle 1 In the first cycle, you are looking at the risks associated with the alternative transfer strategies, the alternative technologies to be transferred, and the alternative cycle strategies.

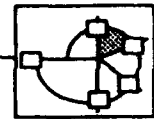
As a further aid in identifying risks, this guidebook lists potential risk items in other process activities in which you would first become aware of the risk. These risks should be included in your risk management plan.

- **Risks of Alternative Transfer Strategies.** You need to understand the risks associated with each of the alternative transfer strategies. For each strategy, you need to look at the following risks:
 - **Impact on Stakeholder Practices.** You need to understand how the stakeholders perceive the transfer strategy from their frame of reference in terms of how it will impact their day-to-day work and what the perceived benefits are. The higher the perceived impact and the lower the perceived benefits, then the higher the risk of failure.
 - **Conflict With Other Efforts.** You need to understand other organizational or project plans or efforts that will affect the end user groups at the same time as the transfer and identify risks associated with too much change occurring at once and constraints on support resources. Examples of other efforts include a corporate-level program or effort (e.g., a quality assurance program), which will take precedence over project or division-level efforts; reorganizations, which may cause you to lose your sponsors; and proposal efforts, which will require the full attention of the end users.
 - **Adequate Time and Resources.** Determine whether the strategy provides adequate resources to plan, integrate the technology into the organization, train, sell, and support the transfer. If not, then solicit your managers and the transfer sponsors to get the necessary resources. If they will not provide the resources, then indicate this as a high risk.

When assessing risks of the alternative strategies, revisit the success factors identified in Section 2.3, under What Makes Technology Transfer Successful?, that relate to the organization, the end users, and the change agents and see whether the strategy supports those success factors. For example, if the strategy does not allow adequate time for the users to participate in the planning and decision making, then the transfer runs a high risk of failing because of lack of end user buy-in.

- **Risks of Alternative Technologies.** You need to understand the risks associated with each of the alternative technologies.

To understand many of the risks, you will first need to get information from each technology's producer. The information you need to get



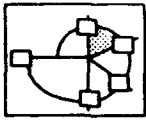
includes support upgrade plans and major development plans; sample documentation; references from other users, particularly those in a similar environment; technology costs, including the costs for the basic product, upgraded versions, and transfer mechanisms (e.g., courses, hotline support, workshops, and consulting); and, whether technical support services, such as training and a hotline, are available on a regular basis.

For each technology, you need to look at the following risks:

- **Impact on Stakeholder Practices.** Understand whether the technology is consistent with the current practices of each stakeholder group, from their frame of reference, and with your organization's technology strategy. If not, then you run a higher risk of resistance and failure and will need to spend time training and selling.
- **Training and Support.** Understand any risks associated with inadequate training and support. Either the producer or your organization will have to provide training and technical, hotline support when the technology is in use. You need to make sure that both types of support are adequate. In addition, assess the quality of the documentation to see how well it will help the support efforts.
- **Industry Support.** Understand whether industry provides adequate support in terms of standards or tools. The more prevalent the technology is in your industry, the more likely it will be supported by industrial standards and have a range of supporting products from producers.
- **Integration.** Understand whether the technology is compatible with the current hardware and software environment. If not, then you run a high risk of not being able to integrate the technology smoothly into the target unit's daily practices.
- **Technology Costs.** Compare the costs of the technology to original projections on budget for purchasing the technology. If the technology is very expensive and you are still unsure of whether it is the right choice, you may want to try to get demonstration or evaluation copies to test on the projects so that you do not outlay a lot of money for a high-risk venture.

The *Technology Benefits Prototype User Manual* (Software Productivity Consortium 1993c) and accompanying tool will help you estimate the cost impact a new tool will have on your software development process.

- **Other Hardware and Software.** Understand whether or not you need to purchase other hardware and/or software to support use of the technology and whether these costs will cause you to run over your budget for the transfer.



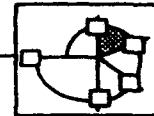
- **Tailoring Costs.** Understand whether there are tailoring costs that need to be incurred before the technology can be used and how this will impact the schedule for the transfer.
- **Prior Uses.** Gather information from other groups, internal and external to your organization, that have used the technology in the past. They may be able to share lessons learned about how well the technology integrated into their environment, how well the producer supported and trained the users, and how well the users received the technology.
- **Consistency with Future Trends.** If there is an identified trend that will potentially obsolete certain technology alternatives in the short or long term, then you need to factor that into your selection. To identify trends, get information from the research and development (R&D) community on the potential for substantial changes in technology capabilities in a short time frame. In addition, look among your peers for attempts to improve technology and practice and identify recurring themes. While some of the advanced development being performed by competitors or producers is not made public, other R&D work is readily accessible. In addition, you can check with industry analysts who track technology trends across industries.

Example 4-1 shows how one organization gathered information from vendor and research communities.

When assessing risks of the alternative technologies, revisit the success factors identified in Section 2.3, under What Makes Technology Transfer Successful?, that relate to the technology. For example, if the technology has high complexity and low observability, then the transfer runs a high risk of failing because people will not easily see its benefit, and you will need to spend time training and selling management and staff.

When performing your assessment of the alternative technologies, involve suppliers or customers. For example, a major supplier may be just as interested as you are in discerning how their technology stacks up against others. In addition, they might be willing to loan you free copies of their tools for evaluation purposes hoping that there will be potential sales.

- **Risks of Alternative Cycle Strategies.** You need to understand the risks associated with each of the alternative cycle strategies. Because the focus of the current cycle is relatively narrow—to develop a transfer plan and get approval on it from involved change agents and champions—your primary risk areas will include inability to define a transfer plan soon enough because of other change agent or champion commitments



Acme Aerospace has decided to upgrade its CASE tool, Justin CASE. Acme has been a successful user of the Justin CASE tool for 10 years, but the tool is showing signs of age and the vendor does not have any clear upgrade plans.

As the first step in the search for technology options in the CASE tool arena, the president of Acme put Ed Katz, manager for software development, in charge of the search. Ed begins to amass information and artifacts from several available sources. He and several key staff members attend CASE Expo. Ed's assistant reviews selected journals in the field for information about both the state of the art and the state of the practice. Ed personally visits the University of Houston, Clear Lake, and the Software Engineering Laboratory at Maryland to discuss recent work in support of NASA. Technical reports from other research organizations, such as the Software Productivity Consortium, ESPRIT, and the SEI, are collected and reviewed. The recent products and efforts of the Software Technology for Adaptable Reliable Systems (STARS) Program are reviewed for relevance.

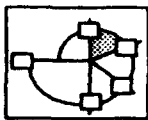
Ed decides to investigate CASE research and products in Western Europe through his contacts in his Brussels office. Through them, Ed hears of a rumor about a new intelligent avionics system under development at Airbus. The system, named PAPOOS (Primary Automatic Piloting Operating On-line System), provides improved automatic piloting of commercial aircraft. Mail traffic on the Usenet discussed how this system was collaboratively developed by software professionals in three countries using a distributed CASE system developed jointly by Airbus and a leading CASE vendor. Ed also talks with a group of researchers at Imperial College in the U.K., who are developing some interesting next-generation CASE methodologies.

Meanwhile, two of Ed's associates, Bill Buttons and Terri Marthin, luck into some very unexpected treasures in technology intelligence. Bill Buttons had taken his daughter to Space Camp in Huntsville, AL. In the airport bar, Bill runs into a software engineer from the University of Houston, Clear Lake. He informs Bill about some interesting CASE tool development being done on a priority basis for his company, BigCo. As it turns out, Terri Marthin is an old college roommate of a senior software engineer from BigCo. Terri takes her out for dinner and receives a back-of-the-napkin summary of BigCo's current strategy in CASE tools.

Using his professional contacts, Ed begins to line up a select list of knowledgeable CASE consultants who can provide valuable advice and assistance to the selection and implementation process. These contacts also provide some feedback on their current systems and personal experience that cannot generally be obtained from other sources. After the field was narrowed to a few CASE systems, Ed attends some user group meetings for these systems to get a better sense of how these systems work and how they are currently being applied within similar firms.

As a result of his research, Ed identifies an up-and-coming CASE company, InCase, with a new CASE system that supports the same principles and methods of their existing CASE system (Justin CASE) while providing flexibility to adapt to a changing CASE market. Ed spends time with the management, marketing, and development staff of InCase, and they decide to form a strategic alliance that utilizes the development staff of InCase and the knowledge and experience of ACME's in-house CASE group. Together, they develop, field, and support a CASE system that, for ACME, is a natural evolution from Justin CASE; and, for InCase, results in a system that is tested and validated in the large aerospace market.

Example 4-1. A Case of Gathering Information From Research and Vendor Communities



and inability to find enough funds to support definition of the transfer plan.

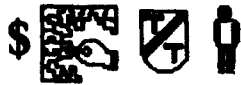
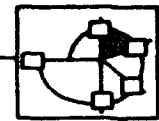
Cycle 2 In Cycle 2, you will identify and analyze risks associated with any modifications to the transfer plan and the technology based on sponsor and stakeholder comments. You should use the guidance given for Cycle 1 of this task to perform this analysis.

You will also need to identify and analyze risks associated with the alternative cycle strategies for obtaining sponsorship, forming an infrastructure, and getting stakeholder buy-in to the transfer. To identify risks in these areas, look at the guidance the Build/Reinforce Sponsorship and Foundation activity on establishing a transfer support staff, assessing end user readiness to change, and identifying sponsors. If your situation differs from the guidance, then you should identify that difference as a risk and analyze the risk's potential impact on the transfer.

Cycle N In subsequent cycles, you need to understand the risks associated with each of the alternative cycle strategies. For each strategy, you need to look at the following risks:

- **Impact on Stakeholder Practices.** You need to understand how the stakeholders perceive the cycle strategy from their perspective (their "frame of reference") in terms of what their expected role is in the cycle, how it will impact their day-to-day work, and what the expected benefits are.
- **Conflict With Other Efforts.** You need to understand other organizational or project plans or efforts that will affect the end users at the same time as the cycle and identify risks associated with too much change occurring at once and constraints on support resources.
- **Adequate Time and Resources.** Determine whether the cycle strategy provides adequate resources to plan the cycle and perform the transfer activities described in the cycle strategy. If not, then solicit your managers and the transfer sponsors to get the necessary resources. If they will not provide the resources, then cancel or delay the transfer until this issue is resolved.

If modifications were made to either the transfer plan or the selected technology based on the results of previous cycles, you will need to identify and analyze risks associated with the alternative strategies or technologies developed for addressing the modifications. In this case, you should use the guidance given under Cycle 1 for this task.



Cycle 1...N

2. Review Risk Analysis. All stakeholders need to review and agree to the risk analysis done in Task 1 of this activity.

Have all stakeholders review the risk analysis. Incorporate their comments as needed.



3. Evaluate and Plan Risk Aversion. A risk aversion strategy attempts to reduce the cost and/or probability of risk occurrence to an acceptable level. Risk aversion strategies generally fall into one or more of the following categories:

- **Risk Reduction.** Risk reduction reduces the likelihood of a risk occurring and/or the magnitude of a risk. For example, you may extend the schedule of the transfer if you have a high risk of a being late.
- **Risk Protection.** Risk protection lessens the impact of a risk should it occur. For example, a company may bid many proposals to protect itself from the risk of current contract cancellation.
- **Risk Transfer.** Risk transfer reallocates risk to areas better able to handle it. For example, you may transfer responsibility for the development of a high risk software component to a project more capable of handling it.
- **Risk Contingency Fund.** A risk contingency fund establishes a reserve of resources to compensate for risks occurring. For example, you may build some slack into a schedule or budget to accommodate unexpected risks.
- **Risk Acceptance.** You may accept the consequences because there are no cost-effective strategies for risk aversion.

If your risks are too high and you have no cost-effective aversion strategies, then you may decide to delay the transfer until some of the risks stabilize. However, you need to understand and analyze whether the risks associated with making or continuing the change are lower or higher than the risks of waiting until later. In other words, is it crucial to make the change now because you will lose your competitive edge by waiting? Can you wait until other things have stabilized or until the technology matures or is tailored, increasing your chances of success?

Cycle 1...N

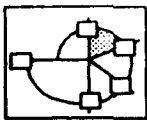
You need to identify risk aversion strategies and examine the impact of each strategy on the risk(s) that you are attempting to avert. You need to document and identify the costs and schedule of each strategy. You also

\$ Sponsor

 Change Agent

 Champion

 End User



need to make sure that the resources called out in the risk aversion plan are consistent with the resources available for this cycle. However, if you need additional resources to avert risk, then you may need to devote the rest of this cycle to risk aversion activities.

Example risk aversion strategies for technology transfers include:

- To reduce the risk that the technology does not address end user needs, use an outside consultant to poll the end users to determine their technology requirements.
- To reduce the risk of selecting the wrong transfer or cycle strategy, pilot the technology using different transfer strategies to see which strategy is the most successful.
- To reduce the risk of not understanding the impact of the technology on the end users, study the work habits of the target unit for 1 month before defining the technology requirements and the transfer strategy.
- To reduce the risk of not having stakeholder buy-in, spend multiple cycles ensuring that you have the complete buy-in of all stakeholders.
- To reduce the risk of rumors starting about the transfer before you can adequately allay staff concerns, delay publicizing the transfer until the results of a pilot project can clearly show the benefits received.



Cycle 1...N

4. Commit to Risk Aversion Plan. All stakeholders need to review and agree to the risk aversion plan developed in Task 3 of this activity.

You need to solicit the commitment of all stakeholders on the risk aversion plan that you developed in the previous task, incorporating comments as appropriate. Since risk aversion strategies can require a substantial number of resources, it is important that all stakeholders agree that the aversion strategies adequately address the risks, that they do not incur new risks or impact other risks, and that the assigned schedule and budget are adequate.



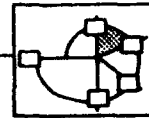
5. Execute Risk Aversion. To mitigate the transfer and technology risks, you need to execute the risk aversion activities defined in the approved risk aversion plan.

\$ Sponsor

 Change Agent

 Champion

 End User



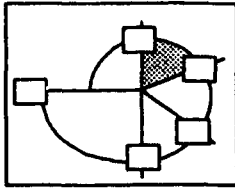
Cycle 1...N You perform the risk aversion activity(ies) outlined in the approved risk aversion plan. For a risk aversion activity that requires a large amount of resources, you may want to devote one or more cycles or even spin off another process, or spiral, to complete it. Depending on the risk aversion strategy being performed, you may need to involve the users and champions.

.....

STOP CRITERIA

You should stop this activity when you have identified, analyzed, and averted risks related to, when appropriate, the alternative transfer strategies, alternative cycle strategies, and alternative technologies.

4.2 SELECT STRATEGY



OVERVIEW

This activity begins in Step 2, Analyze Risks and Select Technology.

.....

Your objective in this activity is to select a transfer and/or cycle strategy and, when appropriate, a technology to use in the transfer. Your selection will be based on your transfer and cycle objectives and constraints, your understanding of the process to be changed, and your analysis of the risks associated with each of the identified alternatives.

You need to create an electronic or paper trail in this activity to help you justify and/or explain your reasons for selection or rejection at a later date.

.....

START CRITERIA

Use information and/or working knowledge of the following items as inputs to this activity:

- Defined and approved objectives, alternative strategies, and constraints for the transfer and the cycle that all stakeholders support
 - When appropriate, the technology requirements and the alternative technologies identified in the Define/Update Transfer Strategies activity
 - Your understanding of the current process and computing environment related to the technology area being changed
 - Risk analysis results for the transfer, cycle, and technology
-

TASKS

You will select the recommended transfer and/or cycle strategy and the recommended technology.



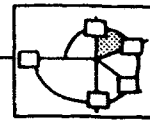
1. **Select a Transfer and/or Cycle Strategy.** Based on your approved transfer and cycle objectives and constraints, the alternative strategies

\$ Sponsor

 Change Agent

 Champion

 End User



identified, and the risk analysis done in the Analyze and Resolve Risks activity, you need to select a recommended strategy for the transfer and the cycle. You will need to document why you selected one strategy over the others.

- Cycle 1** In Cycle 1, you will select a strategy for the transfer. You will also select a cycle strategy that focuses on how to get the transfer plan developed.
- Cycle 2** In Cycle 2, you will select a cycle strategy that focuses on getting sponsorship and stakeholder buy-in to the transfer. If modifications were made to the transfer plan, then you may need to select a new transfer strategy.
- Cycle N** In later cycles, you will select a strategy for the current cycle. If modifications were made to the transfer plan, then you may need to select a new transfer strategy.



2. Select the Technology. You need to select a technology that you recommend for transfer. You will need to document why you selected one technology over the others.

- Cycle 1** In the first cycle, you need to evaluate and select a technology from the alternative technologies identified in the Define/Update Transfer Strategies activity. To perform the evaluation and selection, you can use the Comparative Evaluation Method (CEM) (Software Productivity Consortium 1991). The software package, Expert Choice, by Decision Support Software, Inc., (Forman et al. 1983) provides automated support for CEM. This task summarizes the CEM; you should refer to Software Productivity Consortium (1991) for a full description of the method.

CEM, adapted for technology transfer, is based on the Analytic Hierarchy Method (Saaty 1980). CEM requires you to establish needs, evaluate the alternatives, and then select the technology. The following guidance summarizes each of these actions.

- **Establish Needs.** Perform the following to establish the needs for the technology:
 - Using the transfer objectives, alternatives, and constraints; the technology requirements; and the risk analysis, categorize and analyze the functions of the desired technology and determine a set of mandatory and desired needs for the technology. These needs should include technical needs (e.g., the technology needs to have a response time not greater than 2 seconds), cost considerations (e.g., you have limited funds for integration), and other transfer constraints (e.g., you need to show progress within 2 months or risk losing sponsor support).

\$ Sponsor



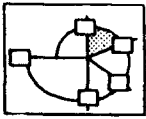
Change Agent



Champion



End User



- Develop a decision model that prioritizes each of the needs and provides a weight that indicates the relative measure of the importance of each need. That is, instead of just indicating that A is better than B, you need some relative measure of how much better A is than B.
- **Evaluate Alternatives.** Perform the following to evaluate the alternative technologies:
 - Based on the alternative technologies identified in the Define/Update Transfer Strategies activity, eliminate those technologies that do not meet the mandatory needs.
 - Develop a questionnaire based on the decision model and the mandatory and desired needs. The purpose of the questionnaire is to determine not only that a product provides the mandatory needs, but to determine how well it provides them compared to the other products. The questionnaire ensures thorough coverage of each product against the identified needs.

The questionnaire should include a cost profile (e.g., acquisition, training, support, and integration costs) and a producer profile (e.g., producer stability, experience, and available support).

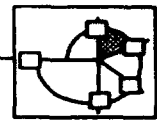
- Analyze each of the technologies against the questionnaire. The risk analysis you did for each technology in the Analyze and Resolve Risks activity provides some of the information to perform this analysis.

If the technology you are trying to transfer has an impact on your organization's software development process, you should refer to the *Technology Benefits Model User Manual* (Software Productivity Consortium 1993c) and accompanying prototype tool. The Technology Benefits Model tool is a spreadsheet implementation of various models for estimating the effect of using a new technology on the cost of software development. You can use this tool to estimate the benefits of each alternative technology on your organization's software development process.

- **Select Technology.** You compare the evaluations done of each technology and select the technology to be transferred. You can use the Expert Choice tool to help you in this activity. You should perform this activity with the input and buy-in from all stakeholders.

If you cannot narrow your recommendation down to a single technology, then try one or more of the following approaches:

- Define high-level implementation plans for each technology. These plans will focus on the ease or difficulty of the implementation,



potentially helping you identify the right technology (see the Define Implementation Plan activity for guidance on how to generate an implementation plan).

- Test a technology on a small pilot project.
- Present more than one technology recommendation to the stakeholders and have them make the final selection (see the Commit to Strategy activity).

Cycle 2...N You will perform this task in a later cycle if the technology selected earlier is not transferring well and all stakeholders agree that the technology selection needs to be revisited. In this case, you should follow the guidance given under Cycle 1 for this task.

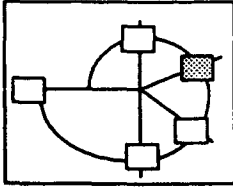
.....

STOP CRITERIA

You are done with this activity when you have:

- The recommended transfer and/or cycle strategy, plus documentation explaining why this strategy is recommended over the others
- The technology recommended for implementation, plus documentation explaining why this technology is recommended over the others

4.3 COMMIT TO STRATEGY



This activity begins at the end of Step 2, Analyze Risks and Select Strategy.

