

**Technical Report
CMU/SEI-91-TR-14
ESD-TR-91-14**

Proceedings of the CASE Adoption Workshop

**Cliff Huff
Dennis Smith
Kim Stepien-Oakes
Ed Morris**

May 1992

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CASE Technology Project

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FOR THE COMMANDER

(signature on file)

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SEI Joint Program Office

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Proceedings of the CASE Adoption Workshop

Abstract: The Software Engineering Institute (SEI) CASE Technology Project sponsored a workshop to address a number of key CASE adoption issues. The workshop was held at the SEI in Pittsburgh, Pennsylvania on November 13-14, 1990. At the workshop, a representative group of SEI affiliates from industry, government, and academia discussed among themselves such adoption topics as CASE benefits, realistic CASE budget estimates, CASE tool fit, CASE adoption roles, and factors in the project success of CASE. The results of these discussions are summarized in this report.

1 Introduction

The adoption of new technology into an organization is rarely a simple matter. This is true when adopting a new CASE (computer-aided software engineering) technology into a large organization. There are many factors that have an impact on the ultimate success or failure of a new CASE tool. Potential adopters should be aware of these factors, so they can consider what ramifications they might have in their organization and plan accordingly.

A CASE adoption workshop was held at the Software Engineering Institute on November 13-14, 1990, to collect, explore, and share the CASE adoption expertise and insight of the SEI affiliates. This workshop gathered 43 professionals from industry, government, and academia with a common interest in CASE and CASE adoption. It was sponsored by the CASE Technology Project at the Software Engineering Institute.

1.1 Keynote Address

As the introductory keynote address, Dr. Jonathan Morell of the Industrial Technology Institute spoke on "CASE Implementation: Dynamics Through the Technology Life Cycle." This address and the commentary that followed were based on the considerable experience that he and the Industrial Technology Institute have in transitioning many forms of high technology from research to commercial practice. Summarized below are his four keynote conclusions:

- CASE implementation can be planned, managed, and evaluated.
- Efforts to promote the use of CASE must be seen in terms of the entire technology life cycle.
- Strategies within that life cycle have varying time horizons for success and different requirements for collective and individual action.
- Within any single organization, CASE implementation hinges on a set of highly dependent interactions among HiTOP (High Integration of Technology, Organization, and People) elements.

For a complete hard copy of his companion paper on this topic, see Appendix E.

1.2 Workshop Session Overviews

There were five concurrent workshop sessions:

- Adoption Roles and the Adoption Life Cycle for CASE Tools.

Identified the key roles, activities, and issues that must be addressed in a typical adoption life cycle for CASE. During the session these items were documented in a Life Cycle Matrix. The matrix suggested entry and exit criteria and actions to take for each adoption life-cycle phase, and issues to pay attention to for each of the appropriate roles in a particular adoption phase.

- Can You Get the Benefits of CASE Without Buying It?

Determined which benefits (if any) could be derived from CASE technology, independent of the CASE tools themselves, i.e., benefits that result from the formal specification of a development project.

- The 'CASEability' of Projects.

Examined what essential qualities of a software development project must exist to introduce CASE or, if already begun, to accelerate CASE adoption. In addition, the session tallied a list of recommended actions needed to create these essential project qualities.

- Developing a Realistic Estimate for CASE Tool Adoption.

Developed a core cost estimation framework to aid others in preparing detailed CASE budgets. This CASE budget framework included guidelines for determining the amounts of people, time, and money needed for CASE tool adoption.

- Making the CASE Tool Fit the Organization and the Organization Fit the CASE Tool.

Explored tool and organizational characteristics that facilitate or inhibit CASE tool adoption. Examined changes to tools and to organizations that improve the chances for successful adoption.

2 Executive Summary of CASE Adoption Workshop

This first CASE Workshop sponsored by the SEI yielded useful models and insights to aid SEI affiliates in their efforts to integrate CASE technology effectively into their organizations. In some cases the sessions had implications for additional work and future research. One such topic is the CASE estimation model, which aids in developing realistic CASE estimates. In addition, the session on the CASEability of projects raised a number of provocative issues for SEI consideration. Summary results from each of five CASE Adoption Workshop sessions are presented below.

2.1 Adoption Roles and the Adoption Life Cycle for CASE Tools

This session identified the key roles, activities, and issues that must be addressed in a typical adoption life cycle for CASE. These items were documented in a Life Cycle Matrix. The matrix illustrated entry and exit criteria for each adoption life-cycle phase, identified specific actions to take, and illuminated issues for each of the appropriate roles in a particular adoption phase. This matrix provides a good model for change agents to use when planning and executing a CASE adoption in their organizations.

The completed matrix is composed of 42 cells. The matrix contains 6 columns of roles and 7 rows of life-cycle phases. The 5 roles are:

- Upper Management
- Line Management
- Product Champions
- Change Agent
- Pilot Project Team
- Target Users

The 7 life-cycles phases are:

- Assess the Need
- Select Candidate Products
- Evaluate Candidate Products
- Present Product to Management, Users
- Gather User Information
- Plan the Implementation
- Implementation and Ongoing Support

2.2 Can You Get the Benefits of CASE Without Buying It?

This session addressed which benefits (if any) could be derived from CASE technology, independent of the CASE tools themselves.