.....

OVERVIEW

Your objective in this activity is to get all stakeholders to commit to the strategy for the transfer and/or the cycle and, when appropriate, the technology selected for the transfer. A key part of this activity is for the sponsors to publicize the recommendation and commitment across the organization.

You should not proceed with the transfer until you have successfully completed this activity.

.....

START CRITERIA

You should start this activity when you have:

- A recommended strategy for the transfer and/or the cycle, along with documentation explaining why the strategy is recommended
- When appropriate, a recommended technology, along with documentation explaining why the technology is recommended

.....

TASKS

You need to obtain approval from the stakeholders on the selected transfer and/or cycle strategy and, when needed, on the selected technology.

If this transfer is part of a process improvement effort, then you need to get review and approval from the Process Group. Depending on your particular situation, the Process Group will either be the sponsors or the champions for this transfer.



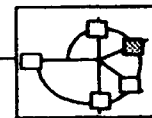
1. Obtain Review and Approval From Champions, Change Agents, and End Users. You should seek approval first from all stakeholders other than

\$ Sponsor

 Change Agent

 Champion

 End User



the sponsors. The sponsors will be more likely to approve a selection when there is buy-in from all the other players involved in the transfer. Because the champions and the change agents helped identify the selected strategies, then the focus of this task will be on getting review and approval from the end users and any other champions and change agents that did not participate in the selection. You may need to go through several iterations of the review process before they will approve it.

Cycle 1 In the first cycle, you will get approval on the transfer and cycle strategies and the selected technology. You need to get commitment from the change agents and champions involved in developing the transfer plan.

Cycle 2...N In future cycles, you need to get approval on the cycle strategy and on any modifications to the transfer strategy or to the technology selection. You need to get commitment from the change agents, champions, and end users identified in the Build/Reinforce Sponsorship and Foundation activity.



2. Obtain Commitment From Sponsors. After you have buy-in from all champions, change agents, and the end users, you need to present your recommendations for the strategy and technology to the sponsors for their commitment. Your presentation should include:

- A description of the recommendation(s)
- Your rationale for the recommendation(s)
- The impact of the recommendation(s) on the organization, especially the impact on each sponsor's group
- The estimated cost and time frame for the recommendation(s)

Depending on your situation, you may decide to stagger the presentations, targeting first those sponsors who are more supportive in order to build up a stronger case for those sponsors who are less supportive.

You may have several iterations in your presentation to management before you get a final decision to go ahead with the implementation. If so, return as necessary to any task in this activity or in the Analyze and Resolve Risks or Select Strategy activities to get the decision to proceed.

Cycle 1 In the first cycle, you will not perform this task since you do not yet have a sponsor.

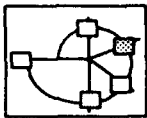
Cycle 2 In Cycle 2, you need to get a commitment on the selected cycle strategy and on any modifications to the transfer strategy or technology selection. You will seek commitment from the authorizing and reinforcing sponsors identified in the Build/Reinforce Sponsorship and Foundation activity.

\$ Sponsor

 Change Agent

 Champion

 End User



Cycle N In later cycles, you will get a commitment on the cycle strategy and any modifications to the transfer strategy or the selected technology. You will seek commitment from the authorizing and reinforcing sponsors identified in the Build/Reinforce Sponsorship and Foundation activity.



3. Publicize Commitment. After approving the recommendation, the sponsors need to publicize their support and commitment throughout their organization to keep everybody informed, to ensure the end users that the transfer is important, and to help prepare everybody for the changes ahead. To publicize their support and commitment to the transfer, the sponsors may send a memorandum or electronic mail, hold an organization-wide meeting, or hold a series of briefings across the organization.

You can use the influence strategy developed in the Build/Reinforce Sponsorship and Foundation activity in planning and implementing this task.

Cycle 1 In the first cycle, you will not perform this task because you do not want to publicize any strategies or technologies until you have commitment from all stakeholders.

Cycle 2...N In later cycles, you should work with the sponsors to publicize the decision and their support and commitment to the transfer to help prepare everybody for the changes ahead.

.....

STOP CRITERIA

You are done with this activity when:

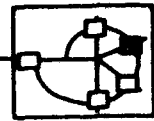
- You have commitment from all stakeholders on the transfer and/or cycle strategy and, when appropriate, on the technology selected for transfer
- The sponsors have publicized their commitment to the organization

\$ Sponsor

 Change Agent

 Champion

 End User



This page intentionally left blank.

5. FOCUS THE TRANSFER: PLAN TECHNOLOGY IMPLEMENTATION

Organizations that successfully introduce new technology concern themselves with the *implications* of the new system as much or more so than with the technology itself.

Daryl Conner, *Managing at the Speed of Change*

Section Objectives

1. Provide guidance for planning the implementation for this cycle

2. Provide guidance for getting commitment on the plan

Implementation of the technology will be helped if a coherent, informed, documented, and public planning activity occurs. Figure 5-1 shows the two activities described in this section.

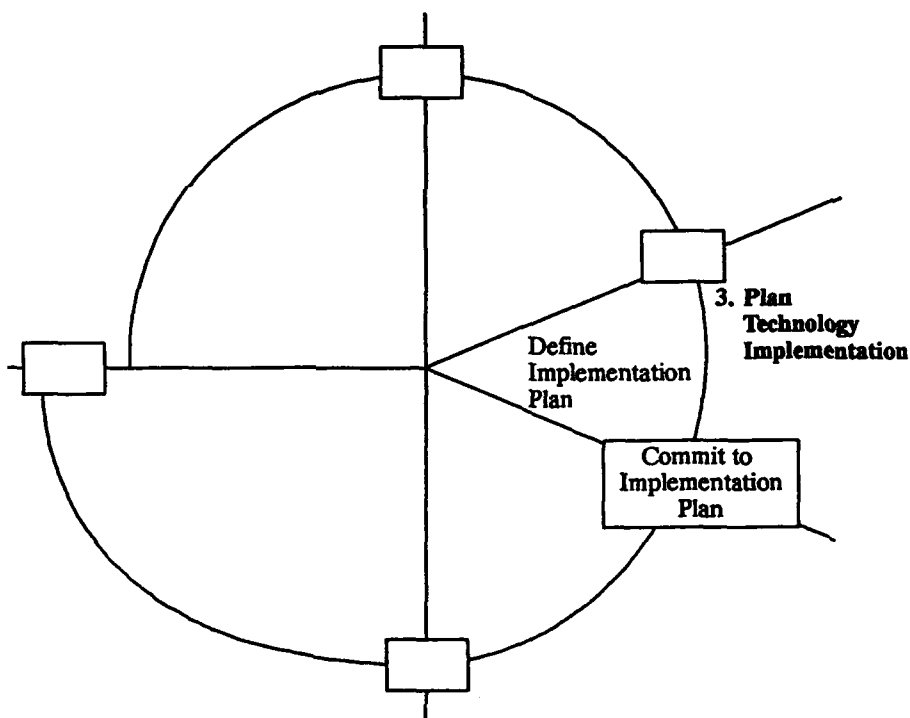
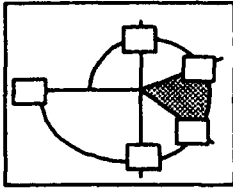


Figure 5-1. Plan Technology Implementation Activities

You will perform the Define Implementation Plan activity first, followed by the Commit to Implementation Plan activity.

5.1 DEFINE IMPLEMENTATION PLAN



This activity begins in Step 3, Plan Technology Implementation.

.....

OVERVIEW

Your objective in this activity is to define the implementation for the current cycle and document it in an implementation plan. The plan will be based on the cycle objectives, constraints, and strategy defined and approved in the previous steps of this cycle.

You will not perform this activity until you have achieved sponsorship, defined and received approval on a transfer and cycle strategy, and selected a technology.

.....

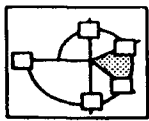
START CRITERIA

You should start this activity when you have:

- Sponsorship and stakeholder buy-in to the transfer
 - An approved cycle strategy, objectives, and constraints
 - A technology approved for implementation
 - A risk management plan that documents the risks associated with the technology and the selected transfer and cycle strategies
 - An understanding of the process and computing environment to be changed
 - Previous examples of implementation plans, if available
-

TASKS

You will develop a plan that defines the implementation for the cycle and then assess the risks associated with the plan. The implementation plan will include success criteria for the implementation, along with associated data collection requirements; implementation tasks; and budget and staffing.

**1. Identify Success Criteria and Associated Data Collection Requirements.**

You need to define the success criteria for the current cycle and define when in the cycle's implementation you will assess progress against these success criteria. You need to predict how far along the transfer will proceed in this cycle; you will compare this prediction to the actual progress made in the Review Progress activity. You will also use your predictions when you seek sponsor commitment to the plan.

Cycle 1,2 You will not perform this task in Cycles 1 or 2.

Cycle N The following list contains guidance for defining the success criteria and data collection requirements:

- **Success Criteria.** The cycle's success criteria will be the measure against which you will determine when the implementation has reached such a state that you should perform a full-scale review and update of plans as described in Step 5 (see Section 7, *Determine Where To Go Next: Review and Update Transfer Plan*). Your success criteria must:
 - Support both the cycle and transfer objectives and strategies.
 - Define when the implementation will be complete for this cycle.
 - Ensure progress against the overall transfer objectives and success criteria.
 - Incorporate criteria by which your stakeholders will measure the success of the transfer. What are potential or actual baseline measures for time, productivity, quality, and cost?
 - Incorporate criteria that measure user satisfaction with the technology and the transfer. For example, does a poll of the users show that more than half are satisfied with the technology? Do the users feel that training and support were adequate?
 - Incorporate criteria that measure the degree of transfer. For example, you may want to include a success criterion that requires that a core feature of the technology be used because that feature was key to that technology's selection. If the key feature is never used, then you need to understand why this has occurred and address it in future cycles.

To define success criteria, you can use the Goal-Question-Metric (GQM) paradigm. GQM systematically develops and specifies quantitative management measurements and metrics appropriate for an identified need. The GQM paradigm is summarized in the following

\$ Sponsor



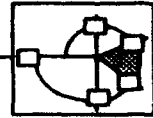
Change Agent



Champion



End User

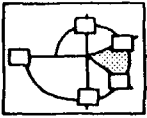


list; for additional detail, see Basili and Weiss (1984), Gilb (1988), and Weiss (1981).

- **State the Goal.** State a single goal of importance to the transfer. For example, a goal may be for the technology to increase productivity by 25%.
- **State the Question.** Decide which question(s) you need to ask to determine whether the goal is being or has been met. Continuing the previous example, your questions may include: "How long does it currently take the organization to perform this task?" "What parts of the task are affected by the new technology?"
- **State the Metrics.** Select the metrics you need to collect to answer the questions. Continuing the example, your metrics may include staff months expended on the task. These metrics form the basis for the data you collect during the implementation to determine whether the transfer, as defined for the current cycle, has succeeded.
- **Data Collection Requirements.** You need to define requirements for how the data will be collected during the implementation. Your data collection requirements must:
 - Be tied directly to this cycle's success criteria.
 - Include specifications of what data will be collected, when it will be collected, who will collect it, and from whom the data will be collected.

Subjective measures will be the easiest to collect early in the transfer; therefore, early in the transfer you should collect subjective measures frequently (e.g., every 2 months for the first 12 months) in the transfer and then taper off as the transfer progresses. Objective measures are better collected after the users have used the technology for a while and should be collected after the technology has had a chance to make an impact (e.g., after 6 months). However, if the technology is easily measured objectively (e.g., a tool) then, early in the transfer you should measure frequently (e.g., every 2 months for the first 12 months) in the transfer.

- Ensure that data collected includes data received from talking to and surveying users to determine their level of satisfaction with the new technology.
- Identify the specific times during the cycle's implementation period ("snap shots") when implementation should be assessed against the success criteria.



2. Define Implementation Tasks. You need to define what tasks will be performed during the current cycle's implementation.

If this transfer is part of a process improvement effort, then you need to work with the Process Group to make sure that the implementation tasks you define are consistent with the overall process improvement plan as well as other transfer efforts. For example, you do not want to plan on using support resources that are already heavily burdened by parallel improvement and transfer efforts. These issues should have been identified as constraints and/or risks in earlier activities in the current cycle; however, they are repeated here because of their importance to the process.

General planning-related guidance that relates to each implementation task includes the following:

- Order the implementation tasks, including task interactions, roles and responsibilities, schedules, and level of effort.
- Indicate the expected results and deliverables of specific tasks.

When scheduling the implementation tasks, you need to be aware that the schedule will be influenced by your available resources, the technology, and the end users. Specific influences in each of these areas follow:

- **Resource Influences.** If you have limited resources but are less constrained on schedule, then assign less staff and more time to perform the activities (however, be aware of biases resulting from a single person doing all of the analyses and definition). If you have a tight schedule but are less constrained by resources, then perform activities concurrently with more staff on each activity (however, in this case, be aware of integration issues across the activity results). If you are limited on time and resources (and cannot change the situation), the best guidance is to delay the transfer until your situation improves. Figure 5-2 depicts these ideas.
- **Technology Influences.** Technologies differ in their complexity, adaptability, compatibility with the existing environment, maturity, and scope of impact on your organization. For example, some technologies may involve no more than a plug-in to a handful of workstations (e.g., a new scheduling tool) while other technologies may demand changes in the skills of all employees (e.g., switching everybody to a high-powered workstation). You need to factor in the technology's characteristics when scheduling integration, support, and training tasks.
- **End User Influences.** The transfer will be influenced by the number of staff targeted to use the new technology, the existing skills of the staff

\$ Sponsor



Change Agent



Champion



End User

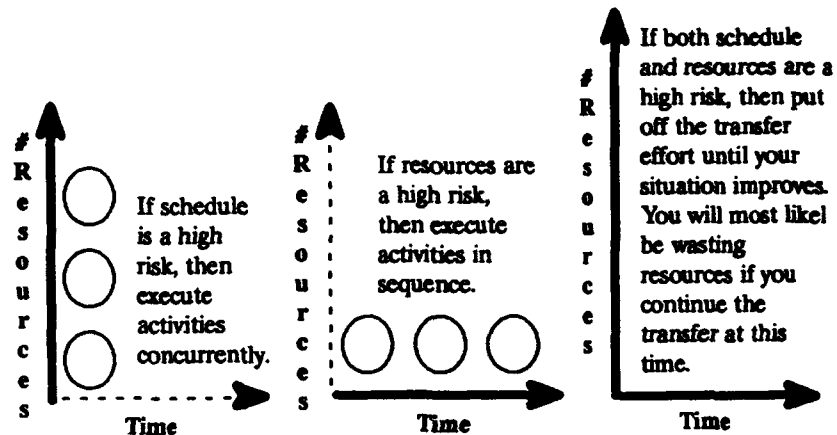
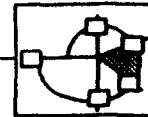


Figure 5-2. High Risk Areas and Order of Activities

(e.g., how much training will be needed?), and the current environment that they work in (e.g., will the end users also need training in the new hardware environment required by the technology?). You need to factor in the end user characteristics when scheduling training and support tasks.

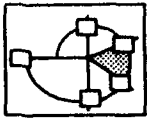
Cycle 1,2 You will not perform this task in Cycles 1 or 2.

Cycle N You need to define implementation tasks that address integration, training, support, and organization change and logistics requirements. The following lists provides guidance for each of these tasks.

- **Integration Task.** You need to integrate the new technology into the existing environment. This may include:
 - Interfacing the technology to existing hardware and software, including identifying any new hardware or software that needs to be acquired for the integration
 - Modifying or creating policies and procedures to maximize integration into the system
 - Identifying and developing any new standards (e.g., conventions, formats) that need to be put in place to support the technology

As an aid, your organization might have in place an approach, or plan, on integrating computer-based tools, methods, and technologies into the environment that you can use in the implementation.

This task discusses integration issues for product technologies (e.g., tools or methods). Transferring process technologies requires a major integration effort within the organization's culture, practices, and environment. Refer to *Managing Process Improvement: A Guidebook for Implementing Change* (Software Productivity Consortium 1993b) for guidance on how to integrate a new process into your organization.



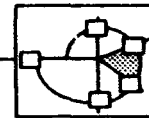
- **Training Task.** You need to define any training tasks to be performed in this cycle. Specifically you need to:
 - Identify the personnel to be trained, required training types (e.g., management overview, classroom), and the schedule.
 - Identify the source of the training, including any needed training tools, and the training providers. If the technology is available from a producer and you have an internal training group, then you need to understand the tradeoffs between using one group or another. If a small number of staff will be using the new technology, then producer-provided training is probably the most cost-effective. If a large number of staff will be using the new technology, then it might be cost-effective to use your organization's internal training functions, possibly in cooperation with the producer, to provide the training. The cut off point for when it is cost-effective to use internal versus producer resources for training should be based on cost estimates for course development and delivery and on cost estimates for producer-supplied training.

If the technology is not available from a producer, then you need to build adequate time into the schedule to develop your own training. A general rule of thumb in industry is that it takes at least 40 hours of course development time for each 1 hour of classroom time.

- Identify how the training will be evaluated (e.g., did the users acquire the needed skills?)
- Closely coordinate the timing between training and the other tasks. If the technology is bolted in and turned on and nobody knows how to operate it, the benefits will be negligible. In addition, if the staff is trained 4 months before they use the technology, then the training benefits are greatly reduced.

As an aid, if you or your organization has modeled the process for the area being modified by the technology, then you can use that model in your training.

- **Support Task.** You need to define who will be providing support services in this cycle. These services may include consulting and hotline support. Specifically, you need to:
 - Define what support services will be provided, including procedures for how to handle support calls and how the support services will be staffed.
 - Identify the source of the support, including any needed support tools, and the support providers. If support is available from a



producer and you have an internal support group, then you need to understand the tradeoffs between using one group or another. If a small number of staff will be using the new technology, then producer-provided support is probably the most cost-effective. If a large number of staff will be using the new technology, then it might be cost-effective to use your organization's internal support functions, possibly in cooperation with the producer, to provide the support. The cut-off point for when it is cost-effective to use internal versus producer resources for support should be based on cost estimates for training and funding internal support personnel and on cost estimates for producer-supplied support.

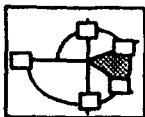
- If using a producer for any or all of the support, make sure they agree to provide these services. If not using a producer, make sure that your internal support personnel are available to provide the support and agree to their role in the transfer.

The support techniques you can use include:

- Access to technology experts, preferably permanently or temporarily transferred to the group.
- Consulting, especially access to one-on-one, hand-holding by an expert for the first 1 to 3 hours using the tool. Have the expert come back at least once every month throughout the transfer to help solve problems and address concerns.
- Hotline support, especially toll-free, unlimited support for the first, critical period of the transfer.
- A frequently asked questions list that documents common end user problems and solutions that you can hand out to all users.

During the initial transfer period, plan to have a high demand for support, including installation, usage questions, and solutions to bug reports. Demand should taper off as experience is gained, but new users will require a high level of support, and existing users will still require support from time to time.

- **Organization Change Task.** In the current cycle, you need to define any changes needed in the organization. Specifically, you need to identify the structural changes in the organization necessitated by the chosen technology, including reporting relationships, group composition, titles, redesign of positions, compensation plans, and procedures. For example, some technologies may demand new job responsibilities and job descriptions while other technologies may demand different communication patterns across functions. You may want to simulate the changes through models, games, role playing, or other approaches to help identify potential problems before they are instituted.



- **Logistics Task.** You need to address the logistical aspects of transfer. These include issues of capital acquisition, movement of offices and people, organizational infrastructure changes (e.g., running cable), and other technology specific issues.



3. Define Budget and Staffing. You need to define the expected budget and staffing requirements for this cycle. If part of a process improvement effort, the budget and staffing for the transfer need to be consistent with the budget and staffing defined for the improvement effort.

Cycle 1,2

You will not perform this task in Cycles 1 or 2.

Cycle N

In later cycles, you need to:

- Identify needed internal and external resources, including trainers, system administrators to perform hardware or software integration, and consultants to do hand-holding with the new users. These requirements should be consistent with the implementation tasks you have described in the implementation plan.
- Identify the expected costs for this cycle. Understand the costs for any acquisition of hardware and software, training (both development and delivery), support requirements, integration time and costs, and initial productivity loss due to the learning curve. These costs should be consistent with the implementation tasks you identified earlier and should be within the budget defined for the cycle.
- Allocate time and resource contingencies to handle such problems as emerging opposition, fading management support, interference of other seemingly independent changes, and system troubles.



4. Identify and Analyze Risks Associated With Implementation Plan. You need to identify any risks associated with your implementation plan and analyze and avert those risks. You should document the results of this task in your risk management plan. This task lists some risks common in an implementation plan; you should refer to the Analyze and Resolve Risks activity for guidance on how to identify, analyze, and avert risks.

Cycle 1,2

You will not perform this task in Cycles 1 and 2.

Cycle N

You need to look at the implementation plan and identify any risks inherent in the plan. Risks that you should look for include:

- Overly ambitious success criteria, schedule, staffing, or budget.
- Staffing assignments that require staff who do not like each other to work together.

\$ Sponsor



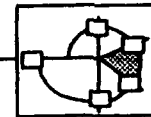
Change
Agent



Champion



End User



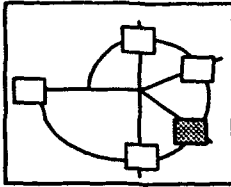
- Producer inability to meet the demands of the cycle (e.g., there are a lot of new users for the cycle and the producer cannot meet the support demands).
- Any stakeholders to be involved in the cycle have not bought into the transfer yet.
- New users do not have adequate prerequisites or experience to either use the tool or be trained.
- Inadequate resource contingencies to address new risks as they occur.

.....

STOP CRITERIA

You should stop this activity when you have an implementation plan that details what needs to be done to progress the transfer during this cycle.

5.2 COMMIT TO IMPLEMENTATION PLAN



This activity begins at the end of Step 3, Plan Technology Implementation.

.....

OVERVIEW

Your objective in this activity is to get all stakeholders to commit to the implementation plan for this cycle. A key part of this activity is that the sponsors publicize the commitment across the organization.

You will not perform this activity until you have achieved sponsorship and defined and received approval on the transfer and cycle strategies.

You should not proceed with the transfer until you have successfully completed this activity.

.....

START CRITERIA

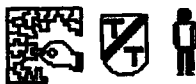
You should start this activity when you have:

- An approved cycle strategy, objectives, and constraints
 - A detailed implementation plan for the cycle
-

TASKS

You need to obtain approval from the stakeholders on the implementation plan.

If this transfer is part of a process improvement effort, then you need to get review and approval from the Process Group. Depending on your particular situation, the Process Group will either be the sponsors or the champions for this transfer.



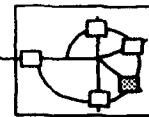
1. Obtain Review and Approval From Champions, Change Agents, and End Users. You should seek approval first from all stakeholders other than the sponsors. The sponsors will not approve the plan until there is buy-in from all the other players involved in the transfer.

\$ Sponsor

 Change Agent

 Champion

 End User



Cycle 1,2 You will not perform this task in Cycles 1 and 2.

Cycle N You need to get the identified champions, change agents, and end users to review and approve the plan. You may need to go through several iterations in the review process before they will approve it.



2. Obtain Commitment From Sponsors. You need to get a commitment from the identified sponsors on the implementation plan.

Cycle 1,2 You will not perform this task in Cycles 1 and 2.

Cycle N After you have approval from the champions, change agents, and end users, you need to present your plan to the identified sponsors for their commitment. Your presentation should include:

- A description of the plan
- How the plan supports the cycle objectives and your predictions on the progress that will be made against the overall transfer objectives
- How this plan will affect each part of the organization for this cycle, especially the groups related to the sponsors you are briefing
- The estimated cost and time frame for the implementation of this plan

Depending on your situation, you may decide to stagger the presentations, targeting first those sponsors who are more supportive in order to build up a stronger case for those sponsors who are less supportive.

You may have several iterations in your presentation to management before you get a final decision to go ahead with the implementation. If so, return as necessary to any task in this activity or in the Define Implementation Plan activity to get the decision to proceed.



3. Publicize Commitment. After approving the implementation plan, the sponsors need to publicize their support and commitment throughout their organization to keep everybody informed, to ensure the end users that the transfer is important, and to help prepare everybody for the changes ahead. To publicize approval, the sponsors may send a memorandum or electronic mail, hold an organization-wide meeting, or hold a series of briefings across the organization.

You can use the influence strategy developed in the Build/Reinforce Sponsorship and Foundation activity in planning and implementing this task.

Cycle 1,2 You will not perform this task in Cycles 1 and 2.

\$ Sponsor



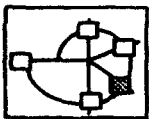
Change Agent



Champion



End User



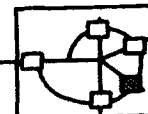
Cycle N You should work with the sponsors to publicize the decision and their support and commitment to the transfer.

.....

STOP CRITERIA

You are done with the activity when:

- You have commitment from the stakeholders on the implementation plan
- The sponsors have publicized their commitment to the organization



This page intentionally left blank.

6. GETTING IT DONE: IMPLEMENT TECHNOLOGY

There has been an enormous amount of pain and trauma. And the culture's not completely changed yet.

J. Phillip Samper, Vice Chairman, Kodak

Section Objective

Provide guidance for implementing the technology into the organization

Getting the end users to use the new technology is the hardest part of the entire process. People naturally resist new things and without constant motivation and support will not use the new technology. If you do not pay adequate attention to this activity, despite all of the planning you have performed, the transfer will fail. Figure 6-1 shows the three activities described in this section.

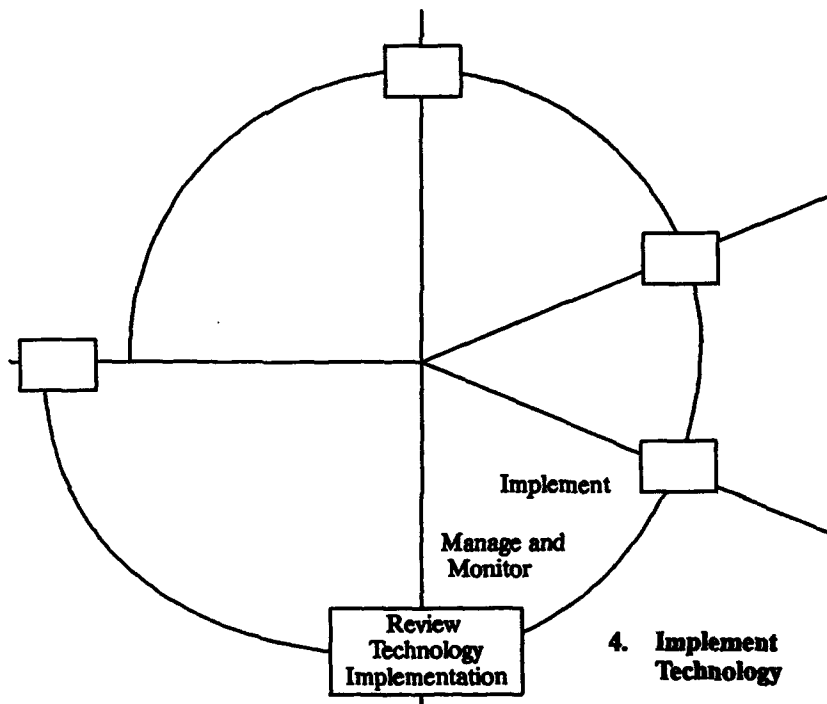
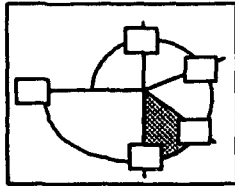


Figure 6-1. Implement Technology Activities

You will perform the Implement and Manage and Monitor activities in parallel and the Review Technology Implementation activity at the end.

6.1 IMPLEMENT



This activity begins in Step 4, Implement Technology.

.....

OVERVIEW

Your objective in this activity is to carry out the implementation plan for this cycle. You should do this with the same urgency as you would a contract project for an external client, including following standard scheduling and monitoring procedures. However, in the process of carrying out the plan, you will run into users that are not willing or able to use the technology, sponsors that have wavering support for the transfer, change agents that get distracted by other work demands, and champions that do not have the energy to continue publicly supporting the transfer.

To alleviate some of these problems, you need to first be aware that these problems will occur. By being aware of this, you may be able to prevent them from occurring, or at least reduce their severity, by maintaining communication with the sponsors, keeping the champions motivated, and supporting the end users so that their problems are resolved quickly.

You will not perform this activity until you have achieved sponsorship and defined and received approval on the implementation plan.

.....

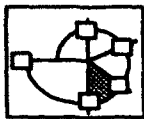
START CRITERIA

You should start this activity when you have:

- An approved, detailed implementation plan
 - Resources to perform the implementation
-

TASKS

The primary task in this activity is transferring the technology as specified in the implementation plan for this cycle. The other tasks are listed here as separate tasks to emphasize their key role in the success of the transfer: reinforcing sponsorship, addressing resistance to change, and supporting the end users.

*Cycle 1,2*

1. Carry Out Implementation Plan. You will carry out the actions specified in the implementation plan.

You will not perform this task in Cycles 1 and 2.

Cycle N

Implement the technology as specified in the implementation plan for this cycle. This may include initiating pilot projects, conducting the training, starting up support mechanisms, and carrying out all other tasks in the implementation plan.

To aid the implementation, use the help of local experts in the use of the technology. These people can be invaluable in helping new users learn and become comfortable with the technology. In addition, these people can become local champions for the technology.

*Cycle 1,2*

2. Reinforce Sponsorship. Unless you maintain communication and show ongoing progress to your sponsors, you risk losing their support and their sponsorship for the implementation and the transfer.

You will not perform this task in Cycles 1 and 2.

Cycle N

To reinforce sponsorship, you need to periodically update your sponsors on the progress of the implementation, including problems that you encountered and resolved and progress against the overall transfer.



3. Address Resistance to Change. Despite the fact that you have sought commitment and approval throughout the transfer process, you will still encounter management and staff who resist the change throughout the implementation.

Resistance is a natural response to changes that cause major disruptions or inconsistencies to the status quo. The more dramatic the change, the greater the resistance. You can increase your effectiveness in implementing the technology by understanding and respecting this natural reaction.

People express their resistance differently. Covert resistance, the harder to manage, occurs when people disagree with the change, but do not share their concerns. Instead, they may choose to undermine or sabotage the change. Overt resistance is much easier to manage because you can directly address their issues since you know about them. Therefore, you should not try to stifle people's resistance to the change; rather you should try to bring their resistance in the open and address it publicly. If one stakeholder has an issue with the transfer or technology, you can bet that others have the same issue; if you address the issue publicly, then you address it for people that have not voiced or have not yet run into the issue. In fact, if you encourage people to question the transfer and the technology, then you

\$ Sponsor



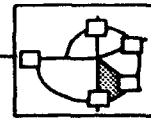
Change Agent



Champion



End User



will build up trust and support because of your openness and your belief that the opinions of others are important.

People resist change even when it is perceived as positive. The positive reaction pattern to change is depicted in Figure 6-2. The terms used to describe these stages are found in O.D. Resources (1989) and are as follows:

- **Stage 1, Uninformed Certainty.** In this stage, a person is confident that the change is entirely for the better and has high expectations of the results.
- **Stage 2, Informed Doubt.** In this stage, a person begins to realize that expectations were set too high. Resistance will most likely surface during this stage and can be either covert or overt.
- **Stage 3, Realistic Concern.** In this stage, a person begins to reconcile expectations with reality and to think positively about the change.
- **Stage 4, Informed Certainty.** In the last stage, people are once again confident of success but only because they have a better understanding of what will and will not change.

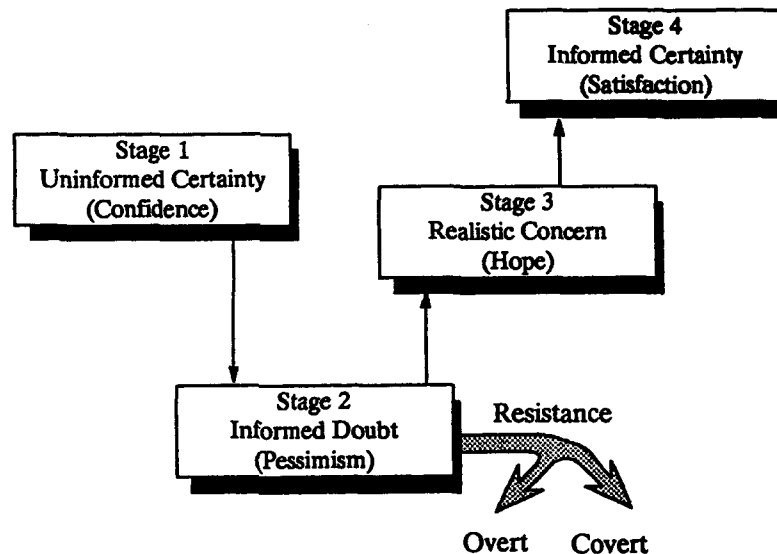
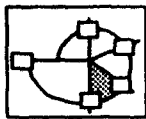


Figure 6-2. Positive Response to Change

By being aware of the way people will respond to change, you can be proactive in helping them through the stages. Guidance for how to do this is given later in this task.

Cycle 1,2 You will not perform this task in Cycles 1 and 2.

Cycle N Sponsors, end users, and even champions and change agents will all resist the change at one time or another throughout the process. By being aware of this, you can be proactive in reducing the resistance and helping them



through the positive response to change depicted in Figure 6-2. Table 6-1 lists several reasons why each stakeholder group may resist the change along with some strategies you can adopt to reduce this resistance. Several of these strategies are described in other activities in this guidebook. They are repeated here for emphasis.

Table 6-1. Resistance to Change Responses and Mitigation Strategies

Resistance to Change Responses	Mitigation Strategies
If end users: • Refuse to use the new technology because of dislike for the technology or for the transfer • Quietly subvert the transfer to their peers • Publicly complain about the technology and the transfer	Then you can: • Involve end users in the planning and decision-making activities. Be honest but upbeat about the transfer and the technology. Use a reward/recognition system for participants. Provide support. • Encourage the end users to express their complaints and problems publicly. Continuously check with the end users to see how things are going. • Encourage continued discussion and address their concerns as best you can.
If change agents or champions: • Lose some of their enthusiasm for the transfer as the transfer progresses	Then you can: • Hold meetings throughout the transfer to keep spirits up. Use a rewards and incentive program to maintain enthusiasm.
If sponsors: • Want to discontinue support of the transfer due to loss of political power	Then you can: • Involve the sponsors in every decision and review. Make sure they feel a part of the transfer. Address their concerns.

Example 6-1 describes a case where resistance was met because of lack of customer and management buy-in to the technology and how the resistance was successful in stopping the transfer.



4. Support the End Users. Once end users have a new technology in hand, they must have adequate support while installing and using the technology. If they do not get adequate support, the probability of full acceptance and use of the technology will decrease rapidly.

Cycle 1,2

You will not perform this task in Cycles 1 and 2.

\$ Sponsor



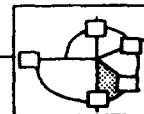
Change Agent



Champion



End User



Matchless Computing, Inc., is a highly regarded defense supplier with a large backlog of contracts for Navy information systems. Matchless prides itself on the cohesiveness of its management team. (Ed Froth, the CTO, routinely takes other members of the executive group on golf outings.) The firm is also known for promoting innovativeness among "the troops."

Linda Harris, manager of Computer Systems for Matchless, has taken advantage of this support for innovation in the past and sees another change to move her organization ahead technically. Currently, most of Matchless' applications use the System 402 database product from Computer Architects of Central America (CACA). She knows this system is outdated; the new DELPHI database system offers more features at a lower cost. In her opinion, this system is destined to become the de facto industry standard.

But how can she deal with Matchless' large investment in legacy systems? In her search for a solution, Linda calls a staff meeting to discuss alternatives. At the meeting, her Advanced Technology Group assures her that they can readily develop a translator to convert the existing applications. After some discussion, Linda commissions the group to develop the system, and within a few weeks they have achieved a 98 to 99% translation automatically. The effort is deemed a technical success, and Matchless is poised to convert from System 402 to the DELPHI system.

John Eyore, the accounting department manager who is responsible for many of the System 402 applications the translator would change, was not informed of Linda's work, and resists the transfer. Changing the database system will require some changes in the way his department operates. John is also concerned it could eventually reduce his staffing level, in effect reducing his status within the organization. As a result, he simply refuses to adopt Linda's solution, putting her work in limbo. The CTO is called in as a mediator. The weekend before the CTO is to resolve the conflict, he is seen playing golf with John at John's country club. Later that week, the CTO issues a memo providing John's department with a waiver from this conversion requirement.

Example 6-1. A Case of Not Getting User and Management Buy-In

Cycle N Provide support as defined in the implementation plan for this cycle. You may need to provide support dynamically if you are running into unexpected support problems.

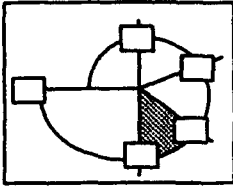
One of the most effective ways to get users to use a new technology is to have an expert work with them as they use it the first time. This way, questions can be answered immediately and the user and expert can develop a rapport which will increase the user's comfort level.

.....

STOP CRITERIA

You will stop this activity when you have completed the implementation as defined in the implementation plan for this cycle.

6.2 MANAGE AND MONITOR



OVERVIEW

This activity begins in Step 4, Implement Technology.

.....

Your objectives in this activity are to manage and collect data on the implementation. You should perform this activity in the same manner as a contract project for an external client. In fact, you should adopt analogous processes (i.e., schedule monitoring and status meetings and reports).

You will not perform this activity until you have achieved sponsorship and defined and received approval on the implementation plan.

.....

START CRITERIA

You should start this activity when you have:

- An approved, detailed implementation plan
 - Resources to manage and monitor the implementation
 - A risk management plan describing potential risks for the cycle
-

TASKS

In this activity you will manage the implementation, gather data on the implementation as it progresses, and stay on top of implementation risks.



1. Manage Implementation. It is important that the implementation show visible progress against the objectives of the cycle and of the transfer. To do this, you need to manage the implementation so that you will have insight into how the transfer is proceeding and can show visible progress to your sponsors and other stakeholders.

Cycle 1,2

You will not perform this task in Cycles 1 and 2.

Cycle N

The implementation needs to be managed just as any contract project would be managed. Specifically, you will:

\$ Sponsor



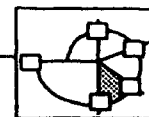
Change Agent



Champion



End User



- Track progress of the implementation against the schedules defined in the implementation plan.
- Track progress against your assigned budget.
- Publicize progress of the implementation periodically to your management, other sponsors, users, and other groups within the organization.
- Begin the implementation with a kickoff meeting and invite the champions, the change agents, and a representative of senior management (his/her role is to present management commitment and expectations). Devote the meeting to reviewing each implementation task, reviewing the transfer and cycle schedules, confirming resource and people availability, and building enthusiasm for the transfer. The meeting should close with an agreement on when the implementation tasks will begin and when the next meeting will be held.
- Hold regular meetings throughout the implementation to highlight issues and problems on the part of the change agents (which may have interdependencies across tasks), maintain morale, and provide a context for bargaining over the implementation plan and schedule.
- Maintain communication between all of the stakeholders on the status of the transfer. This will help continue momentum and buy-in to the transfer.
- Work with the producer to ensure that any support, resolution of bug reports, and training are provided and maintained.



2. Gather Implementation Data. You need to gather data on the implementation as it progresses. Requirements for what data to collect and when to collect it are outlined in the implementation plan. This data will be used in the next task to determine progress against the implementation plan and in the Review Progress activity to review the implementation against the transfer objectives.

Cycle 1,2

You will not perform this task in Cycles 1 and 2.

Cycle N

Assess information to ensure that the transfer is proceeding according to plan. Specifically, you will:

- Ensure that you are routinely receiving any progress reports of transfer tasks.
- Gather information directly from the transfer sites because the progress reports might not include seemingly minor details.