In general terms, CASE technology can be thought of as “any computer-based assistance that reduces the labor intensity of project development.” Participants in this session felt that the current orientation of CASE to software is at too low a level, and that what is really needed is Computer Aided Project Engineering (CAPE).

Participants determined that the primary benefit of CASE tools is in the enabling or automating of a defined methodology. A methodology is essentially a network of iterative work tasks. To benefit effectively from CASE technology, users would first have to define a methodology appropriate to their development process. But in automating a methodology, automation should not control the development process or methodology, but rather should work flexibly in support of the project.

Finally, as the emphasis of the session was on CASE without tool support, participants discussed several aspects of CASE that related specifically to adoption of the technology. The following conclusions were drawn:

- Many methodology decisions give inadequate regard to cost.
- Management underestimates the difficulty of change.
- Productivity is the result of a well-defined process.
- Process quality, not productivity, must be the focus of change.
- Product quality will result from process quality.
- Tools will evolve in support of a viable defined methodology.

2.3 The ‘CASEability’ of Projects

This session examined what essential attributes of a software development project must exist to introduce CASE or, if already begun, to accelerate CASE adoption. It uncovered no “silver bullets,” but it did identify a number of key areas in which more work is required.

This session identified 76 attributes of a software development project for consideration. These attributes were organized into 7 different classifications. Of the 76 attributes identified, 13 top attributes were highlighted as most relevant to the potential success of using CASE on a particular project. Of these, it was noted that preconditions and management factors far outweighed technical and tool issues.

This session also developed a list of 13 recommendations which, when implemented, would do the most to ensure the success of using CASE on a particular project. An abbreviated version of these recommendations is listed below:

- Develop a plan for CASE adoption.
- Create a metrics program.
- Establish a dedicated process, methods, and tools group.
- Establish a management mandate for automated process, methods, and tools.
- Select CASE tools that are extensible.
- Modify MIL STD DIDS to focus on methods and plans for CASE utilization.
- Designate a CASE adoption leader with a mandate for action.
- Establish or join CASE adoption societies.
- Identify incentives and rewards for CASE adoption.
- Create a CASE adoption risk reduction program.
- Establish a plan for up-front and continued training and incentives for CASE tools.
- Provide adequate schedule flexibility for CASE adoption.
- Establish a lessons-learned CASE tools usage database.

2.4 Developing a Realistic Estimate for CASE Tool Adoption

The aim for this session was the development of a core cost estimation framework to aid others in preparing detailed CASE budgets. This CASE budget framework is aimed at developing guidelines for determining the appropriate amounts of people, time, and money needed for CASE tool adoption.

There were three main products from this session:

- A list of 51 CASE economic issues
- Two summary tables:
 - CASE Adoption Life-Cycle Estimate Matrix
 - CASE Adoption Principle Cost Estimate Matrix
- An action plan for further investigation and refinement of this preliminary CASE Adoption Economic Model

These 51 CASE economic issues were divided into 6 categories:

- Process
- Management
- Economics
- Technical

- Standards
- Implementation

The two summary tables, the CASE Adoption Life Cycle Estimate Matrix and CASE Adoption Principle Cost Estimate Matrix, provide a quick overview of the major economic factors pertinent to CASE adoption. In addition, they attempt to highlight those elements that are primary cost drivers. Overall, these tables are designed to encourage potential planners to consider a wide range of factors that can influence the total cost of CASE adoption.

To achieve all of the session's original mission objectives, further effort coordinated by the SEI to complete the design of the CASE cost model is necessary. When completed, this CASE cost model would consist of a set of estimation algorithms, structured like the COCOMO software cost estimate model, and a guide book in its use.

For those seeking detailed information about specific tools and vendors, a set of CASE resource pointers was assembled.

2.5 Making the CASE Tool Fit the Organization and the Organization Fit the CASE Tool

This session examined changes that improve the chances for successful CASE tool adoption. Characteristics of tools and organizations that facilitate or inhibit CASE adoption were examined. Each characteristic was discussed in terms of the following factors (as applicable):

- Definition
- Examples
- How to implement
- Risks

Listed below is a summary of the four characteristics within each category:

1. Tool characteristics that facilitate CASE adoption
 - Customizable
 - Integratable
 - Vendor support
 - Extensibility
 - Documentation
 - Platform independence
2. Tool characteristics that inhibit CASE adoption
 - Failure to adopt industry trends
 - Poor performance
 - Tool proprietary methodologies

- Single-user versus multi-user tools
- 3. Organizational characteristics that facilitate CASE adoption
 - Defined/understood processes and standards
 - Training
 - Communication
 - Management support for implementation
 - Ongoing support
- 4. Organizational characteristics that inhibit CASE adoption
 - Cost
 - Maintenance versus new development
 - Heterogeneous development environment

3 Adoption Life Cycle and Roles

3.1 Theme Description

The purpose of the Adoption Life Cycle and Roles session was to identify the key roles, activities, and issues that must be addressed in a typical adoption life cycle for CASE.

3.2 Goal

The goal of this workshop session was to complete a matrix illustrating suggested entry and exit criteria and action to take for each adoption life-cycle phase, and issues to pay attention to for each of the appropriate roles in a particular adoption phase. This matrix is not definitive, but should provide a good model for change agents to use when planning and executing a CASE adoption in their organizations.

3.3 Process

Starting with a practical adoption model suggested by Barbara Bouldin [4], we examined the actions in each life-cycle phase that foster adoption. We also considered the issues and constraints that typically arise. Finally, we developed a prototype set of entry and exit criteria for each phase. We looked at the roles that are key to success in each adoption phase, and at the impact of each role on the overall success of adoption. We documented all this information in the form of a matrix, with the roles on the horizontal axis, the life-cycle phases along the vertical axis, and each cell containing entry and exit criteria as well as actions and issues. (See Table 1 for a view of the empty matrix)

To limit the scope of our work and focus our session, we assumed that we were:

- Working to describe the adoption of a CASE tool that addressed software design.
- Describing the adoption of the design method embedded in the tool.
- Dealing with a cohesive organizational unit, no larger than about 200 people, having multiple projects, and reporting to one manager.
- Dealing with a manager who had control over resources and could make a decision that this organization would or would not adopt the CASE tool.
- Viewing the adoption process from inside the adopting organization.

We were asking, in effect, what actions by members of that organization were needed to expedite the adoption. These actions need to be considered in the context of an organization. Smaller organization units would keep the roles described here, but scale down the effort accordingly. Smaller organization units would keep the roles described, but scale down the effort.

CASE Adoption: Roles and Life Cycle

<i>Life-Cycle Phases</i>	<i>Roles/Players</i>					
	Upper Mgt.	Line Mgt.	Product Champion	Change Agent	Pilot Project Team	Target Users
Assess the Need	Entry Crit.					
	Actions					
	Issues					
	Exit Crit.					
Select Candidate Products	Entry Crit.					
	Actions					
	Issues					
	Exit Crit.					
Evaluate Candidate Products	Entry Crit.					
	Actions					
	Issues					
	Exit Crit.					
Present Product to Mgt., Users	Entry Crit.					
	Actions					
	Issues					
	Exit Crit.					
Gather User Information	Entry Crit.					
	Actions					
	Issues					
	Exit Crit.					
Plan the Implementation	Entry Crit.					
	Actions					
	Issues					
	Exit Crit.					
Implementation and Ongoing Support	Entry Crit.					
	Actions					
	Issues					
	Exit Crit.					

Adapted from B. Bouldin, *Agents of Change*, Yourdon Press, 1989

Table 1 CASE Adoption: Roles and Life Cycle

The approach to the session chosen by the session's facilitators, John Maher and Priscilla Fowler, provided an efficient structure for participants to pool their collective experience. Bouldin's adoption life cycle is representative of a number of life cycles that appear in the technology transition literature (see, for example, [25] and [6]). It was selected for three reasons: first, it exists in published form; second, it was derived from an industrial setting where CASE tools

were being adopted; and third, beginning with an existing and representative model allowed participants to focus on the actual steps needed by players in the adoption process. It was assumed that a session participant or anyone reading this material subsequently would need to tailor it, especially its terminology, to suit local environments and customs. At the beginning of the session, the approach was reviewed with participants and agreed to with slight modifications.

John Maher began the session with a brief tutorial, "Transitioning New Technologies," to introduce some concepts that would be needed to understand and fill the matrix. Most importantly, he defined the terms used in the horizontal axis of the matrix: upper management and line management (sponsors), product champion, change agent, pilot project team, and individual users (targets). At the upper management level, the sponsor provides resources, strategic and policy direction, and final approval to proceed with the adoption of CASE. At the line management level, the sponsor may authorize resources and direct efforts toward planning for CASE adoption and experimental use. The product champion is the individual who initially introduces the idea of a particular CASE tool or type of tool, and informally advocates it, calling it to the attention of others. The change agent is an individual or team, drawn from line management or software personnel, who does the detailed planning and implementation of the CASE adoption. The pilot project team tries the CASE tool for the first time on behalf of the larger organizational unit. The target users are the remainder of the organization who will eventually adopt the CASE tool. "Adoption" is defined as routine, everyday use of a CASE tool or technology. More background on these definitions can be taken from the details of the matrix itself.

3.4 Adoption Life-Cycle Phases

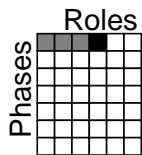
During the session, definitions of the adoption life-cycle phases, initially adapted from Bouldin, evolved:

1. **Assess the Need.** The champion considers how a CASE technology might improve the manner in which the organization develops software and collates information about what CASE tools might address the problems the organization faces.
2. **Select Candidate Products.** A quick survey of likely CASE products is made and candidates are selected which meet the organization's requirements.
3. **Evaluate Candidate Products.** One or two CASE products are tested by users working in projects typical of the organization. The best product is selected as a candidate for broader use within the organization.
4. **Present Product to Management, Users.** The product chosen is presented to management and potential users, with information on its costs, benefits, application, and projected results.