\$ Sponsor



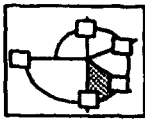
Change Agent



Champion



End User



You should make sure that you are gathering the following data:

- **User Satisfaction Data.** You need to question the end users and ask about their level of satisfaction with the technology. Do they feel that they were adequately trained to use the technology? Were their problems and questions resolved in a timely manner? Did they run into any integration problems? Do they like the new technology and is it helping them in their job? If your end users are not happy with the technology, then the transfer is running a high risk of failure and you need to devote your efforts to solving their problems.
- **Technology Effectiveness Data.** You need to collect data on the use of the technology itself, including whether the end users are using the technology correctly, are using it in ways not originally intended, or are using it at all.
- **Schedule Data.** You need to track how long the implementation is taking, including training, integration, and learning curve time.
- **Budget Data.** You need to track the staff hours logged against the implementation, including training hours, support hours, and hours spent documenting the technology and the transfer process. You also need to track other costs of the implementation, including acquisition and support costs.



3. Determine Progress of Implementation Against the Plan. You will take the data collected in the previous task and compare it to the success criteria defined in the implementation plan.

Cycle 1,2

You will not perform this task in Cycles 1 and 2.

Cycle N

Compare the information you gathered against the success criteria to determine whether you are progressing as expected. If the implementation achieves success criteria, you need to determine whether to continue with the implementation or start a formal review of the implementation. Keep the following guidance in mind when making this determination:

- **Check Progress of Implementation.** Before you move to the next step of the process for a formal review, you need to ensure that the implementation has been completed to such a point that it makes sense to proceed with the next activity. If you stop implementation too early, before the technology has had a chance to generate improvements, you risk reporting benefits that do not accurately portray what the technology is capable of providing your organization. If you wait too long, you risk dampening the enthusiasm for the change or losing management commitment by not publicizing success stories early enough.

\$ Sponsor



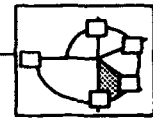
Change
Agent



Champion



End User



If you do not make the expected progress, find out what has happened. Slowed progress might be due to problems in several areas: the implementation plan, producer support, political and management support, user buy-in, unexpected or expected risks, the technology itself, or the technology's interface to the environment. Stop or slow down the implementation; determine how to resolve the problems; and replan, reformulate, or reperform certain tasks to resolve the problems. Then continue the implementation.

- **Assess Qualitative and Quantitative Progress.** Ongoing implementation assessment should examine not only **quantitative** progress towards the implementation goals (e.g., how many lines of code are being written using the new technology versus the old), but also whether the technology fits the users' needs and expectations in a **qualitative** sense. Is the technology being used in ways that support the transfer goals? Does the implementation maximize the technology's potential?

Figure 6-3 graphically depicts quantitative as well as qualitative assessments. The productivity and quality targets in this figure would have come directly from your understanding of the expected benefits.

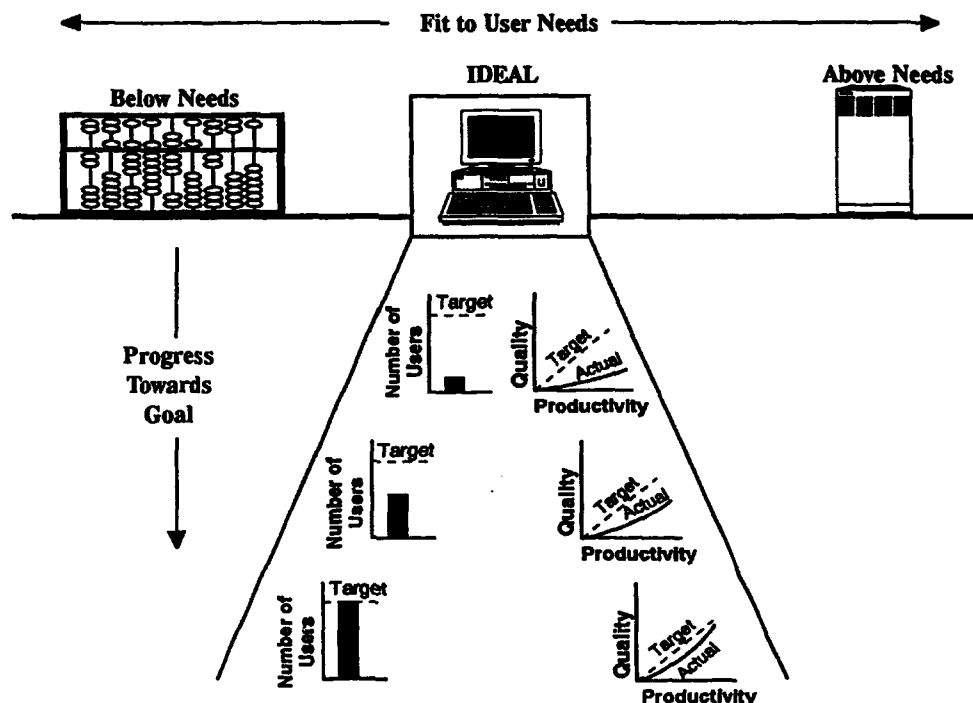
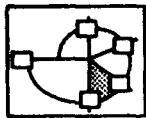


Figure 6-3. Assessing Quantitative and Qualitative Progress



4. Identify and Analyze Risks Associated With Implementation. You need to address any risks identified in the risk management plan as they occur and stay on top of any new risks that occur during the implementation. You should document the results of this task in your risk management plan. This task lists some risks that may occur during implementation; you should refer to the Analyze and Resolve Risks activity for detailed guidance on how to identify, analyze, and avert risks.

Cycle 1,2

You will not perform this task in Cycles 1 and 2.

Cycle N

You need to stay on top of risks documented in the risk management plan for the cycle and keep your eyes open for new risks that may occur. The following are some common implementation risks:

- End users do not feel they are adequately supported during their first days with the technology.
- The technology does not integrate into the environment as planned.
- End users complain that, though they agree to support the transfer, they are in the middle of a schedule crunch and cannot use the technology until later.
- Champions and change agents start getting other demands for their time.
- Sponsors are nervous about spending resources without any immediate, perceived benefit.

Other common risks associated with stakeholder resistance to the transfer are listed in Table 6-1 in Task 3 in the Implement activity.

If a risk occurs, you have several options for how to proceed. The following list describes your options, based on the severity and number of risks:

- **Minor Risks.** If you do not feel that a risk will have a major impact on the cycle or the transfer, and there are not a large number of risks occurring, then you should address the risk the best you can and continue the implementation for the cycle.
- **Major Risks.** If a risk is severe (e.g., the technology cannot be used at all because of integration problems or a key sponsor is transferred out of the organization), then you may want to stop the cycle's implementation to understand the impact on the transfer.
- **Large Number of Risks.** If a large number of risks are occurring, even though any single one may not be too severe, then you may want to stop

\$ Sponsor



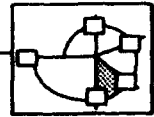
Change Agent



Champion



End User



the transfer to try to understand why the risks are occurring and what the impact is on the transfer.

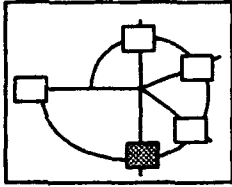
Keep in mind that stopping the transfer in the middle of the implementation can have an adverse affect on stakeholder's attitudes toward the transfer. You should not make the decision without first getting stakeholder buy-in to the decision.

.....

STOP CRITERIA

You should stop this activity when the implementation for this cycle has been completed as defined in the implementation plan, or you and other stakeholders agree that a formal review of the implementation's progress needs to be performed.

6.3 REVIEW TECHNOLOGY IMPLEMENTATION



This activity begins at the end of Step 4, Implement Technology.

.....

OVERVIEW

Your objectives in this activity are to collect and review the process assets and the lessons learned generated during the implementation. You will use this information in the next step to formally review the progress of the current cycle's implementation.

You will not perform this activity until the implementation for the current cycle has met the success criteria defined in the implementation plan.

.....

START CRITERIA

You should start this activity when you have:

- An approved, detailed implementation plan
 - A risk management plan
 - Data on the progress of the implementation
-

TASKS

In this activity, you will collect and review process assets and document the lessons learned during the implementation.

If this transfer is part of a process improvement effort, then you need to involve the Process Group in this activity. Depending on your situation, the Process Group will either be the sponsors or the champions.



1. Collect and Review Process Assets. During the implementation, change agents, champions, end users, and possibly even sponsors will develop documents—including memos, policies and procedures, and reports—that support the implementation. For example, if you are transferring in a new electronic mail system, you may have developed a set of directions for how

\$ Sponsor



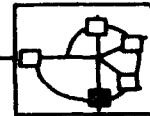
Change Agent



Champion



End User



to send and receive mail. In addition, you have developed a transfer plan, a risk management plan, and an implementation plan related to the transfer and cycle. These documents are called **process assets**.

Cycle 1,2 You will not perform this task in Cycles 1 and 2.

Cycle N You need to collect the assets developed during each cycle and have them reviewed by the stakeholders identified in the Build/Reinforce Sponsorship and Foundation activity. Each stakeholder should review the asset for accuracy and completeness. Your stakeholders in this cycle are the change agents, champions, end users, and sponsors identified in the Build/Reinforce Sponsorship and Foundation activity. You should incorporate the comments from the review in the process assets as appropriate.



2. Collect and Review Cycle-Level Lessons Learned. As the implementation progresses, change agents, champions, end users, and sponsors will learn what works and what does not work regarding the implementation of the technology. These cycle-level lessons learned, which are tied to the specific technology, process activity, or organizational unit involved in the current cycle's implementation, need to be collected and reviewed in this task. Strategic-level lessons learned, or how the current cycle's lessons learned will impact the overall transfer or the organization's overall transfer process, will be identified in the Review Progress activity.

Cycle 1,2 You will not perform this task in Cycles 1 and 2.

Cycle N Cycle-level lessons learned, which might be tied to the specific technology or to the specific part of the organization or process being changed, must be collected, documented, and reviewed by the transfer's stakeholders. Each stakeholder should review the lessons learned for applicability to their own role in the transfer process. Your stakeholders in this cycle are the change agents, champions, end users, and sponsors identified in the Build/Reinforce Sponsorship and Foundation activity.

.....

STOP CRITERIA

You should stop this activity when you have collected and the stakeholders have reviewed the process assets and cycle-level lessons learned generated by the current cycle's implementation.

\$ Sponsor



Change Agent



Champion



End User

7. DETERMINE WHERE TO GO NEXT: REVIEW AND UPDATE TRANSFER PLAN

It is a mistake to look too far ahead. Only one link of the chain of destiny can be handled at a time.

Winston Churchill

Section Objectives

1. Provide guidance for formally reviewing the results of the transfer to date
2. Provide guidance for updating planning documents
3. Provide guidance for deciding and getting commitment on what to do next

Once the technology implementation for the cycle has been completed, you need to review the progress against the objectives in both the implementation plan and the technology strategy. Based on this review, you will update your plans and strategy; define recommendations for how to proceed; and, if it makes sense and you can get commitment, proceed with the transfer. Figure 7-1 shows the three activities described in this section.

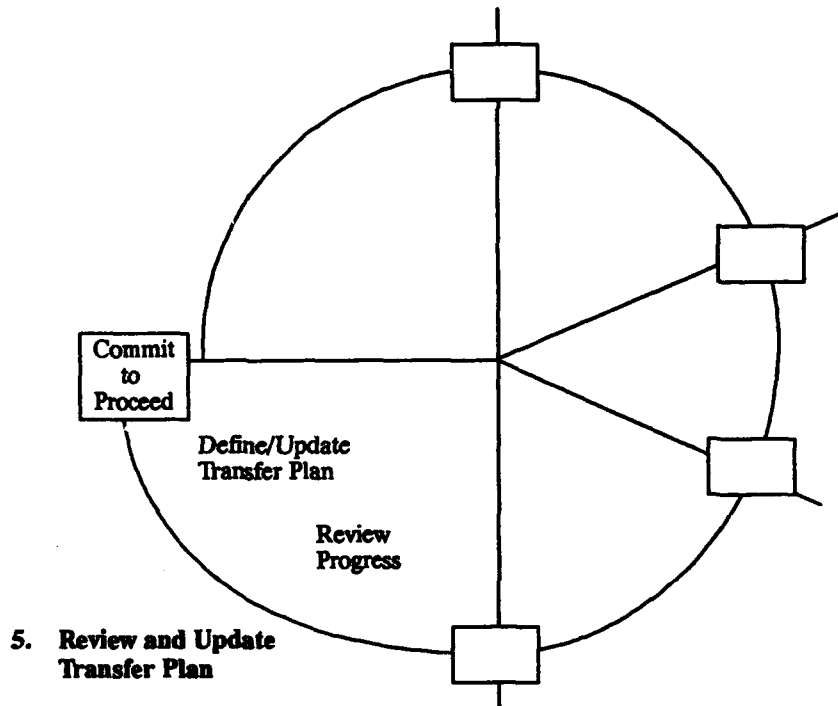
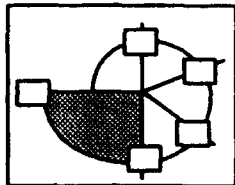


Figure 7-1. Review and Update Transfer Plan Activities

You do not need to perform the Define/Update Transfer Plan and Review Progress activities linearly; however, you will need to finish the Review Progress activity before you can completely define or update the transfer plan. You will perform the Commit to Proceed activity at the end of the step.

7.1 REVIEW PROGRESS



This activity begins in Step 5, Review and Update Transfer Plan.

.....

OVERVIEW

Your objectives in this activity are to perform a formal review of the progress made in the current cycle against the cycle and transfer objectives and to understand the impact of the current cycle's lessons learned on the rest of the transfer. You will use this information in the Define/Update Transfer Plan activity to define and/or update any planning documents before committing to proceed.

You will not perform these tasks until all or part of the implementation has been completed and the process assets and lessons learned for the cycle have been reviewed by all identified stakeholders.

Examples 7-1 and 7-2 provide a summary of an entire transfer experience.

.....

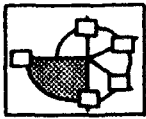
START CRITERIA

You should start this activity when you have:

- An approved implementation plan for the cycle
 - Approved transfer and cycle objectives, constraints, and strategy
 - Data and results from the implementation
 - Reviewed process assets and lessons learned generated during the current cycle's implementation
-

TASKS

You will compare the implementation progress to the cycle and transfer objectives and to the cycle success criteria, collect data on the transfer process, analyze the lessons learned from the current cycle's implementation for how they will impact the rest of the transfer, and baseline the process assets and the lessons learned documents.



Charlie, a senior project lead at Jones' Aircraft, was tasked with the problem of figuring out how to capture design decisions and rationale for reuse on later projects. There had been some ad hoc software code reuse going on at Jones' Aircraft, and management's first step at helping systematize this reuse was to look for ways to capture design decisions.

Recently, Charlie had been assigned to head a project that was scheduled to start in approximately 6 months. The project, called MicroControl, was responsible for the design and implementation of software for the control of a distributed system of microprocessors. It was part of a larger contract within Jones' Aircraft and therefore had to integrate with other subsystems developed under the same contract. MicroControl had a total development time (with little slack) of 24 months. Charlie saw this as the perfect opportunity for piloting a new design capture technology.

Before MicroControl kicked in, Charlie started looking through journals, contacting vendors, and talking with his friends in the industry to see what technologies were out there that could capture design decisions and rationale. Charlie also reviewed and analyzed previous company projects where handwritten notes were the chief form of record keeping to see what type of data was being kept and how the record keeping could be improved and utilized.

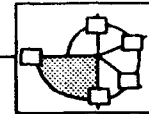
After a couple of weeks of analysis, Charlie found a new technology (method and tool), Vis-Graph, that seemed to solve some of the key problems. Charlie analyzed Vis-Graph to make sure it addressed the basic requirements set down by Jones' Aircraft's management.

The entire analysis of available technologies and the detailed analysis of Vis-Graph took Charlie approximately 3 staff months spread over a period of 6 calendar months.

During each planning meeting of the MicroControl project team, Charlie examined the environment to be used in development. In these meetings, Charlie learned that Vis-Graph was not available on the computing platform chosen for MicroControl. To mitigate this risk, Charlie talked with the vendor of Vis-Graph to see if a text-only version of Vis-Graph could be developed that, while preserving the methodology and the basic functionality of the technology, would be hardware independent. Vis-Graph's vendor was interested in developing such a product since it would expand their potential customer base, and agreed to develop a text-only version as long as Charlie and his team would use early copies of the software to test and find bugs in the software.

Charlie also worked with the MicroControl project team to define current work practices. He analyzed Vis-Graph to understand how it would impact integration with the other subsystems being developed under the contract and decided that there would be no impact except for the fact that the teams developing the other subsystems would have to "learn" Vis-Graph to the extent that they could understand Vis-Graph's design output during integration planning meetings.

Example 7-1. Summary of an Entire Transfer (Part 1 of 2)



Starting immediately after the Vis-Graph selection, Charlie used one-on-one interviews with management from all affected areas to gain buy-in to the technology. He also spent time with the MicroControl project team and used demonstrations, prototypes, and related experiences both to ensure the applicability of Vis-Graph as well as convince the team to use it. In addition, throughout the implementation, Charlie continually acted as an interface to management (especially management outside the software development organization) to inform them of the progress and to ensure them of a positive return on the investment they were making. Charlie answered management's questions with reports on how well the design was being evaluated for quality using the Vis-Graph technology and how this would pay off when customer delivery time came.

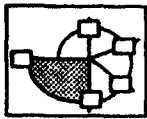
All in all, Charlie spent approximately 30 staff-days spread over an 18-month period to sell management on the Vis-Graph technology.

When implementation time came, the text version of Vis-Graph developed by the vendor was installed on all of the computers being used by the MicroControl project team. In addition, as part of the implementation, Charlie:

- Defined an incremental approach to the implementation where, as each stage in the life cycle was reached by the MicroControl project team, Charlie would introduce and train that portion of Vis-Graph to the team.
- Modified the vendor's standard training course to concentrate on the methodology since the project was using a text-only version of the technology. Training schedules were ad hoc in nature since Charlie was a working member of the development team.
- Ensured that design meetings always used Vis-Graph as the documentation and methodology-control communication mechanism and ensured that the implementation of Vis-Graph was integrated into the MicroControl project team's schedule.
- Kept track of the time it took to be trained and to use Vis-Graph for all decision meetings. The estimated time for this was about 1 staff-week to learn Vis-Graph and the methodology and about 3 staff-months to transform the data from the simple, text-oriented version to the full-scale version and analyze the data for results.
- Continually recorded data related to how much time was spent using Vis-Graph and the methodology in order to be able to measure benefits against costs at the end of the MicroControl project.

Charlie documented and presented to management his observations about Vis-Graph use: there was increased potential for code reuse because of the capture of design decisions that might be applicable to other projects; Vis-Graph was used to help produce MicroControl project management reports; meetings grew shorter because team members used the methodology to "remember" the open issues; other organizational units became familiar with the technology, though they did not necessarily adopt it; and, most important, the MicroControl project team reported a savings of three to six times the invested effort for errors found early on the design that would have been costly to fix after delivery.

Example 7-2. Summary of an Entire Transfer (Part 2 of 2)



1. Compare Implementation Data to Objectives. You need to understand the progress made during this cycle's implementation compared to the success criteria made in the transfer plan and to the success criteria and the predictions for progress against the success criteria documented in the implementation plan for this cycle.

Cycle 1,2 You will not perform this task in Cycles 1 and 2.

Cycle N Analyze the data gathered during the implementation for the following:

- **End User Satisfaction.** Was the implementation considered a success by the end users? Were they satisfied with how the technology worked? Did they feel that they were adequately trained and supported? If shortcomings of the technology or the implementation mechanisms are identified, then these need to be addressed in the transfer strategy and future cycle strategies.
- **Technology Impact.** Was the technology used to its fullest extent? Were there key features of the technology that were not used? Were all of the key features used, yet the expected impact on the process was not made? If a key feature is never used (maybe the users are uncomfortable with that feature), then you need to understand why this has occurred and address it in future cycles. However, if all key features are used, but the expected impact was not made, then you either need to lower stakeholder expectations about the speed at which the technology will show benefits or plan to address this issue in the next cycle. For example, you may want to do a study to try to understand the reason why the technology is not making an impact (maybe the users do not realize they are using the technology incorrectly).
- **Sponsor Satisfaction.** Was the implementation considered a success by the sponsors? Do they feel that they either have or are getting a positive return on their investment in the transfer?
- **Transfer Strategy.** Did the realities of the implementation stray from the original strategy? For example, maybe the strategy called for a pilot of the technology on one project before moving to more of the organization but, in reality, this technology is not conducive to being used on a trial basis because it requires cooperation from multiple support functions (e.g., network support, accounting) to be most effective.
- **Transfer Success Criteria and Objectives.** Did the implementation make progress against the transfer success criteria and objectives? If there was no progress, then you need to carefully look at your objectives for the next cycle. You can not afford to spend resources and time on a

\$ Sponsor



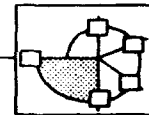
Change Agent



Champion



End User



transfer without making any progress toward your goal. Your best bet will be to develop a next-cycle strategy that stands a high chance of making progress quickly. Alternatively, you can alter your transfer success criteria objectives, though that might start making stakeholders suspicious of any other transfer plans that have been developed. However, please keep in mind that since everybody has bought in to the current plans at each milestone in the process, everybody will be looking for the best way to proceed. In addition, you can use this knowledge as lessons learned when you modify your objectives.