- Opportunities for information sharing
- Stability or degree of entrenchment of current system

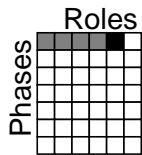
Exit Criteria

- Management convinced of need to look at candidate tools and methods
- Change agent appointed

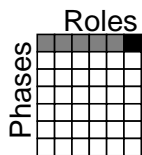


3.5.1.4 Change Agent (Assess the Need)

See Product Champion



3.5.1.5 Pilot Project Team (Assess the Need)



3.5.1.6 Target Users (Assess the Need)

Entry Criteria

- Champion or management contact

Actions

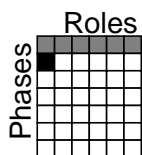
- Provide input to champion and/or management on work issues, needs, potential solutions

Issues

- Parochial views of problems

Exit Criteria

3.5.2 Select Candidate Products



3.5.2.1 Upper Management (Select Candidate Products)

Entry Criteria

- Commitment to look at candidate products

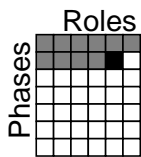
prepares report

Issues

- Adequacy of resources, time
- How legitimacy of role is conveyed to organization
- Competence of agent in methods and tools
- Competence of agent as change agent
- Rewards and risk for agent role
- How to deal with reluctant agent

Exit Criteria

- Methodology, tools selected for evaluation
- Report prepared and delivered to management



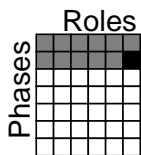
3.5.2.5 Pilot Project Team (Select Candidate Products)

Entry Criteria

Actions

Issues

Exit Criteria



3.5.2.6 Target Users (Select Candidate Products)

Entry Criteria

- Announcement of candidate selection process
- Announcement of change agent

Actions

- Respond to “idea” of innovation
- Provide input to selection plan
- Attempt to influence selection of pilot project, methods, tools

Issues

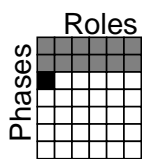
- Impact on users’ projects, schedules

- Learning curve (contact, awareness, understanding)
- Unclear goals, information (affects expectations)
- Acceptance of change agent

Exit Criteria

- Input provided to management, agent
- Announcement of candidate products to evaluate

3.5.3 Evaluate Candidate Products



3.5.3.1 Upper Management (Evaluate Candidate Products)

Entry Criteria

- List of candidate methods, tools to evaluate
- Commitment to evaluate

Actions

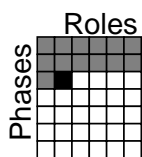
- Authorize resources for evaluation
- Communicate commitment to strategic goals
- Provide ongoing support and guidance from business perspective
- Make decision on recommended product

Issues

- Impatience with process
- Tendency to meddle with technical issues

Exit Criteria

- Decision communicated to organization on recommended product



3.5.3.2 Line Management (Evaluate Candidate Products)

Entry Criteria

Actions

- Commit resources to evaluation task (people, \$\$, time)

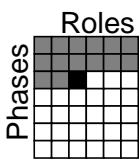
- Support preparation of business case
- Select pilot projects
- Deflect outside pressure on evaluation team
- Facilitate procurement of product
- Approve plan for pilot testing
- Monitor progress of evaluation
- Manage expectations (up, across, and down)
- Recommend product to implement
- Foster consensus among all those at risk

Issues

- Risk associated with trial use of new product
- Persistence of management in providing support
- Estimates (time, money, etc.) that are too small for task
- Risk of poor decision due to incomplete data

Exit Criteria

- Business case completed and product recommended



3.5.3.3 Product Champion (Evaluate Candidate Products)

Entry Criteria

Action

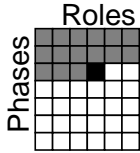
- Provide expertise on methodology, tool
- Influence selection of pilot project

Issues

- Conflict with change agent on goals, procedures, etc.
- Will champion support organization decision?
- Impact of championship on regular job

- Influence on pilot execution

Exit Criteria



3.5.3.4 Change Agent (Evaluate Candidate Products)

Entry Criteria

Actions

- Document the adoption life-cycle process
- Develop criteria and metrics for pilot selection, product evaluation, trial evaluation
- Recommend pilot projects
- Facilitate team development (evaluation team, pilot project teams, etc.)
- Develop plan for pilots
- Develop contract with tool vendors
- Procure products to evaluate
- Facilitate training of pilot teams
- Document software engineering process
- Monitor pilot execution and measure effectiveness
- Evaluate trial results
- Decide which tool and method to recommend
- Build business case with support from management
- Report to line management on progress
- Monitor budget and schedule of trial projects
- Manage pilot effort
- Conduct external evaluation of vendor, tool

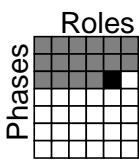
Issues

- Management of risk during pilot implementation
- Management of expectations in management, pilot teams, vendors
- Management of interface with everyone else
- Risk of partiality

- Potential lack of change agent and managerial skills
- Inability of pilot team to carry through test and meet production schedule
- Lack of authority to make decisions for pilot effort
- Inadequate access to line management, resources
- How best to develop metrics for trial results
- How to compare results across pilot teams

Exit Criteria

- Recommended tool(s) and method(s) identified
- Business case built and delivered to management



3.5.3.5 Pilot Project Team (Evaluate Candidate Products)

Entry Criteria

Actions

- Participate in developing pilot plan
- Be trained in use of method and tool
- Execute pilot project according to pilot plan
- Collect metrics during pilot testing
- Provide feedback on method and tool use

Issues

- Conflict between schedule and task assignment (pilot and other jobs)
- Separation of project tasks from product evaluation tasks
- Consistency of application across team of the tools or methods

- Rewards and risks for pilot implementation

Exit Criteria

	Roles			
Phases	■	■	■	■
	■	■	■	■
	■	■	■	■
	■	■	■	■

3.5.3.6 Target Users (Evaluate Candidate Products)

Entry Criteria

Actions

- Respond to “idea” of innovation
- Attempt to influence selection of pilot project, methods, tools, metrics

Issues

- Impact on users’ projects, schedules
- Learning curve (contact, awareness, understanding)
- Unclear goals, information (affects expectations)
- Acceptance of change agent
- Acceptance of pilot project as “typical” of their work

Exit Criteria

- Input provided to management, agent
- Pilot results/decision known

3.5.4 Present Product to Management, Users

	Roles			
Phases	■	■	■	■
	■	■	■	■
	■	■	■	■
	■	■	■	■

3.5.4.1 Upper Management (Present Product to Management, Users)

Entry Criteria

Actions

- Commit time, staff, money
- Identify target organizations for implementation
- Make public commitment to information gathering, presentation of method and tool

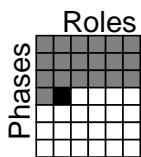
- Handle interface with higher management

Issues

- Potential for lack of understanding
- Potential for diminishing interest in effort
- Potential for “cold feet” due to cost, risk

Exit Criteria

- Decision to go ahead with implementation



3.5.4.2 Line Management (Present Product to Management, Users)

Entry Criteria

Actions

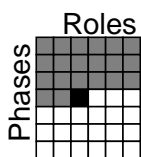
- Allocate time, staff, \$\$
- Identify target projects for implementation
- Make public commitment to information gathering, presentation of method and tool
- Handle interface with superiors, peers, subordinates

Issues

- Potential for lack of understanding
- Potential for diminishing interest in effort
- Potential for “cold feet” due to cost, risk
- Support from upper management

Exit Criteria

- Recommend decision to implement



3.5.4.3 Product Champion (Present Product to Management, Users)

Entry Criteria

Actions

- “Sell” the method and tool to users, management

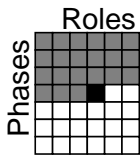
- Take part in demos

Issues

- Satisfaction with pilot results, recommendation
- Champion and change agent conflict on goals, procedures, etc.
- Support of organization decision
- Impact of championship on regular job
- Potential for defeated champions to resist decision

Exit Criteria

- Satisfaction with outcome (continues as champion)
- Dissatisfaction with outcome (because no longer a player)
- Presentations to management, users (if participant)



3.5.4.4 Change Agent (Present Product to Management, Users)

Entry Criteria

Actions

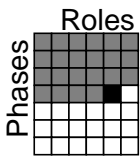
- Document the adoption life-cycle process (lessons learned)
- Undertake marketing, sales campaign
- Collect feedback, make notes for implementation planning
- Follow up with management for open action items
- Seek sponsorship

Issues

- Inexperience in marketing, sales
- Lack of confidence in method and tool decision

Exit Criteria

- Presentations to management, users completed
- Management decision on implementation



3.5.4.5 Pilot Project Team (Present Product to Management, Users)

Entry Criteria

Actions

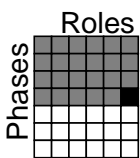
- Supports marketing effort
- Provides demos
- Influences target users

Issues

- Acceptance of method/tool
- Major dissension in project

Exit Criteria

- Demos and presentations completed (as requested)



3.5.4.6 Target Users (Present Product to Management, Users)

Entry Criteria

Actions

- Attend presentations/demos
- Voice concerns, issues, support (as appropriate)

Issues

- Parochial view of work, method and tool, etc.
- Split in support by user community
- Indifference to innovation
- Perception that method/tool doesn't fit need
- Low morale
- Unsystematic implementation

Exit Criteria

- Presentations/demos done
- User input voiced

3.5.5 Gather User Information

3.5.5.1 Upper Management (Gather User Information)

Entry Criteria

Actions

- Authorize activity to gather information
- Voice expectations about timetables, results
- Address questions as necessary
- Authorize preparation of implementation plan

Issues

- Exaggerated expectations of near-term results
- Support may not be unanimous

Exit Criteria

- Implementation plan preparation authorized

3.5.5.2 Line Management (Gather User Information)

Entry Criteria

Actions

- Identify key people for implementation planning
- Initiate and monitor activity to gather information
- Voice expectations about timetables, results
- Address questions as necessary
- Communicate information-gathering effort
- Gather and maintain support of peers
- Maintain an atmosphere for open dialogue

Issues

- Exaggerated expectations of near-term results

- Support may not be unanimous

Exit Criteria

- Information reported to management
- Planning team identified and assigned to work with agent