- **Cycle Strategy and Objectives.** Did the implementation make progress against the cycle objectives? If not, or if progress was not as much as expected, then you should use that information as lessons learned when you define your objectives for the next cycle (and not make them as ambitious). Did the cycle strategy turn out to be the correct one to follow or did the realities of the implementation deviate from the strategy? Again, the lessons learned from the current cycle can be used in defining the objectives and strategy for the next cycle.
- **Other Impacts.** You need to analyze the results of the implementation for other impacts that you might not have foreseen in the planning process. These other impacts include:
 - **Indirect Impacts.** A new technology tends to have a wider effect beyond the targeted impacts. This may include permanent changes in job duties, organizational structures and processes, or skill demands. Comparatively analyze the implementation in these areas.
 - **Implementation Processes.** Among the impacts of implementing new technology are those that are tied to the implementation process itself. In effect, the before-versus-after disturbances of organizational life, and the qualitative (or quantitative) costs.

Document your analysis in a lessons-learned document. Include analyses of risks and whether risk aversion plans were successful. Figure 7-2 shows an example of different outcomes for a sample set of measures. Example 7-3 describes a case where there were multiple successful outcomes from the implementation of a single tool.



2. Collect Data on Technology Transfer Process. To improve the way your organization transfers technology, you need to collect data across multiple transfers. From this data, you can:

- Identify transfer activities needing improvements by identifying those process steps that are consistently costly and/or problematic.

\$ Sponsor



Change Agent



Champion



End User

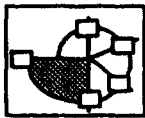


Figure 7-2. Different Implementation Outcomes

General Inertia Company (GIC) recently implemented a Configuration Management Tool and has evolved a set of measures to assess the impact of the tool, as well as provide a greater level of precision in the management of its system design function.

Both quantitative and qualitative measures are used. For example, managers are now systematically "clocking" the time from initial concept to prototype system. Other, more qualitative indexes suggest that the level of communication across disciplines and sub-groups has increased significantly as a result of the tool implementation. The materials management group tracks the projected bills of materials versus as-built product descriptions. Disciplined use of the configuration management tool is improving the designers ability to accurately forecast material requirements.

Example 7-3. A Case of Multiple Outcomes

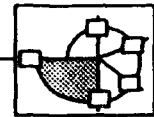
- Identify how much it costs to plan and implement a technology transfer. By understanding these costs, your organization can make more informed decisions on whether to transfer a technology (e.g., will the transfer cost more than the benefits expected from the technology?) and whether to institutionalize a defined technology transfer process.

Cycle 1,2 Based on the data collected in the activities in this cycle, collect the following measurements:

- Status of sponsorship and project commitment to the technology
- Cost and effort spent on management presentations and selling management and staff on the transfer
- Cost and effort spent on analyzing and resolving risks
- Number of replans performed and the impact on the transfer

Cycle N Based on the data collected in the activities in this cycle, collect the following measurements:

- Status of sponsorship and project commitment to the technology
- Cost and effort spent on management presentations and selling management and staff on the transfer



- Cost and effort spent on analyzing and resolving risks
- Cost and effort expended on planning the technology implementation
- Number of replans performed and the impact on the transfer
- Estimate versus actual for implementation schedule, costs, and effort
- Cost and effort expended on support activities, by type
- Cost and effort expended on integration activities
- Cost and effort expended on staff training
- Results of training evaluations and reviews
- Number of training attendees

As you collect data across multiple cycles in the current transfer, you can identify consistently risky areas and incorporate that into your transfer-level lessons learned (see Task 3). In addition, store this data in a single location along with data saved from other transfers, so that it can be used in planning future transfers and in improving your organization's technology transfer process.



3. Collect Transfer-Level Lessons Learned. The previous activity, Review Technology Implementation, collected and reviewed cycle-level lessons learned; these lessons learned were related to the specific technology, process activity or organizational unit involved in the current cycle's implementation. In this activity, you need to understand how these cycle-level lessons learned, along with the data collected on the transfer process in Tasks 1 and 2 of this activity, might affect future cycles and document this in transfer-level lessons learned. For example, a cycle-level lessons learned may be that each user needed to have 1 hour of hand-holding before feeling comfortable with the technology. This might translate into a transfer-level lessons learned that requires all new users to have 1 hour of hand-holding by an expert. These transfer-level lessons learned might also impact future transfers within the organization.

Cycle 1,2 You will not perform this task in Cycles 1 and 2.

Cycle N In each cycle, you need to collect the cycle-level lessons learned and determine how they might affect future cycles of the transfer. You need to document these lessons learned and give them to your stakeholders for their review. Each stakeholder should review the lessons learned for applicability to their own role in the transfer process and for agreement that these lessons learned should be applied in future cycles.

\$ Sponsor



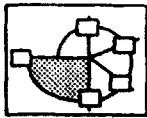
Change Agent



Champion



End User



4. Baseline Process Assets and Lessons Learned. You need to baseline the process assets generated during the current cycle's implementation and baseline both the cycle and transfer lessons learned.

Cycle 1,2

You will not perform this task in Cycles 1 and 2.

Cycle N

In the previous activity, Review Technology Implementation, you collected and stakeholders reviewed process assets and cycle-level lessons learned. In the previous task of this activity, you collected and stakeholders reviewed transfer-level lessons learned. In this task, you need to baseline these materials by putting them through your organization's configuration management system; that is, you need to make sure that you save the latest version of each document for possible reference in a later cycle or later transfer.

.....

STOP CRITERIA

You should stop this activity when you have:

- Documented the results of a formal review of the implementation progress, including identifying transfer-level lessons learned
- Baselined all of the process assets and lessons learned generated during this cycle

\$ Sponsor



Change Agent

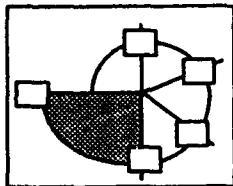


Champion



End User

7.2 DEFINE/UPDATE TRANSFER PLAN



This activity begins in Step 5, Review and Update Transfer Plan.

.....

OVERVIEW

Your objective in this activity is to define and/or update the transfer plan based on the results of the current cycle. The transfer plan is a living document that should be updated in each cycle of the transfer process.

The information used to update the plan will come from many sources, depending on where you are in the process. These sources include any risk analysis done in the Analyze and Resolve Risks activity; any implementation progress made in the Implement activity; and your analysis of the implementation progress done in the Review Progress activity.

.....

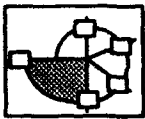
START CRITERIA

You should start this criteria when you have:

- An approved transfer strategy, objectives, and constraints
 - An approved cycle strategy, objectives, and constraints
 - The results of the risk analysis done in the Analyze and Resolve Risks activity
 - Data gathered during any implementation done in this cycle, including cycle-level lessons learned and process assets
 - Any results from the Review Progress activity, including transfer-level lessons learned
 - If a continuing transfer, the transfer plan from the previous cycle
-

TASKS

You need to define recommendations and define and/or update the transfer plan, including the budget and schedule; and the plan for the first three steps of the next cycle. The transfer plan will be the basis by which stakeholders will agree to continue or not continue the transfer.



1. Define Recommendations and Define/Update Transfer Plan. Define your recommendation(s) for how the transfer should proceed in the next cycle and update the transfer plan accordingly, including the budget and schedule and the plan for the next cycle.

Cycle 1 In Cycle 1, you will plan the entire transfer and the next cycle based on the approved transfer strategy, objectives, and constraints, and on the results of the risk analysis performed in the Analyze and Resolve Risks activity. Specifically, you need to:

- Develop your long-range, strategic plan for performing the transfer. This will include the long-range goals for the transfer; the general order in which the transfer will be performed (that is, which parts of the organization will be affected and in which order); the stakeholders needed for the transfer, both short- and long-term; and who is responsible for the transfer.
- Develop success criteria against which you will measure the transfer. You should take the expected benefits (see Task 3 in the Define/Update Transfer Strategies activity) into consideration when developing the success criteria.
- Develop a budget and schedule for the transfer.
- Plan for the first three steps of the next cycle. That is, you need to allocate resources and budget to address sponsorship and foundation issues, develop the cycle plan, understand the process, analyze and avert risks, select the cycle strategy, and plan the implementation.

When defining your transfer plan, you need to make sure that you meet both the technical and the human objectives of the transfer. You can have the technology integrated perfectly and provide all the necessary training, but still have a failure if you do not realize that a new technology requires people to change their lives and they will naturally resist that change. You need to address this in your plan by allocating adequate time and resources to selling the transfer, supporting the users, and allowing the users to participate in the review and decision-making processes.

Cycle 2 In Cycle 2, you will update the transfer plan (including budget and schedule if necessary) developed in the first cycle based on any changes needed due to changes in sponsorship or organizational readiness issues. For example, in the first cycle you may have expected not to get accounting's approval for the transfer; however, in the process of understanding organizational readiness you may have learned that the accounting office had been planning to change soon anyway and that you will be able to work

\$ Sponsor



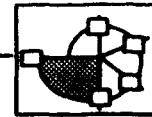
Change Agent



Champion



End User



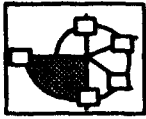
together on the transfer. This type of change needs to be incorporated into the transfer plan.

Again, as in the first cycle, you need to plan for the first three steps of the next cycle in this activity.

Cycle N

When updating the transfer plan, you will heavily use the analysis of the implementation you performed in the Review Progress activity, including the transfer-level lessons learned you generated, and as much quantified justification as possible as the basis for your changes. You will update the transfer plan, update the budget and schedule, and plan the first three steps of the next cycle.

- **Update Transfer Plan.** Based on the results of the implementation, any of several recommendation scenarios might be suitable and should be incorporated into the transfer plan where it will feed into the definition of the objectives and strategy for the next cycle:
 - The implementation went well and it should be expanded to more of the organization as is (opening the door to institutionalization of the technology).
 - The organization should reconduct the implementation to iron out more bugs. This is the situation when the implementation was incomplete or had difficulties. You may recommend in the transfer plan that the next cycle focus on reevaluating peoples' assignments to the transfer and seeking new champions.
 - The organization should reconsider the technology selected because, though there is a need or opportunity, the wrong technology was selected. For example, maybe the impacts to productivity and quality were not what you had expected. However, you do not want to be changing technologies without first serious consideration and complete stakeholder buy-in; users will be wary of changing to a new technology after investing time in the first technology that is now not going to be used.
 - The organization should reevaluate the entire situation because the implementation was a failure.
 - The implementation should be considered complete because the goal of the implementation was to successfully use the technology for a fixed period of time, and that goal was achieved. No additional effort should be expended on the transfer, except for the development of a lessons-learned report recounting what worked and what did not work in the implementation.



- The implementation went well and should be expanded to more of the organization, though with some needed minor changes. For example, there may be additional benefit gained in adjusting the technology interface.

A major danger in moving to institutionalization is that later implementations may not achieve the same success as the initial implementation. More often than not, the steps taken in the original detailed implementation plan are not followed in subsequent implementation efforts. This can be partially avoided by assigning staff to support and monitor the implementation of the technology as it is initially tried on new projects and by maintaining a high level of visibility into the continuing benefits received from the new technology.

- **Update Budget and Schedule.** When updating the budget and schedule for the transfer, you need to allocate time and resource contingencies to handle such problems as emerging opposition to the transfer, fading management support, interference of other seemingly independent changes, and system troubles. It is important that the transfer plan anticipate and budget contingencies for solving these problems. Example 7-4 describes how inadequate contingencies for ongoing support negatively affected the transfer of a technology.

Airframe Ltd. decides to transfer, initially on a trial basis, a new software design methodology to address a history of software bugs that traces back to faulty designs (which each project did differently on an ad hoc basis). A site license for the method is purchased, and training is provided for all staff in the trial project. Transfer assistance and hand-holding is provided for the trial project, and there are extensive efforts to iron out early misconceptions and documentation limitations. The design method is a success on the trial project, plans are drawn up and transferred to train everybody in the company on the new design method, and the transfer team is disbanded.

Eighteen months later, Airframe has experienced a 20% turnover of staff in certain key divisions and is in the process of trying to get their new employees up to speed on their software development processes. One stumbling block seems to be the employees' difficulty in understanding the new design methodology. No individual has responsibility for training new users. The original training materials and overheads cannot be found. Since the introduction of the method about 2 years earlier, the vendor has already released two upgrades, neither of which has been incorporated into company operations. After 3 years, nearly 40% of Airframe's employees are "new," and the level of effective use of the new design method is negligible. In fact, most projects have reverted to the old ad hoc way of developing designs.

After 3 years, the method is withdrawn from Airframe operations, and the CTO judges the effort a dismal failure.

Example 7-4. A Case of an Incomplete Support Plan



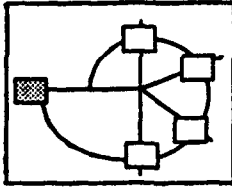
- ***Plan Next Cycle.*** Based on the results of the implementation, and on the resulting impacts on the transfer plan, you need to allocate resources and a budget for the next three steps of the next cycle.

.....

STOP CRITERIA

You should stop this activity when you have updated the transfer plan based on the results of the current cycle.

7.3 COMMIT TO PROCEED



This activity begins at the end of Step 5, Review and Update Transfer Plan.

.....

OVERVIEW

Your objective in this activity is to get all stakeholders to commit to proceed with the transfer based on the transfer plan you defined in the Define/Update Transfer Plan activity. A key part of this activity is for the sponsors to publicize their commitment across the organization.

You should not proceed with the transfer until you have successfully completed this activity.

.....

START CRITERIA

You should start this activity when you have a plan for how the overall transfer and the first part of the next cycle should be conducted, including a budget and schedule.

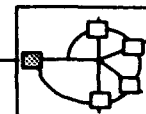
.....

TASKS

You need to get a commitment from the stakeholders to proceed with the transfer based on the transfer plan.

If this transfer is part of a process improvement effort, then you need to follow these steps:

- *Get Commitment From the Process Group.* You first need to get commitment from the Process Group managing the improvements on how to proceed. You will do this by presenting your plans and recommendations to the Process Group and getting their commitment on the future direction of the transfer given the full context of the process improvement effort. The Process Group may direct you to present and get commitment from the Steering Committee on the direction of the transfer. Your presentation should include the topics listed under Task 2 of this activity, Obtain Commitment From Sponsors.
- *Get Commitment From Transfer Stakeholders.* After you have the Process Group's commitment, proceed with this activity, first getting buy-in from the champions, change agents, and end users, and then



getting a commitment from any sponsors independent of the Process Group.

You may need to work between the transfer stakeholders and the Process Group in order to come to an agreement on which direction the transfer should take; however, remember that you need full consensus before proceeding or else risk losing support for the transfer from a critical stakeholder.



1. Obtain Commitment From Champions, Change Agents, and End Users. Focus this task on getting champions, end users, and change agents to commit to the plan and agree to proceed with the transfer. Sponsorship is more easily achieved if there is buy-in from all the other players involved in the transfer. You may need to go through several iterations of the review process before they will give their commitment.

In all cycles, you will be looking for commitment to proceed with the transfer based on your transfer plan which describes the strategy for the transfer, including a budget and schedule, and a plan for proceeding with the first three steps of the next cycle.

Cycle 1

In the first cycle, you need to get commitment only from the change agents and champions who have been developing the transfer plan.

Cycle 2...N

In all other cycles, you need to get commitment from all champions, change agents, and end users identified in the Build/Reinforce Sponsorship and Foundation activity.



2. Obtain Commitment From Sponsors. After you have buy-in from all champions, change agents, and end users, you need to present your plan to the sponsors for approval and commitment to proceed. Your presentation should include:

- A description of the plan, including likely transfer scenario(s) and suggested assignment of responsibility for the transfer
- Your rationale for the plan, including justification for the overall objectives of the transfer (both long- and short-term benefits)
- The impact of the plan on the organization, especially the impact on each sponsor's group
- The estimated cost and time frame for the plan

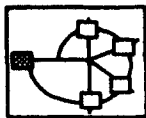
Depending on your situation, you may decide to stagger the presentations, targeting first those sponsors who are more supportive in order to build up a stronger case for those sponsors who are less supportive.

\$ Sponsor

 Change Agent

 Champion

 End User



You may have several iterations in your presentation to management before you get a final decision to go ahead with the plan and proceed with the recommendations. If so, return as necessary to any activity in this step (Define/Update Transfer Plan or Review Progress) to make the changes before getting their commitment.

In all cycles, you will be looking for commitment to proceed with the transfer based on your transfer plan which describes the strategy for the transfer, including a budget and schedule, and a plan for how to proceed with the first three steps of the next cycle.

Cycle 1 In Cycle 1, you will not perform this task since you do not have a sponsor.

Cycle 2...N In all other cycles, you need to get commitment from all authorizing and reinforcing sponsors.



3. Publicize Commitment. After committing to proceed, the sponsors need to publicize their commitment throughout their organization to keep everybody informed, to assure the end users that the transfer is important, and to help prepare everybody for the changes ahead. To publicize approval, the sponsors may send a memorandum or electronic mail, hold an organization-wide meeting, or hold a series of briefings across the organization.

An important part of this task is for the sponsors to publicize why the transfer is being performed; that is, the current problems the organization is having and how the technology will alleviate those problems.

You can use the influence strategy developed in the Build/Reinforce Sponsorship and Foundation activity in planning and implementing this task.

Cycle 1 In Cycle 1, you will not perform this task since you do not have a sponsor.

Cycle 2...N In later cycles, you should work with the sponsor needs to publicize the decision and their support and commitment to the transfer to help prepare everybody for the changes ahead.

.....

STOP CRITERIA

You are done with the activity when:

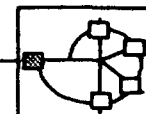
- You have commitment from all stakeholders to proceed with the transfer based on the transfer plan
- The sponsors have publicized their commitment to the organization

\$ Sponsor

 Change Agent

 Champion

 End User



This page intentionally left blank.

8. IMPROVING YOUR TECHNOLOGY TRANSFER PROCESS

The establishment of a technology-transfer function was judged the most profound of the actions taken.

Watts Humphrey, Terry Snyder, and Ronald Willis, *IEEE Software*

Section Objectives

1. Provide general guidelines for improving your organization's technology transfer process

2. Provide guidelines for justifying following a defined technology transfer process

In contrast to Sections 3 through 7 of this guidebook, which gave you specific step-by-step guidance on how to transfer a particular technology into your organization, this section provides **generic guidelines** for improving your organization's overall technology transfer process.

This section assumes that your organization will frequently transfer in technology. This section also assumes that your organization can learn to manage these efforts to systematically organize, learn, and optimize the process over many transfers.

8.1 THE BIG PICTURE

Organizations differ widely in the ways they address technology transfer: some handle it as stressful episodes; others try to learn from each transfer but are poor at applying any lessons; and others treat technology transfer as a "core competency" with organizational structures, processes, and incentives aimed at maximizing their competitive advantage in this area.

This section provides strategies you can use to improve your own technology transfer process. You will learn how you should, with adaptations for your situation, change your organization's strategy, culture, structure, mechanisms, and external relationships.

.....

ORGANIZATIONAL CONTEXT

Instead of viewing the technology transfer process as an isolated set of activities that you only perform during a transfer, consider technology transfer as an ongoing function with a permanent set of organizational processes and relationships. From this perspective, technology transfer involves the managed exchange of information and resources both within your organization and with related, external organizations. Figure 8-1 shows a number of organizations that might affect a technology transfer, along with the types of information and resources that may flow between them.