	Roles				
Phases	■	■	■	■	■
	■	■	■	■	■
	■	■	■	■	■
	■	■	■	■	■
	■	■	■	■	■

3.5.5.3 Product Champion (Gather User Information)

Entry Criteria

Actions

- Provides information
- Clarifies how method and tool can be used

Issues

- Biased
- May oversell
- May interfere with orderly data gathering process

Exit Criteria

	Roles				
Phases	■	■	■	■	■
	■	■	■	■	■
	■	■	■	■	■
	■	■	■	■	■
	■	■	■	■	■

3.5.5.4 Change Agent (Gather User Information)

Entry Criteria

Actions

- Document the adoption life-cycle process
- Prepare plan, instruments for gathering data
- Identify key data sources
- Gather data
- Facilitate worker-level consensus
- Raise issues with management

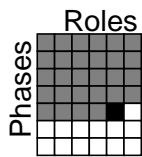
Issues

- Covert resistance/dishonesty of users
- Lack of experience in gathering data systematically

- Attempts to sabotage process
- Confidentiality of data, attribution
- Credibility of agent, sources

Exit Criteria

- Data gathered and ready for factoring into planning
- Data reviewed with planning team



3.5.5.5 Pilot Project Team (Gather User Information)

Entry Criteria

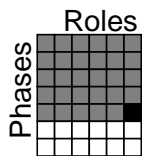
Actions

- Support change agent
- Provide conduit of information to and from users

Issues

- Inaccurate representation of users
- Credibility (if pilot not initially successful)

Exit Criteria



3.5.5.6 Target Users (Gather User Information)

Entry Criteria

Actions

- Provide information, concerns, perspective to agent
- Move toward consensus by looking at differences, similarities in user group
- Participate actively in data gathering effort
- Keep an open mind

Issues

- Parochial view of effort

- Polarization of user group

Exit Criteria

- Interviews, etc., completed

3.5.6 Plan the Implementation

	Roles				
Phases	■	■	■	■	■
	■	■	■	■	■
	■	■	■	■	■
	■	■	■	■	■
	■	■	■	■	■

3.5.6.1 Upper Management (Plan the Implementation)

Entry Criteria

Actions

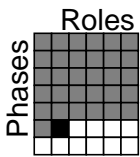
- Determine sources of funding
- Authorize funding, resources, etc.
- Approve or reject implementation plan
- Convey ongoing support of effort
- Maintain external interfaces

Issues

- Cost of implementation
- Funding sources
- Impact on ongoing projects, resources
- Link with strategic goals
- Legal ramifications

Exit Criteria

- Implementation decision made
- Funds for implementation authorized
- Sources for funding determined



3.5.6.2 Line Management (Plan the Implementation)

Entry Criteria

Actions

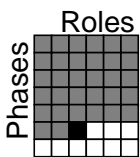
- Direct and monitor plan development
- Recommend plan to upper management
- Provide support, time for planning
- Convey impact of decision to organization
- Monitor staff morale
- Convey public support for effort
- Facilitate consensus among peers, subordinates
- Maintain an atmosphere for open dialogue

Issues

- Impact of planning, implementation on ongoing projects
- Impact on organization morale
- Maintenance of open atmosphere for discussion

Exit Criteria

- Plan to recommend to upper management
- Sense of level of support in organization



3.5.6.3 Product Champion (Plan the Implementation)

Entry Criteria

Actions

- Provides information for planning
- Provides input on training issues

Issues

- Biased
- May oversell
- May underestimate training needs

- Provide conduit of information to and from users
- Provide input for plan
- Review plan

Issues

- May not typify the user population

Exit Criteria

- Plan reviewed

	Roles				
Phases	■	■	■	■	■
	■	■	■	■	■
	■	■	■	■	■
	■	■	■	■	■
	■	■	■	■	■
	■	■	■	■	■

3.5.6.6 Target Users (Plan the Implementation)

Entry Criteria

Actions

- Provide information, concerns, perspective to planning team
- Review plan (sample of users): work estimation, timing, support, rewards for implementation, learning curve, etc.
- Begin to rework existing schedules, if necessary

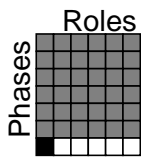
Issues

- Parochial view of effort
- Polarization of user group
- Impact of implementation on current projects
- Confidentiality of feedback
- Rewards for implementation

Exit Criteria

- Plan reviewed by sample of population
- In-progress rework scheduled, as required

3.5.7 Implementation and Ongoing Support



3.5.7.1 Upper Management (Implementation and Ongoing Support)

Entry Criteria

Actions

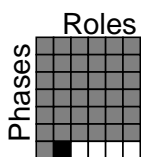
- Convey continuing support/sponsorship
- Link implementation success with reward system
- Initiate policy changes, updates
- Authorize funding, resource allocation updates as necessary
- Manage external interface
- Actively participate in communication, symbolic leadership, etc., in support of effort
- Monitor impact of implementation and ongoing activity
- Reward, recognize, & publicize success

Issues

- Level of continuing sponsorship
- Implementation problems, e.g., cost overruns
- Other pressing issues

Exit Criteria

- Implementation complete: method and tool routine part of business



3.5.7.2 Line Management (Implementation and Ongoing Support)

Entry Criteria

Actions

- Implement plan
- Monitor progress, results
- Facilitate surfacing and resolution of issues
- Facilitate establishment of ongoing implementation/support

activities (e.g., vendor support)

- Develop or direct development of policies that support method and tool
- Ensure that people use the product correctly
- Provide ongoing sponsorship
- Manage interfaces: peer, superior, subordinate
- Reward and publicize success, celebrate
- Allocate and adjust resources during implementation
- Adjust plan as necessary

Issues

- Meeting product delivery dates
- Managing resistance; maintaining morale
- Providing resources for support (training, consultation, equipment, etc.)
- Managing changes in management, strategic direction
- Reacting to staff turnover, reorganization

Exit Criteria

- Implementation complete: method and tool routine part of business

3.5.7.3 Product Champion (Implementation and Ongoing Support)

Entry Criteria

Actions

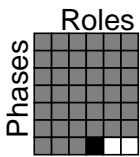
- Continue to provide support for effort
- Celebrate success

Issues

- Re-entry into normal work

Exit Criteria

- Implementation complete: method and tool routine part of business



3.5.7.4 Change Agent (Implementation and Ongoing Support)

Entry Criteria

Actions

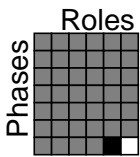
- Document the adoption life-cycle process
- Implement plan (see notes)
- Monitor progress
- Shift direction as necessary: negotiate altering plan
- Communicate sponsor support
- Provide feedback to sponsors, vendors
- Manage resistance
- Facilitate development of formal processes and procedures (e.g., custom user guide, draft organization policy, etc.)
- Facilitate establishment of ongoing implementation and support activities (e.g., vendor support, user group)
- Monitor status of vendor in marketplace
- Monitor developments in tool marketplace

Issues

- Change in strategic direction
- Change in organization, personnel, management
- Change in job
- Succession planning
- Impact of new technology

Exit Criteria

- Implementation complete: method and tool routine part of business



3.5.7.5 Pilot Project Team (Implementation and Ongoing Support)

Entry Criteria

Actions

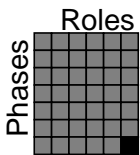
- May “seed” other projects with expertise
- May train other projects
- Provide information for user guide

Issues

- Version changes that make experience obsolete

Exit Criteria

- Implementation complete: method and tool routine part of business



3.5.7.6 Target Users (Implementation and Ongoing Support)

Entry Criteria

Actions

- Get training
- Use method/tool
- Address concerns, issues, problems in use
- Suggest solutions to issues, problems, etc.
- Provide informal training to peers
- Participate in user groups

Issues

- Quality, extent of support
- Learning curve
- Rewards for implementation
- Turnover
- Impact on daily work habits
- Impact on schedule, budget, etc.

- Communication with superiors, agent

Exit Criteria

- Implementation complete: method and tool routine part of business

4 Can You Get the Benefits of CASE Without Buying It?

4.1 Theme Description

The purpose of this workshop session was to determine which benefits (if any) could be derived from the formal specification of a development project using CASE technology, independent of the CASE tools themselves.

4.2 Goal

The output of this workshop session was a set of positions formalized by the participants about questions that were discussed, such as:

- What is CASE?
- What must be automated?
- What cannot be automated?
- What work tasks does CASE change?
- How can “not buying but using” be sold to management?
- What lessons can be learned from workshop participants’ own experience?

4.3 Process

The workshop session began by producing the output of the workshop. All participants played an active role, such as being a scribe on one of 8 flipcharts, or sharing a specific experience that others had not been exposed to.

The workshop session focused on the practitioners’ needs, which included the ability to communicate effectively with management.

4.4 Results

4.4.1 A Definition of CASE

In general terms, CASE technology can be thought of as “any computer based assistance that reduces the labor intensity of project development. The group consensus was that current orientation of CASE (Computer Aided Software Engineering) thinking was not large enough. The group suggests a higher-level orientation like Computer-Aided Project Engineering (CAPE).

The group first proposed a more precise definition of CASE. It was noted that it would be unreasonable to consider implementation of lower-level development tasks (e.g., compilation, code management, debugging) without the aid of tools. Therefore, it was agreed that, for the

purposes of the workshop discussion, “CASE” would mean only “upper CASE” (diagramming and display) tools that operated on diagram types, such as:

- Data flow diagrams
- State transition diagrams
- Entity-relationship diagrams
- Control flow diagrams
- Structure charts

4.4.2 An Enabled Benefit of CASE Technology

The primary benefit of CASE tools is that they enable a defined methodology. A methodology is essentially a network of (iterative) work tasks. To benefit effectively from CASE technology, users would first have to define a methodology appropriate to their development process.

Although CASE tools (in the context selected) automate the diagramming process, they are not fundamentally a part of the methodology. It was decided that, on this level, the benefits of CASE technology can be experienced by users without the requirement of CASE tool adoption.

4.4.3 The Benefits of Automation

As part of the session, the discussion focused on the types of tasks (those which could be performed manually as part of “not buying”) for which CASE automation was useful. The group then identified these tasks.