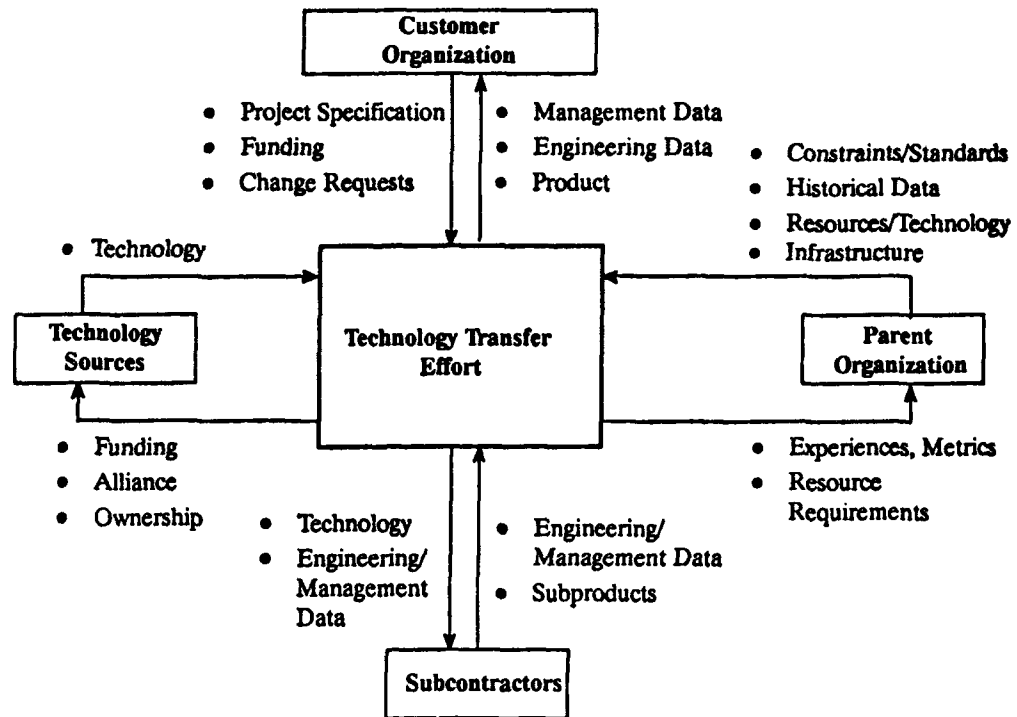


Figure 8-1. Organizational Relationships to Technology Transfer

When an organization views technology transfer as an ongoing function, then organizational arrangements to handle technologies and technology transfers can be instituted and improved. The next sections provide guidelines for these organizational arrangements in the following areas:

- Strategy
- Organizational culture
- Organizational structures and infrastructures
- Technology awareness mechanisms
- External relationships and partnerships

Each section briefly describes the relationship of each area to technology transfer and then lists guidelines on how to improve within that area.

.....

STRATEGY

You transfer technology not for its own sake but for the advantages, both immediate and strategic, it provides. To maximize these advantages, you need to concentrate on technology considerations and their role in strategic efforts and planning. In most cases, these considerations address the successful transfer and use of technology.

Be visionary and aware of technology transfer in your strategic and tactical planning.

- Use strategic efforts as the impetus to transfer technology and plan future strategic technology transfer efforts. Current strategic efforts related to technology include:
 - Moving up the SEI CMM scale
 - Incorporating Total Quality Management (TQM) and related mechanisms for involvement and improvement
 - Becoming certified under the International Organization for Standardization (ISO) 9000 series of quality management system standards
 - Pursuing the U.S. Department of Commerce's Malcolm Baldrige Quality Award or other quality awards
- Examine international competitiveness in your strategic planning. Consider both potential global markets as well as global technology sources.
- Become proactive in technology transfer by exploiting and retaining initiative to influence future events (e.g., influencing standards' directions); making quicker, better decisions regarding technology directions and use; and achieving flexibility to avoid adverse events (e.g., developing a culture of technological change that allows you to enter new markets when old markets fade away).
- Consider technology and technology transfer needs, plans, and opportunities in planning the staff and environment capability of your organization. Involve management and staff who are providing resources, sponsoring, or promoting the use of new technologies.

.....

ORGANIZATIONAL CULTURE

From an organizational viewpoint, technology transfer is more than a simple behavior that can be called upon when needed. It is a complex set of knowledge, skills, values, norms, behavioral patterns, and ongoing activities that few technically educated persons learned in school or fully mastered early in the workplace. To maximize your organization's success at technology transfer, you must direct considerable attention toward building and nurturing a culture that supports and encourages the process.

Develop a culture that supports technology transfer.

- Establish management commitment from the top down to a culture supporting changes that lead to improvements in practices.

- Establish, through a broad consensus process, an organizational mission statement and a statement of organizational values that recognize and encourage ongoing improvement and openness to outside ideas and technology. Make sure your organization's policies and procedures support the new mission and values statements.
- Ensure that management and staff understand the need for technology transfer throughout the organization, including a long-term understanding of technology's position in your business strategy.
- Train management and staff on technology transfer principles and techniques. This can include training in the entire technology transfer process, implementation planning, technology management or product marketing, organizational change, and interpersonal skills.

.....

ORGANIZATIONAL STRUCTURES AND INFRASTRUCTURES

Your organizational structure and infrastructure must change to incorporate new transfer strategies and cultural practices. These changes may involve new functions and groups or new relationships between ones that already exist. Organizational structures deal with permanent or temporary departments, groups, or positions filled by staff members. Infrastructure mechanisms deal with programs, policies and procedures, technologies, or capabilities within your organization.

Ensure organizational structures exist that support technology transfer.

- Use your human resource department to ensure availability of expertise, skills, and training in technology and technology transfer.
- Create a separate technology receptor suborganization that identifies and tests new technologies and helps bring them into the organization. Consider many aspects in forming such an organization, including its relationship with the rest of the organization, staffing (including rotation), resources, duties (to identify, not invent), organizational placement, and permanence.
- Develop a permanent internal training group to rapidly develop and/or customize training materials, successfully deliver them, and maintain ongoing training support. This requires specialized expertise in professional training and instructional design.
- Use a process improvement group, such as the SEPG, to facilitate the introduction of new technology.

Ensure infrastructure mechanisms exist that support technology transfer.

- Develop measurement programs that set baselines and measure changes to the baseline from using new technologies. Read the *Software Measurement Guidebook* (Software Productivity Consortium 1992b) for information on how to set up a measurement program and refer to the *Technology Benefits Model User Manual* (Software Productivity Consortium 1993c) for support on how to estimate and maintain quantitative data on technology improvements.
- Develop written guidelines on how to institutionalize a technology; for example, how to build it into budgeting, infrastructure procedures, and revised job descriptions.
- Coordinate and refine the roles for such areas as technical support, configuration management, the technical library, and purchasing.
- Create information repositories of technology transfer experiences to assess the impact of a change and to identify how to improve your transfer process. Capture both the "folklore" of local technology transfer cases and experiences of managers and staff "telling their story" and more objective data, such as what transfer mechanisms were used, the role of users, and the decision-making process.
- Generating a repository containing information on past technology transfer experiences can be used to help plan and predict future transfers. Information on planned transfers can allow projects to integrate their transfer approaches. The repository does not have to be kept in one central place, but it should be easy to access.
- Migrate toward open hardware and software environments that support addition and/or modification of technologies.
- Integrate the organization's technology transfer process with other organization-wide processes (e.g., TQM) and with any strategic planning processes or groups.
- Establish an organizational assessment and analysis capacity, and use it regularly.
- Consider ways that your organization can distribute expertise among staff, reducing reliance on individual specialists and increasing flexibility. This might include tuition reimbursements for furthering education, improving the flow of information among groups, and rotating staff across divisions and staff positions.

TECHNOLOGY AWARENESS MECHANISMS

Technology awareness mechanisms support your new strategy, culture, and structure by keeping you on top of new technology developments and

by ensuring that you create supportive policies, procedures, and practices. Operational details focus on how the organization will routinely perform the business of technology transfer.

Stay on top of new technology developments.

- Systematically access and digest relevant periodicals, market reports, and government studies. Subscribe to relevant clipping services, databases, and industry analysis groups.
- Develop technology awareness mechanisms (technical libraries, network services, outside database/library services, domain experts, and technology receptor organizations) that help staff identify new technologies.
- Use traditional and nontraditional and local and global sources for technology. Traditional sources of technology include internal R&D laboratories, universities, computer manufacturers, software vendors, consulting firms, colleagues, literature, seminars, and meetings. Less traditional, but sometimes even more effective, sources include joint ventures, consortium membership, government laboratories, federally funded R&D centers, competitors, other suppliers, and customers.
- Participate in or track appropriate standards projects.

Provide education and training in technology.

- Train and educate your management and staff in new technology-related skills and knowledge. Most computing-related skills and knowledge have a half-life of about 5 years or less; this requires the continual training and education of personnel.

.....

EXTERNAL RELATIONSHIPS AND PARTNERSHIPS

For your organization to be a permanent leader in technology transfer, it will need to develop stable and long-term relationships with other important external organizations, including your customers, suppliers (e.g., vendors, consultants), and industrial peers.

Ensure strong and improving relationships with external organizations.

- Encourage staff, end user, supplier, and customer involvement in decisions that affect them.
- Attempt the codesign of the transfer process with your suppliers and customers.

- Form ongoing relationships with select technology sources. This can take forms such as industrial liaison relationships with universities, contracts, joint ventures, strategic alliances, investment, or cross ownership. Ongoing relationships will help facilitate transfer, give you influence on how the technology will fit into your environment, and promote support for the transfer from the technology source.
- Provide a vehicle for systematically asking customers and suppliers about their immediate and expected future technology needs.

8.2 JUSTIFYING A DEFINED TECHNOLOGY TRANSFER PROCESS

Technology transfer economics is in its infancy. Though management understands the need to be successful at technology transfer, a detailed understanding of the costs versus the benefits of following a defined technology transfer process does not yet exist. This section provides a qualitative cost justification for the guidebook's use and then provides some empirical data on technology transfer-related activities in limited, related areas.

A qualitative cost justification for applying the process in this guidebook uses two techniques described by Barton (1990):

- *Value Added Technique.* This technique weighs the benefit of potential gains against expense.
- *Strategic Objective Technique.* This technique focuses on the benefits of improving a competitive situation or strategic position by using new technologies.

Table 8-1 describes these benefits. Many of these benefits, adapted from Barton (1990) and Pressman (1992), depend on the concept that improving your overall technology transfer process decreases the amount of time it takes to transfer technology.

Table 8-1. Justification for Improving Your Technology Transfer Process

Benefit Category	Benefit Description	
	Value Added	Strategic Objective Achieved
Increased Chance of Success	You will increase your chances of getting positive returns on your technology investments.	You will increase your chance of improving your competitive situation through use of new technologies.
Earlier Accrual of More Benefits	Your transfer time will be reduced as you improve your transfer process. More of your staff will receive benefits from using the technology.	You will have an earlier time-to-market for products based on the technology.

Table 8-1, continued

Benefit Category	Benefit Description	
	Value Added	Strategic Objective Achieved
Better Response to Changing Technologies	You increase your ability to respond more quickly and effectively to a changing technology base.	You increase the likelihood that you will be using more current technology than your competitors, and you will be using what your customer has asked for.
Better Decision Making	You will have faster access to more complete information. You will improve your ability to predict and measure future transfers.	You can make more informed decisions on the technology and the transfer process.
Higher Morale Among Staff	You will have better morale from using current technology and improved management control of the transfer process.	You will increase your likelihood of having a lower attrition rate when you have a higher morale among staff.
Better Technology Selection	You will be able to select the technology that best meets your organization's needs.	You will have earlier awareness of new, available technologies.

Quantitative data for justifying a defined technology transfer process can be found in limited, related areas. The following list describes two sources of quantitative information:

- **Survey of Technology Use.** Chris Pickering of Systems Development, Inc., surveyed the Fortune 500 and the Fortune Service 500 in 1991 and provided a statistical snapshot of their use of advanced information technology (Pickering 1992). Specifically, for 40 of these companies, Pickering measured the penetration of 12 existing and emerging information technologies. Though the survey provides much more information, Example 8-1 reports several survey findings that help justify use of technologies.

Example 8-2 lists the top impediments to technology use found by Pickering. Using the technology transfer process defined in this guidebook will help alleviate the top two impediments, difficulty to cost justify and organizational/political factors.

- **Training.** Studies assessing the training's impact on subsequent technology use reaffirm the key role training plays in technology transfer. Example 8-3 recounts, in one case study, the importance of training.

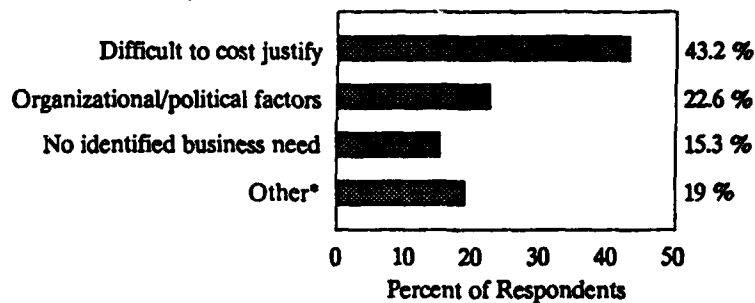
Pickering's 1991 survey of technology use among 40 Fortune 500 and Fortune Service 500 firms includes the following findings (Pickering 1992):

- Projects that do use technology report more successes than failures (p. 17).
- The primary cause of low, effective penetration within companies is simply *not using the technologies* (p. 23).
- All technologies were being used by a nontrivial percentage of the companies. The technology with the lowest penetration was object-oriented methods and technologies at 15%, and the highest penetration was end-user computing at 87.5% (p. 15-16).

In terms of the demographics of the companies who responded: 75% of the respondents characterize their rate of change as moderate, conservative, or extremely conservative; over half of the companies had an advanced technology group; and, only 25% of the respondents had a software metrics program (p. 55).

Example 8-1. Technology Use Survey Findings

Pickering's survey of technology use among 40 Fortune 500 and Fortune Service 500 firms identified the major impediments to technology use (Pickering 1992), as indicated in the chart below (p. 72):



* Other reasons given include lack of understanding of the new technology and budgetary constraints.

Example 8-2. Top Impediments to Technology Use

In a June 1992 IEEE Spectrum article, Capers Jones (1992) recounted a CASEWorld conference presentation by Chuck House, a former executive of Hewlett-Packard Company. House identified training as the most notable factor leading to successful versus unsuccessful usage of CASE. Specifically, House found that without a significant investment in training, the failure rate of CASE deployment tends to exceed 50%.

Jones further states that House's observations have been replicated by other organizations, including Software Productivity Research Incorporated. Their research has found that CASE usage may require between \$0.50 and \$2.00 in training expenses for every \$1.00 spent on the CASE tools themselves, with the more expensive tools requiring more extensive, costly training.

Example 8-3. Impact of Training on Technology Use

8.3 WHAT YOUR ORGANIZATION'S FUTURE SHOULD BE

Assuming that all or most of the preceding suggested changes have been made, you will work in a new type of organization. Your organization will change proactively at a rate that will be uncomfortable but not debilitating. No technology will be totally sacred or unchangeable. The rate of change will be fast enough to respond to and even shape the external considerations that necessitate change.

The resulting situation was summed up well by Steele:

No, the technologically effective enterprise won't be comfortable. But it will prize its alertness, its adaptability, and its realism in evaluating itself and its environment. It will be confident of its ability to succeed and to survive. Its technologists will feel secure in the knowledge that technology plays its needed role in all aspects of the business, even as they compete with others for resources and for the emphasis they believe technology warrants. Meanwhile, they will never lose sight of the necessity to achieve integration between technology and the other elements of a business and will accept both the strengths and the constraints that integration produces (Steele 1989, 347).

The world that you and your organization live in is an accelerating, increasingly exciting, and potentially hazardous one. Moreover, in your well organized enterprise, the interest and excitement of all concerned (manager, technologist, and user) in successfully advancing the technology used in your organization will exceed any discomfort involved.

APPENDIX: CHECKLISTS FOR APPLYING THE TECHNOLOGY TRANSFER PROCESS

Appendix Objective

Provide checklists to guide you through the application of the technology transfer process

The guidance provided in Sections 3 through 7 presents the technology transfer process from a step/activity/task perspective. That is, the guidance is ordered by step, activity, and task, with the guidance tailored for each cycle (1, 2, and N) within the tasks.

This appendix provides a different view into the technology transfer process. Instead of ordering by task, the ordering is done by cycle. Specifically, for each cycle (1, 2, and N), this appendix provides a checklist that outlines the specific tasks you would perform in that cycle. These checklists are based on the cyclic strategies for technology transfer described in Section 2.5, under Key Assumption: Placing Yourself in the Process.

Each checklist contains a Comments column. You can use this column to make notes to clarify why a task was not checked off and/or indicate the person who checked off the task.

Table App-1 provides the checklist for Cycle 1. Table App-2 provides the checklist for Cycle 2. Table App-3 provides the checklist for Cycle N.

Table App-1. Cycle 1 Task Checklist

Cycle 1 Tasks	Comments
1. Step 1: Understand Context Activity: Build/Reinforce Sponsorship and Foundation ☐ Identify transfer support staff (change agents and champions) ☐ Identify end users and initially assess their readiness to change ☐ Identify sponsors ☐ Prepare and implement influence strategy Activity: Define/Update Transfer Strategies ☐ Examine external environment ☐ Examine internal environment ☐ Understand reason and expected benefits for the transfer ☐ Define objectives ☐ Identify alternative strategies ☐ Identify alternative technologies ☐ Identify constraints Activity: Understand Process ☐ Understand hardware and software environment ☐ Understand the current process Activity: Context Review ☐ Obtain agreement from change agents, champions, and end users 2. Step 2: Analyze Risks and Select Strategy Activity: Analyze and Resolve Risks ☐ Identify and analyze risks ☐ Review risk analysis ☐ Evaluate and plan risk aversion ☐ Commit to risk aversion plan ☐ Execute risk aversion Activity: Select Strategy ☐ Select a transfer and cycle strategy ☐ Select the technology	

Table App-1, continued

Cycle 1 Tasks	Comments
Activity: Commit to Strategy ☐ Obtain review and approval from champions and change agents 3. Step 3: Plan Technology Implementation You will perform no activities or tasks in this step in Cycle 1. 4. Step 4: Implement Technology You will perform no activities or tasks in this step in Cycle 1. 5. Step 5: Review and Update Transfer Plan Activity: Review Progress ☐ Collect data on technology transfer process Activity: Define Transfer Plan ☐ Define recommendations and transfer plan Activity: Commit to Proceed ☐ Obtain commitment from change agents, champions, and end users	

Table App-2. Cycle 2 Task Checklist

Cycle 2 Tasks	Comments
1. Step 1: Understand Context Activity: Build/Reinforce Sponsorship and Foundation ☐ Build transfer support staff (change agents and champions) ☐ Assess end user readiness to change ☐ Build sponsorship ☐ Update and implement influence strategy Activity: Define/Update Transfer Strategies ☐ Examine external environment (if needed) ☐ Examine internal environment (if needed) ☐ Understand reasons and expected benefits for the transfer (if needed) ☐ Define objectives ☐ Identify alternative strategies ☐ Identify alternative technologies (if needed) ☐ Identify constraints Activity: Understand Process ☐ Understand hardware and software environment ☐ Understand the current process Activity: Context Review ☐ Obtain agreement from change agents, champions, and end users ☐ Obtain commitment from sponsors ☐ Publicize commitment 2. Step 2: Analyze Risks and Select Strategy Activity: Analyze and Resolve Risks ☐ Identify and analyze risks ☐ Review risk analysis ☐ Evaluate and plan risk aversion ☐ Commit to risk aversion plan ☐ Execute risk aversion	

Table App-2, continued

Cycle 2 Tasks	Comments
Activity: Select Strategy ☐ Select a transfer and/or cycle strategy ☐ Select the technology (if needed) Activity: Commit to Strategy ☐ Obtain review and approval from champions, change agents, and end users ☐ Obtain commitment from sponsors ☐ Publicize commitment 3. Step 3: Plan Technology Implementation You will perform no activities or tasks in this step in Cycle 2. 4. Step 4: Implement Technology You will perform no activities or tasks in this step in Cycle 2. 5. Step 5: Review and Update Transfer Plan Activity: Review Progress ☐ Collect data on technology transfer process Activity: Define/Update Transfer Plan ☐ Define recommendations and update transfer plan Activity: Commit to Proceed ☐ Obtain commitment from change agents, champions, and end users ☐ Obtain commitment from sponsors ☐ Publicize commitment	

Table App-3. Cycle N Task Checklist

Cycle N Tasks	Comments
1. Step 1: Understand Context Activity: Build/Reinforce Sponsorship and Foundation ☐ Reinforce transfer support staff (change agents, champions) ☐ Assess end user readiness to change ☐ Reinforce sponsorship ☐ Update and implement influence strategy Activity: Define/Update Transfer Strategies ☐ Examine external environment (if needed) ☐ Examine internal environment (if needed) ☐ Understand reasons and expected benefits for the transfer (if needed) ☐ Define objectives ☐ Identify alternative strategies ☐ Identify alternative technologies (if needed) ☐ Identify constraints Activity: Understand Process ☐ Understand hardware and software environment (if needed) ☐ Understand the current process (if needed) Activity: Context Review ☐ Obtain agreement from change agents, champions, and end users ☐ Obtain commitment from sponsors ☐ Publicize commitment 2. Step 2: Analyze Risks and Select Strategy Activity: Analyze and Resolve Risks ☐ Identify and analyze risks ☐ Review risk analysis ☐ Evaluate and plan risk aversion ☐ Commit to risk aversion plan ☐ Execute risk aversion	

Table App-3, continued

Cycle N Tasks	Comments
Activity: Select Strategy ☐ Select a transfer and/or cycle strategy ☐ Select the technology (if needed) Activity: Commit to Strategy ☐ Obtain review and approval from champions, change agents, and end users ☐ Obtain commitment from sponsors ☐ Publicize commitment 3. Step 3: Plan Technology Implementation Activity: Define Implementation Plan ☐ Define success criteria and associated data collection requirements ☐ Define implementation tasks ☐ Define budget and staffing ☐ Identify and analyze risks associated with implementation plan Activity: Commit to Implementation Plan ☐ Obtain review and approval from change agents, champions, and end users ☐ Obtain commitment from sponsors ☐ Publicize commitment 4. Step 4: Implement Technology Activity: Implement ☐ Carry out implementation plan ☐ Reinforce sponsorship ☐ Address resistance to change ☐ Support the users Activity: Manage and Monitor ☐ Manage implementation ☐ Gather implementation data ☐ Determine progress of implementation against the plan ☐ Identify and analyze risks associated with implementation	

Table App-3, continued

Cycle N Tasks	Comments
Activity: Review Technology Implementation ☐ Collect and review process assets ☐ Collect and review cycle-level lessons learned 5. Step 5: Review and Update Transfer Plan Activity: Review Progress ☐ Compare implementation data to objectives ☐ Collect data on technology transfer process ☐ Collect and review transfer-level lessons learned ☐ Baseline process assets and lessons learned Activity: Define/Update Transfer Plan ☐ Define recommendations and update transfer plan Activity: Commit to Proceed ☐ Obtain commitment from change agents, champions, and end users ☐ Obtain commitment from sponsors ☐ Publicize commitment	

LIST OF ABBREVIATIONS AND ACRONYMS

ADARTS	Ada-based Design for Real-Time Systems
CASE	computer-aided software engineering
CEM	Comparative Evaluation Method
CMM	Capability Maturity Model
DoD	Department of Defense
ESP	Evolutionary Spiral Process
GQM	Goal-Question-Metic
ISO	International Standards Organization
R & D	research and development
SEI	Software Engineering Institute
SEPG	Software Engineering Process Group
TQM	Total Quality Management

This page intentionally left blank.

GLOSSARY

Activity	A step of a process, the performance of which satisfies objective(s) supporting that process. An activity includes other steps.
Adaptability	The degree to which a technology can be adapted to suit the specific environment and needs of the organization using it.
Authorizing sponsor	A person who possesses sufficient authority or influence to initiate resource commitment for the transfer. See also Sponsor and Reinforcing sponsor.
Awareness	The activities performed by a person(s) or organization(s) to acknowledge and become aware of a technology.
Capability Maturity Model (CMM)	A software development maturity model, developed by the Software Engineering Institute, that provides a framework to assist organizations in improving their software process (Paulk et al. 1991).
Champion	A person who advocates and publicly supports use of a new technology in an organization, but lacks power to provide resources to support it.
Change agent	A person or team empowered by the sponsor that performs the technology transfer activities.
Compatibility	The degree to which a technology is perceived as consistent with the existing values, past experiences, and needs of potential users (Rogers 1983).
Complexity	The degree to which a technology is perceived as relatively difficult to understand and use (Rogers 1983).
Constraint	A limitation on decision(s).
Consumer	A person or group responsible for becoming aware of, evaluating, deciding on, planning, and using a new technology.

Customer	The person(s) or organization(s) that specifies the requirements, accept, and authorize payment for a product.
Cycle	A cycle is a complete traversal of the five steps of the Evolutionary Spiral Process.
Cycle risk	A risk of the current cycle, usually at the implementation or tactical level.
Decision	A choice among allowable alternatives.
End user	The person(s) or organization(s) that will use the technology for its intended purpose when it is deployed in its environment. See also User.
Engineer	A person who performs technical activities for a project.
Environment	All external and internal conditions that influence the form, performance, reliability, or survival of an organization.
Evaluation	The activities performed by a person(s) or organization(s) to understand how a technology works, what is its purpose, and whether it is suitable for use within the organization.
Evolutionary Spiral Process (ESP)	Any enactment of the evolutionary spiral model which is an adaptation of the basic spiral model proposed by Barry Boehm (1986; 1988) that emphasizes the evolutionary development of systems.
Goal	A specific, time-related, measurable target.
Grass-roots campaign	The activities taken by an organization's staff to gain buy-in from management on a technology transfer.
Implementation	The activities performed by a person(s) or organization(s) to acquire and incorporate a technology into existing organizational work environments.
Influence campaign	The activities taken to gain buy-in from appropriate management and staff on the technology and its use within the organization. See also Influence strategy.

Influence strategy	A formal or informal, written or unwritten strategy for gaining buy-in from appropriate management and staff on the technology and its use within the organization. See also Influence campaign.
Infrastructure	The staff and organizational support required to make the transfer succeed.
Institutionalization	The activities performed by a person(s) or organization(s) by an organization to make a technology a routine and necessary part of the organization's work environment.
Manager	A person responsible for the management of a project and/or for the definition, cost, and schedule of a product.
Measurement	A number assigned to a directly observable aspect of a process or product.
Method	Guidance and criteria that prescribe a systematic, repeatable technique for performing an activity.
Metric	A function of one or more measurements. A metric may be directly observable or may be derived through a calculation involving one or more metrics and measurements.
Objective	The intended or desired result of a course of action.
Observability	The degree to which the results of technology use are visible to others (Rogers 1983).
Process	A (partially) ordered set of steps, intended to accomplish specified objective(s).
Process Action Team	A group that is responsible for developing and implementing a plan to improve a specific area of the process.
Process assets	Documentation or work products (e.g., reports, memos, policies, and procedures) developed during the technology transfer process that support the transfer.

Process Group	A group, as defined by the SEI, that is responsible for maintaining and improving the process standards, policies, and procedures, as well as refining any process models and historical data. For software engineering organizations, this group is often called the Software Engineering Process Group (SEPG).
Producer	A person or organization who provides technologies and/or support services to consumer organizations.
Readiness to change	An organization's receptiveness to and ability to change.
Reinforcing sponsor	A person who possesses sufficient authority or influence to reinforce the transfer efforts at the local level. See also Authorizing sponsor and Sponsor.
Relative advantage	The degree to which a technology is perceived as being better than the technology that it supersedes (Rogers 1983).
Resources	People, time, and money.
Risk	A potential for incurring undesirable results.
Risk analysis	The act of identifying, estimating, and evaluating risk to determine whether risk aversion is necessary.
Risk aversion	The act of reducing a risk to an acceptable level by changing the probability or cost of a risk occurring.
Risk management	A management approach focused on identifying, addressing, and removing risk items before they become either threats to successful product operation or major sources of rework.
Role	A function within the technology transfer process.
Spiral	One or more cycles of the Evolutionary Spiral Process that, when combined, accomplish a specific objective.
Sponsor	A person who possesses sufficient authority or influence to either initiate resource commitment for the transfer or reinforce the transfer efforts at the local level. See also Authorizing sponsor and Reinforcing sponsor.

Sponsorship	Management support, including the provision of resources to support the transfer and communication of support to the rest of the organization.
Stakeholders	All persons or groups who are involved with or affected by the technology transfer.
Start criteria	Conditions that must be met before an activity can be started.
Steering Committee	The organization that sets priorities for process improvement initiatives and recommends to the sponsor the authorization of all actions undertaken by the Process Group.
Step	Either an activity or an unelaborated action.
Stop criteria	Conditions that must be met before an activity is considered complete.
Suppliers	A producer who provides technologies and/or support services to your organization.
Task	A work assignment (i.e., subject to management accountability) to accomplish a specified objective.
Technology	Techniques, tools, or knowledge that aids in accomplishing some task (adapted from Williams and Gibson [1990] and Software Productivity Consortium [1988]).
Technology transfer	The process by which a technology goes from development by a technology producer to use by a technology consumer. This term is sometimes referred to as technology transition or technology insertion.
Transfer risk	A risk of the entire transfer. Usually at the strategic level.
Trialability	The degree to which a technology can be used on a limited basis (Rogers 1983).
User	The person(s) or organization(s) that will use the technology for its intended purpose when it is deployed in its environment. See also End user.
Vendor	A supplier of commercial off-the-shelf tools or software.

This page intentionally left blank.

REFERENCES

- | | |
|--|---|
| Barton, Richard A.
1990 | Justifying CASE. <i>CASE Trends Magazine</i> , May/June 1990. |
| Basili, V.R. and D.M. Weiss
1984 | A Methodology for Collecting Valid Software Engineering Data. <i>IEEE Transactions on Software Engineering</i> SE-10, 6. |
| Bayer, Judy and Nancy Melone
1989 | <i>Adoption of Software Engineering Innovations in Organizations</i> , CMU/SEI-89-TR-17, (also NTIS ADA211573). Pittsburgh, Pennsylvania: Software Engineering Institute. |
| Boehm, Barry
1986 | A Spiral Model of Software Development and Enhancement. <i>ACM Software Engineering Notes</i> 11:22-42. |
| 1988 | A Spiral Model of Software Development Software Productivity Consortium and Enhancement. <i>IEEE Computer</i> 21:61-72. |
| 1989 | <i>Tutorial: Software Risk Management</i> . Washington, D.C.: IEEE Computer Society Press. |
| Camp, Robert C.
1989 | <i>Benchmarking: The Search for Industry Best Practices that Lead to Superior Performance</i> . Milwaukee, Wisconsin: ASQC Quality Press. |
| Charette, Robert N.
1989 | <i>Software Engineering Risk Analysis and Management</i> . New York, New York: Intertext Publications, McGraw-Hill. |
| 1990 | <i>Applications Strategies for Risk Analysis</i> . New York, New York: Intertext Publications, McGraw-Hill. |
| 1992 | Case & the Management of Risk, presented to CASE World Conference, Santa Monica, California, February 18-20, 1992. |
| Conner, Daryl R.
1993 | <i>Managing at The Speed of Change</i> . New York, New York: Villard Books. |
| Forman, Ernest H.,
Thomas L. Saaty,
Mary Ann Selly, and
Rozann Whitaker
1983 | <i>Expert Choice</i> . (Software and User manual) McLean, Virginia: Decision Support Software, Inc. |

- | | |
|---|---|
| Fowler, Priscilla J., and Stanley M. Przybylinski, eds.
1988 | "Workshop Overview." <i>Proceedings of Transferring Software Engineering Tool Technology</i> . IEEE Computer Society Press. |
| Gilb, T.
1988 | <i>Principles of Software Engineering Management</i> . New York, New York: Addison-Wesley. |
| Implementation Management Associates
1992 | Accelerating Change Workshop. Brighton, Colorado: IMA, Inc. |
| Jones, Capers
1992 | CASE's Missing Elements. <i>IEEE Spectrum</i> 29, 6. |
| O.D. Resources, Inc.
1989 | <i>The Emotional Cycle of Change</i> . Atlanta, Georgia: O.D. Resources, Inc. |
| Paulk, Mark C., B. Curtis, M.B. Chrissis, E.L. Averill, J. Bamberger, T.C. Kasse, M. Conrad, J.R. Perdue, C.V. Weber, and J.V. Withey
1991 | <i>Capability Maturity Model for Software</i> , CMU/SEI-91-TR-24, ESD-TR-91-21. Pittsburgh, Pennsylvania: Software Engineering Institute, Carnegie Mellon University. |
| Pickering, Chris
1992 | <i>Survey of Advanced Technology—1991</i> . Denver, Colorado: Systems Development, Inc. |
| Pressman, Roger S.
1992 | <i>Process Advisor Workbook: A Self-Directed System for Improving Software Engineering Practice</i> . Orange, Connecticut: R.S. Pressman & Associates, Inc. |
| Redwine, S.T. and W.E. Riddle
1985 | "Software Technology Maturation." In <i>Proceedings 8th International Conference on Software Engineering</i> , IEEE. |
| Redwine, S.T., L.G. Becker, A.B. Marmor-Squires, R.J. Martin, S.H. Nash, and W.E. Riddle
1984 | <i>DoD-Related Software Technology Requirements, Practices, and Prospects for the Future</i> . Technical Report IDA Paper P-1788, Institute for Defense Analyses. |
| Rogers, Everett M.
1983 | <i>Diffusion of Innovations, Third Edition</i> . New York, New York: The Free Press. |
| Saaty, Thomas L.
1980 | <i>The Analytic Hierarchy Process</i> . New York, New York: McGraw-Hill International. |

- Schultz, H.P.
1988 *Software Management Metrics*. ESD-TR-88-001/M88-1. Bedford, Massachusetts: MITRE Corporation.
- Software Productivity Consortium
1988 *Software Productivity Consortium Glossary*, Samuel T. Redwine, Jr., ed. SPC-87-007, version 2.0.
- 1991 *Comparative Evaluation Methodology Guidebook*, SPC-91075-MC, version 01.00.01. Herndon, Virginia: Software Productivity Consortium.
- 1992a *Process Definition and Modeling Guidebook*, SPC-92041-CMC, version 01.00.02. Herndon, Virginia: Software Productivity Consortium.
- 1992b *Software Measurement Guidebook*, SPC-91060-CMC, version 02.00.02. Herndon, Virginia: Software Productivity Consortium.
- 1993a *Evolutionary Spiral Process Guidebook*, SPC-92079-MC, version 03.00.00. Herndon, Virginia: Software Productivity Consortium.
- 1993b *Managing Process Improvement: A Guidebook for Implementing Change*, SPC-93105-CMC, version 01.00.00. Herndon, Virginia: Software Productivity Consortium.
- 1993c *Technology Benefits Model User Manual*, SPC-93111-CMC, version 01.00.04. Herndon, Virginia: Software Productivity Consortium.
- Software Productivity Group
1991 *Case Trends: 1991 Product & Industry Guide*. Shrewsbury, Massachusetts: Software Productivity Group.
- Stalk, George, and Thomas M. Hout
1990 *Competing Against Time: How Time-Based Competition is Reshaping Global Markets*. New York, New York: The Free Press.
- Steele, Lowell W.
1989 *Managing Technology: The Strategic View*. New York, New York: McGraw Hill.
- Tyson, Kirk W. M.
1990 *Competitor Intelligence Manual and Guide: Gathering, Analyzing, and Using Business Intelligence*. Englewood Cliffs, New Jersey: Prentice Hall.
- U.S. Air Force
1986 *Software Management Indicators*, AFSCP 800-43. Washington, D.C.: U.S. Air Force Systems Command.

References

- U.S. Air Force
1988
Acquisition Management. Software Risk Abatement, AFSC/AFLCP 800-45. Washington, D.C.: Air Force Systems Command and Air Force Logistics Command.
- Vaziri, H. Kevin
1992
Using Competitive Benchmarking to Set Goals. *Quality Progress*. 81-85.
- Weiss, D.M.
1981
Evaluating Software Development by Analysis of Change Data, TR-1120. College Park, Maryland: University of Maryland Computer Science Center.
- Williams, Frederick, and
David V. Gibson, eds.
1990
Technology Transfer: A Communication Perspective. Newbury Park, New Jersey: Sage Publications, Inc.
- Willis, R.R.
1983
"Technology Transfer Takes 6 + /- 2 Years." In *IEEE Computer Society Workshop on Software Engineering Technology Transfer*, April 25-27: 108-117.

BIBLIOGRAPHY

Adler, Paul S. and Aaron Shenbar. "Adapting Your Technological Base: The Organizational Challenge." *Sloan Management Review* 32,1 Fall (1990):25-37.

Adler, Paul S., D. William McDonald, and Fred MacDonald. "Strategic Management of Technical Functions." *Sloan Management Review*, Winter (1992):19-37.

Basset, Paul G. "Managing the Transition to New Technology." *Software Engineering Tools, Techniques, Practice*, July/August (1991):25-35.

Ambrosio, Johanna. "Du Pont Brings CASE Solutions Inside—and Out." *Digital Review* (June 26, 1989):41-43.

Babcock, James D., Laszlo A. Belady, and Nancy C. Gore. "The Evolution of Technology Transfer at MCC's Software Technology Program: From Didactic to Dialectic." In *Proceedings of the 12th International Conference on Software Engineering*. Nice, France. IEEE Computer Society Press, 1990.

Basset, Paul G. "Analyzing Is Fitness." *Software Engineering Tools, Techniques, Practice* January/February (1991):32-37.

Basset, Paul G. "Managing the Transition to New Technology." *Software Engineering Tools, Techniques, Practice* (July/August 1991):25-35.

Bayer, Judy, and Nancy Melone. *Adoption of Software Engineering Innovations in Organizations*, CMU/SEI-89-TR-17, 1989 (also NTIS ADA211573) Pittsburgh, Pennsylvania: Software Engineering Institute, Carnegie Mellon University.

Bennis, W.G., K.D. Benne and R. Chin. *The Planning of Change*. Holt, Rinehart and Winston, 1984.

Birkwood, Ilene. "Why Aren't We Using These Marvelous New Methods?" *Software Engineering Tools, Techniques, Practice* (September/October 1990):37-40.

Boehm, Barry W. *Software Engineering Economics*. Englewood Cliffs, New Jersey: Prentice Hall, 1981.

Bouldin, Barbara. *Agents of Change: Managing the Introduction of Automated Tools*. Englewood Cliffs, New Jersey: Yourdon Press, 1989.

Buchwald, L.S. "A Systems Approach to Implementing Software Engineering Technology." In proceedings from workshop on *Transferring Software Engineering Tool Technology*, Stan Przybylinski and Priscilla J. Fowler, eds., Santa Barbara, California (November 15-16, 1987):63-66.

CASE Consulting Group. *CASE Outlook: Guide to Products and Services*. Lake Oswego, Oregon: CASE Consulting Group, 1991.

Chand, Donald R., and Sridhar A. Raghavan. "Diffusing Software Engineering Methods." *IEEE Software* July (1989).

Charette, Robert N., Ph.D. *Training Course on Software Engineering Risk Analysis and Management*, charts from course taught at Software Productivity Consortium, SPC-91088-MC, December 10-12, 1991.

Chew, W. Bruce, Dorothy Leonard-Barton, and Roger E. Bohn. "Beating Murphy's Law." *Sloan Management Review* 32,3 Spring (1991):5-16.

Chikofsky, Elliot J., David A. Martin, and Hugh Chang, eds. Special Issue on Tools Assessment. *IEEE Software* 9,3 (May 1992).

Connors, Martin, John Krol and Janice A. DeMaggio. *Computers and Computing Information Resources Directory*. 2nd ed. Gale Research Co., 1993.

Connor, Richard A., and Jeffrey P. Davidson. *Marketing Your Consulting and Professional Services*. 2nd ed. New York, New York: Wiley, 1990.

Cooper, Robert G. "The New Product Process: A Decision Guide for Management." *Journal of Marketing Management* 3,3 Spring (1988): 238

Dakin, Karl J., and Jennifer Lindsey. *Technology Transfer: Financing and Commercializing the High Tech Product or Service: From Research to Roll Out*. Chicago, Illinois: Probus Publishing Company, 1991.

Dalziel, Murray M., and Stephen C. Schoonover. *Changing Ways: A Practical Tool for Implementing Change Within Organizations*, AMACOM (American Management Association), 1988.

Department of Defense. *Transition from Development to Production*, DoD 4245.7. Washington, D.C.: Department of Defense, 1982.

Earl, Tony. *The Art and Craft of Course Design*. New York, New York: Nichols Publishing Co., 1987.

Feldhusen, John F. *The Three-stage Model of Course Design*. Englewood Cliffs, New Jersey: Educational Technology Publications, 1980.

Fowler, Priscilla, and Linda Levine. "Toward a Defined Process of Software Technology Transition." *American Programmer* March (1992):2-10.

Frank, C. et. al. *EPRI Technology Transfer Guidebook*. Draft report by Electric Power Research Institute and QEI, Inc., Palo Alto, California, June 1991.

Frantzreb, Richard B., ed. *Training and Development Yearbook 1991 Edition*, Englewood Cliffs, New Jersey: Prentice Hall, 1991.

Gilad, Benjamin and Tamar Gilad. *The Business Intelligence System*. New York, New York: AMACOM (American Management Association), 1988.

Glaser, Edward M., Harold H. Abelson, and Kathalee N. Garrison. *Putting Knowledge to Use*. San Francisco, California: Jossey-Bass Publishers, 1983.

Grady, Robert B., and Deborah L. Caswell. *Software Metrics: Establishing a Company-Wide Program*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1987.

Gray, Linda, Jamex C. Brancheau and Kenneth A. Kozar. "Evaluation, Environment, and Education: The 3E Framework for CASE Implementation." *Software Engineering Tools, Techniques, Practice* 2,6 March/April (1992):13-20.

Grove, Andrew S. *High Output Management*, New York, New York: Random House, 1983.

Hammer, Michael. "Reengineering Work: Don't Automate, Obliterate." *Harvard Business Review* July/August (1990):104-112.

Helmer, O. *Social Technology*. New York, New York: Basic Books, 1966.

Krasner, Herb. "Empirical Evidence of Software Engineering Technology Transfer Problems." Presentation at *IEEE Workshop on Software Technology Transfer*, June 10, 1987.

Leonard-Barton, Dorothy. "Implementation Characteristics of Organizational Innovations." *Communication Research* 15, 5 October (1988):603-631.

Liker, Jeffrey K., Mitchell Fleischer, and David Arnsdorf. "Fulfilling the Promises of CAD." *Sloan Management Review* Spring (1992):74-86.

Maier, Norman R. F., Allen R. Solem, and Ayesha A. Maier. *The Role-Play Technique: A Handbook for Management and Leadership Practice*. La Jolla, California: University Associates, Inc., 1975.

Melton, Reginald F. *Instructional Models for Course Design & Development*. Englewood Cliffs, New Jersey: Educational Technology Publications, 1982.

Merkhofer, Miley W. "Quantifying Judgmental Uncertainty: Methodology, Experiences, and Insights." *IEEE Transactions on Man, Systems, and Cybernetics* SMC-17, 5, 1987.

Morton, R. ed., *IEEE Computer Society Workshop on Software Engineering Technology Transfer*, April (1983):25-27.

Pascale, Richard T. *Managing on the Edge*. New York, New York: Simon and Schuster, 1990.

Pickering, Chris. *Survey of Advanced Technology—1991*. Denver, Colorado: Systems Development, Inc., 1992.

Posner, George J., and Alan N. Rudnitsky. *Course Design: A Guide to Curriculum Development for Teachers*. 3rd ed., New York, New York: Longman, 1986.

Pressman, R.S. *Making Software Engineering Happen*. Englewood Cliffs, New Jersey: Prentice-Hall, 1988.

Pressman, Roger S. "Managing the Transition to a Software Engineering Environment." *Software Engineering Tools, Techniques, Practice* July/August (1990):33-41.

Przybylinski, S., and P.J. Fowler, eds. *Proceedings of Transferring Software Engineering Tool Technology Workshop*, IEEE Computer Society Press, 1988.

- Przybylinski, S., P. J. Fowler, and J. Maher. *Tutorial #6: Software Technology Transition*, 13th ICSE, May 12, 1991.
- Putnam, L.H., and A. Fitzsimmons. "Estimating Software Costs." *Datamation*, September (1979):189-198; October (1979):171-178; and November (1979):137-140.
- Raghavan, Sridhar A., and Donald R. Chand. "Diffusing Software Engineering Methods." *IEEE Software* July (1989): 81-89.
- Redwine, Samuel T., Jr., Claude DelFosse, and Wilfred F. Spencer. "1991 Technology Transfer at the Software Productivity Consortium." *American Programmer* March (1992):11-19.
- Redwine, Samuel T., Jr. "Spending your Conference Budget Wisely." *Software Engineering Technical Committee Newsletter* IEEE Computer Society, 9,1 (1990).
- Rifkin, S. and C. Cox. *Measurement in Practice*. CMU/SEI-91-TR-16. Pittsburgh, Pennsylvania: Software Engineering Institute, Carnegie Mellon University, 1991.
- Rothschild, Michael. *Bionomics, The Inevitability of Capitalism*, New York, New York: Henry Holt and Company, 1990.
- Roussel, Philip A., Kamal N. Saad, and Tamara J. Erickson. *Third Generation R&D*. Boston, Massachusetts: Harvard Business School Press, 1991.
- Royce, Winston W. "Managing the Development of Large Software Systems." *Proceedings, IEEE WESCON*, 1970.
- Saaty, Thomas L. *Decision Making for Leaders: The Analytic Hierarchy Process for Decisions in a Complex World*. New York, New York: Van Nostrand Reinhold, 1982.
- Scacchi, Walt, and James Babcock. *Understanding Software Technology Transfer*. MCC Technical Report STP-309-87, October 1987.
- Schaffer, Robert H., and Harvey A. Thompson. "Successful Change Programs Begin with Results." *Harvard Business Review* January/February (1992):80-89.
- Schein, Edgar H. *Process Consultation Volume II: Lessons for Managers and Consultants*. Reading, Massachusetts: Addison-Wesley Publishing Company, Inc., 1987.
- Schoonover, Stephen C. *Managing to Relate: Interpersonal Skills at Work*. Reading, Pennsylvania: Addison-Wesley, 1988.
- Schulmeyer, G. Gordon, and James I. McManus. *Total Quality Management for Software*. New York, New York: Van Nostrand Reinhold, 1992.
- Sherlock, Paul. *Rethinking Business to Business Marketing*. New York, New York: The Free Press, 1991.
- Smith, B.J., and D.L. Delahaye. *How to be an Effective Trainer*. 2nd ed. John Wiley & Sons, Inc., 1987.
- Software Productivity Consortium. *Guide to Member Services*. Herndon, Virginia: Software Productivity Consortium, 1992.

Stokes, Stewart L., Jr. *Controlling the Future: Managing Technology-Driven Change*. Boston, Massachusetts: QED Technical Publishing Group, 1991.

Swanson, Mary E. and Susan K. Curry. "Implementing an Asset Management Program at GTE Data Services." *Software Engineering Tools, Techniques, and Practices* July/August (1990):4-13.

TickIT Project Office. *Guide to Software Quality Management System Construction and Certification* 2nd Issue. London, England: TickIT Project Office, 1992.

Tornatzky, Louis G., and Mitchell Fleischer. *The Processes of Technological Innovation*. Lexington, Massachusetts: Lexington Books, 1990.

Tushman, M.L., and W.L. Moore. *Readings in the Management of Innovation*. New York, New York: Ballinger, 1988.

Utz, Walter J. *Software Technology Transitions: Making the Transition to Software Engineering*. Englewood Cliffs, New Jersey: Prentice Hall, 1992.

Van Ments, Morry. *The Effective Use of Role-play: A Handbook for Teachers and Trainers*. New York: Nichols Publishing, 1989.

Vesey, Joseph T. "Time-to-Market: Put Speed in Product Development." *Industrial Marketing Management* 21 (1992):151-158.

Wheelwright, Steven C., and Kim Clark. *Revolutionizing Product Development*. New York, New York: The Free Press, 1992.

Yourdon, Edward. "A Game Plan for Technology Transfer." *IEEE Software*, 1987.

This page intentionally left blank.

INDEX

Activity

- Analyze and Resolve Risks, 3-5, 3-6, 3-22, 3-28, 3-29, 4-2, 4-15, 5-9, 6-11, 7-10, 7-11
- Build/Reinforce Sponsorship and Foundation, 3-2, 3-22, 3-29, 3-31, 3-32, 4-19, 5-12, 7-16, 7-17
- Commit to Implementation Plan, 5-11
- Commit to Proceed, 7-15
- Commit to Strategy, 4-16, 4-17
- Context Review, 3-30
- Define Implementation Plan, 3-17, 4-16, 5-2, 5-12
- Define/Update Transfer Plan, 7-2, 7-10, 7-15
- Define/Update Transfer Strategies, 3-7, 3-13, 3-27, 4-13, 4-14, 4-15
- format, 2-13
- “cycle” in margin, 2-12
- Implement, 6-2, 7-10
- Manage and Monitor, 6-2, 6-7
- Review Progress, 5-3, 6-8, 6-14, 7-2, 7-10, 7-12
- Review Technology Implementation, 6-13, 7-8, 7-9
- role definitions, 2-11
- role icons, 2-11
- role overlap, 2-11
- Select Strategy, 4-13
- Understand Process, 3-20, 3-27, 3-31
- Analyze and Resolve Risks activity, 3-5, 3-6, 3-22, 3-28, 3-29, 4-2, 4-15, 5-9, 6-11, 7-10, 7-11
- activity objective, 4-2
- Build/Reinforce Sponsorship and Foundation activity, 3-2, 3-22, 3-29, 3-31, 3-32, 4-19, 5-12, 7-16, 7-17
- activity objective, 3-2
- Capability Maturity Model, 1-3, 1-4
- Champion, 3-2, 3-3
- definition of, 2-11
- obtain agreement from, 3-31, 4-17, 5-11, 7-16

requirements, 3-3

summary of tasks, 3-3

Change

- positive response to change, 6-4
- resistance to change, 2-7, 6-3
- strategies for mitigating resistance, 6-5

Change agent, 2-12, 3-2, 3-3

- definition of, 2-11
- number of, 3-3
- obtain agreement from, 3-31, 4-17, 5-11, 7-16
- requirements, 3-3
- success factors, 2-8, 4-5
- summary of tasks, 3-3

CMM, 1-3, 1-4, 8-3

Commit to Implementation Plan activity, 5-11

activity objective, 5-11

Commit to Proceed activity, 7-15

activity objective, 7-15

Commit to Strategy activity, 4-16, 4-17

activity objective, 4-17

Consumer

- guidebook support for, 1-1
- relationship with producer, 2-6

Context Review activity, 3-30

activity objective, 3-30

Culture. See Organization, culture

Customers, 3-9, 3-14, 4-7, 8-6, 8-7

Cycle

checklists

cycle 1, App-2

cycle 2, App-4

cycle N, App-6

definition of, 2-2

risks, 4-2, 4-7

strategies, 2-12

cycle 1, 2-12

cycle 2, 2-12

cycle N, 2-12

Define Implementation Plan activity, 3-17, 4-16, 5-2, 5-12

- activity objective, 5-2
- Define/Update Transfer Plan activity, 7-2, 7-10, 7-15
 - activity objective, 7-10
- Define/Update Transfer Strategies activity, 3-7, 3-13, 3-27, 4-13, 4-14, 4-15
 - activity objective, 3-13
- End user, 3-2, 3-4, 8-6
 - definition of, 2-11
 - identifying, 3-4
 - needed skills, 2-8
 - obtain agreement from, 3-31, 4-17, 5-11, 7-16
 - participation, 2-8
 - readiness to change, 2-8, 3-4
 - satisfaction, 7-5
 - success factors, 2-8, 4-5
 - support, 1-1, 2-8
- Environment
 - external
 - customers, 3-14
 - government policies and actions, 3-15
 - markets, 3-14
 - suppliers, 3-15
 - internal
 - business or technology strategies, 3-17
 - current process, 3-28
 - existing support and training resources, 3-17
 - hardware and software environment, 3-27
 - organizational culture, 3-16
 - organizational strengths and weaknesses, 3-17
 - policies and procedures, 3-17
 - reward programs, 3-17
- Evolutionary Spiral Process, 1-3, 2-2
 - cycle definition, 2-2
 - motivation for ESP approach, 2-1
 - spiral definition, 2-2
- Guidebook
 - audience, 1-1, 1-5
 - objectives, 1-1
 - organization, 1-5, 2-12
 - starting assumptions, 1-4
- Implement activity, 6-2, 7-10
 - activity objective, 6-2
- Implementation
 - analysis
 - of implementation process, 7-6
 - of indirect impacts, 7-6
 - approach, 6-7
 - changes to organization, 5-8
 - collecting data, 6-8
 - costs of, 5-9
 - duration, 2-9
 - managing, 6-7
 - meetings, 6-8
 - problems with, 6-2
 - process assets, 6-13
 - definition of, 6-14
 - producer interaction, 6-8
 - progress of
 - determining, 6-9
 - qualitative progress, 6-10
 - quantitative progress, 6-10
 - publicize implementation, 6-8
 - resistance to change. *See* Change, resistance to change
 - risks of, 6-11, 7-6
 - slow progress, 6-10
 - support end users, 6-5
 - timing, 2-9
 - use of consultants, 5-8
 - use of local experts, 6-3, 6-6
 - when to evaluate, 5-4
- Implementation plan, 3-2, 3-13, 4-15, 5-2, 6-2, 6-3, 6-8
 - budget and staffing, 5-9
 - contingencies, 5-9
 - data collection requirements, 5-3, 5-4
 - getting approval on, 5-11
 - integration task, 5-6
 - logistics task, 5-9
 - organization change task, 5-8
 - risks of plan, 5-9
 - success criteria, 5-3, 6-9, 7-5
 - support task, 5-7
 - training task, 5-7
- Influence strategy, 3-2, 3-4, 3-8, 3-13, 3-32, 4-19, 5-12, 7-17
 - definition of, 3-8
 - influence campaign, 3-10
- Institutionalization, 7-12, 8-5
 - danger in, 7-13
- ISO 9000, 8-3

- Lessons-learned
 - cycle-level, 6-14, 7-8
 - transfer-level, 7-8
- Manage and Monitor activity, 6-2, 6-7
 - activity objective, 6-7
- Management support, 1-1, 5-9, 8-3
- Managing Process Improvement guidebook, 2-11
 - relationship to this guidebook, 1-4
- Organization
 - assessment, 8-5
 - business or technology strategies, 3-17
 - culture, 2-8, 2-13, 3-16, 8-3
 - relationship to technology transfer, 8-1
 - strengths and weaknesses, 3-17
 - structure, 8-4
 - success factors, 2-8, 4-5
- Pilot project, 3-24, 4-11, 4-16, 6-3
- Plan
 - implementation, 5-2
 - risk management, 4-3
 - transfer, 7-10
- Process Action Teams, 2-11
- Process assets, 6-13, 7-9
 - definition of, 6-14
- Process Group, 2-11, 3-6, 3-22, 3-30, 4-17, 5-11, 6-13, 7-15, 7-16
- Process improvement
 - action plan, 3-2
 - focus, 1-4
 - relationship to technology transfer, 1-1, 1-3, 1-4, 3-9
 - use of new technologies in, 1-4
- Process improvement guidebook, 5-6
- Producer, relationship with consumer, 2-6
- Readiness to change
 - end user resources, 3-5
 - end user skills, 3-6
 - how to assess, 3-4
 - impact on transfer, 3-6
 - level of stress, 3-5
 - organizational issues, 3-5
 - prior change efforts, 3-5
- Review Progress activity, 5-3, 6-8, 6-14, 7-2, 7-10, 7-12
 - activity objective, 7-2
- Review Technology Implementation activity, 6-13, 7-8, 7-9
 - activity objective, 6-13
- Risk management plan, 3-2, 3-13, 4-3
- Risks
 - cycle risks, definition of, 4-2
 - of implementation, 6-10
 - risk aversion, 4-10
 - risk acceptance, 4-10
 - risk contingency fund, 4-10
 - risk protection, 4-10
 - risk reduction, 4-10
 - risk transfer, 4-10
 - risk estimation, 4-4
 - risk evaluation, 4-4
 - risk identification, 4-3
 - risks of alternative strategies, 4-5, 4-7, 4-9
 - risks of alternative technologies, 4-5
 - transfer risks, definition of, 4-2
- Role definitions
 - champion, 2-11
 - change agent, 2-11
 - end user, 2-11
 - sponsor, 2-11
 - stakeholder, 2-11
- Role icons, 2-13
- SEI, 1-3, 8-3
- Select Strategy activity, 4-13
 - activity objective, 4-13
- SEPG, 1-3, 8-4
- Sponsor
 - authorizing sponsor, 2-11, 3-6, 3-7
 - definition of, 2-11
 - obtain commitment from, 3-31, 4-18, 5-12, 7-16
 - publicize commitment, 3-32, 4-19, 5-12, 7-17
 - reinforcing sponsor, 2-11, 3-6, 3-8
 - satisfaction, 7-5
 - summary of tasks, 3-6
- Sponsorship, 3-6
 - approach to getting, 3-7
 - definition of, 3-2
 - impact on transfer, 3-7
 - reinforcing, 6-3
- Stakeholder, 2-13, 3-9
 - definition of, 2-11
 - frame-of-reference, 3-9
 - relationships, 3-9
- Standards, 8-3, 8-6

- Steering Committee, 2-11, 3-6, 7-15
- Success factors, 2-8
- Success stories, 3-23
- Suppliers, 3-9, 3-15, 4-7, 8-6, 8-7
- Support, 5-7, 6-3, 6-5, 8-5
 - for initial implementation, 5-8
 - for new users, 5-8
 - hot-line support, 5-8
 - producer vs. internally supplied, 5-8
- Technical support. *See* Support
- Technology
 - adaptability, 2-8, 5-5
 - approve selection of, 4-17
 - assessing impact, 7-5
 - characteristics, 5-5
 - compatibility, 2-8, 5-5
 - complexity, 5-5
 - consistency with culture, 1-1
 - consistency with needs, 1-1
 - deviation from current practices, 3-29
 - identifying, 3-20
 - integration issues, 3-28
 - maturity, 2-8
 - observability, 2-8
 - rate of change, 1-2
 - relative advantage, 2-8
 - requirements, 3-20
 - benchmarking, 3-21
 - prioritizing and weighting, 3-20
 - selection, 4-14
 - sources of, 8-6
 - success factors, 2-8, 4-7
 - trialability, 2-8
- Technology awareness, 8-6
- Technology transfer
 - benefits of positive change, 2-5
 - concepts, 2-5
 - consumers, 2-6
 - costs of failure, 2-8
 - focus, 1-4
 - in strategic planning, 3-17, 8-2
 - influences, 2-6
 - human influences, 2-7
 - organizational influences, 2-7
 - technology influences, 2-6
 - compatibility, 2-6
 - maturity, 2-7
 - type of, 2-6
 - infrastructure
 - human resource departments, 8-4
 - measurement program, 8-5
 - open environments, 8-5
 - repository of previous transfer experiences, 8-5
 - technology awareness mechanisms, 8-6
 - technology receptor suborganization, 8-4
 - integration within organization, 8-5
 - motivation for, 1-1—1-3
 - producers, 2-6
 - requirements pull, 2-6
 - similarities among transfers, 1-2
 - speed of, 1-2—1-3
 - success factors, 2-8
 - technology push, 2-6
 - too much change, 2-9
- Technology transfer process, 2-1, 8-8
 - activity duration, 2-9
 - activity format, 2-13
 - adapting, 1-2
 - case studies, 2-13
 - checklists, App-1
 - cycle 1, App-2
 - cycle 2, App-4
 - cycle N, App-6
 - collecting data on, 7-6
 - constraints, 3-25
 - cost and schedule, 2-9
 - costs of ad hoc process, 1-2
 - cycle 1 strategy, 2-12
 - cycle 2 strategy, 2-12
 - cycle duration, 2-9
 - cycle N strategy, 2-12
 - cycle objectives, 3-18, 7-6
 - cycle planning, 2-9
 - cycle strategies, 2-12
 - cycle-level lessons learned, 7-8, 7-9
 - example scenario, 2-2
 - cycle 1, 2-3
 - cycle 2, 2-4
 - cycle N, 2-5
 - expected benefits of transfer, 3-18
 - explanation of structure, 2-1
 - guidance for using, 2-11
 - improving, 8-1
 - frequency of transfers, 8-1
 - organizational relationships, 8-1
 - influences
 - end user characteristics, 5-5
 - technology characteristics, 5-5
 - justification for, 8-7
 - qualitative cost justification, 8-7
 - survey of technology use, 8-8