The group felt that automation should not control the development process or methodology, but rather work flexibly in support of the project. A list of the automated tasks and associated support desired from the CASE tools would then include:

- Production of documentation
- Interface connections between work tasks
- Assistance in impact analysis
- Project formalism
- Integration of higher levels of abstraction
- Enforcement of project standards and procedures

4.5 Lessons Learned

Finally, as the emphasis of the session was on CASE without tool support, the group discussed several aspects of CASE related specifically to adoption of the technology through modification or installation of the development process:

- Many methodology decisions give inadequate regard to cost.
- Management underestimates the difficulty of change.
- Productivity is the result of a well-defined process.
- Process quality, not productivity, must be the focus of change.
- Product quality will result from process quality.
- Tools will evolve in support of a viable defined methodology.

5 The “CASEability” of Projects

5.1 Theme Description

This workshop session examined a range of characteristics of a software development project, including process factors that are positive and negative indicators that a CASE tool can be successfully employed and bring beneficial results to the project.

5.2 Goal

The goals of this workshop session were twofold:

1. Identification of what attributes of a software development project are essential to introduce CASE or (if already begun) to accelerate CASE adoption.
2. Identification and recommendations of actions needed to create these essential project attributes.

5.3 Process

To accomplish the goals of this workshop session, the following brainstorming approach was employed:

1. nominate attributes
2. debate, agglomerate
3. rank attributes
4. nominate recommendations
5. debate, agglomerate
6. rank recommendations
7. review of other issues, rebrainstorm, debate, rank

Nominations were made using a simple round-robin process. The floor was closed for new nominations either when time expired, or when there were eight passes (equal the number of workshop participants) in a row.

Workshop participants voted on attributes. Each participant was allotted a fixed number of votes (equal to 1/3 the number of items to be ranked) which could be allocated to a maximum of 2 votes per attribute. The attributes with the most votes were considered the most important problem areas and resolutions to these problems were sought using the same brainstorming, voting, and ranking method.

5.4 Attributes

From the initial nomination step, 76 attributes were identified. (See Appendix C.1 for this complete list.)

5.5 Classification

A rudimentary classification scheme was proposed to identify clusters of related attributes. This classification scheme originally consisted of the following classes, with their associated attributes. Attributes could appear in more than one class.

- Pre-conditions
- Change Process/Management
- Implementation Phase - Tool
- Implementation Phase - Process/Feedback
- Implementation Phase - People
- Economics (discussion and further consideration of economic issues were tabled in view of the concurrent cost estimation session)
- Other

(For a complete cross reference of attributes and their related class assignment, subsequent agglomeration, and voting, see Appendices C.2, C.3, and C.4.)

5.5.1 Top Attributes

Summarized below are the final “top 13” attributes from this session. These attributes have the most significant bearing on the potential success of using CASE on a particular project:

- Pre-conditions
 1. commitment to training and education.
 2. acceptance of CASE tools by development team.
 3. room for failure; plan for success; mitigate risk (freedom from worth of CASE tools).
 4. sufficient lead time and resources committed plus adequate schedule.
 5. customer reinforcement (the government must have leverage to reinforce the use of CASE).
 6. commitment to well-defined standards and procedures.

- Change Process/Management
 7. champion with stature (clout).
 8. management mandate for tool usage and its products.
 9. identification of and commitment to incentives for CASE adoption, plus rewards for/recognition of success.
- Implementation Phase - Tool
 10. organizational and technical support for needed future abstractions and methods for reuse, maintainability, auto-documentation, auto-design, integration of software packages, reengineering, etc.
- Implementation Phase - Process/Feedback
 11. metric/measurement program in place plus feedback loop for improvements and lessons learned.
 12. establishment of a dedicated tools/methods/process group.
- Other
 13. SEI assessment program (similar to the Process Assessment program) for maturity of tool users and vendors.

5.6 Recommendations

Recommendations were “brainstormed” using the same nomination process used for identifying attributes. One constraint, however, was that recommendations had to satisfy (i.e., be traceable to) attributes that received 5 or more votes. From the initial recommendations step, 33 recommendations were tallied, grouped, traced, and voted upon. (See Appendix C.5 for this complete list.)

5.6.1 Top Recommendations

Summarized below are the final “top 13” recommendations from this session. When implemented, these recommendations will do the most to ensure the potential success of using CASE on a particular project:

- Develop a plan for CASE Adoption which includes: establishment of project standards and procedures, training in tools and methods, tool selection, installation, and customization.
- Create a metrics program to provide feedback for process evaluation and continuous improvement.
- Establish a dedicated process, methods, and tools group.
- Establish a management mandate for automated process, methods, and tools (i.e., CASE Adoption).

- Select CASE tools that are extensible and open to provide for future methods, abstractions, reuse, maintainability, etc., to avoid obsolescence.
- Modify MIL STD DIDS (e.g., SD, CM QA Plans) to focus on methods and plans for CASE utilization.
- Cause corporate leadership (CEO or equivalent) to designate a VPGM (or other with “clout”) to be the CASE adoption leader with a mandate for action.
- Establish or join CASE adoption societies (internal or external) for mutual support, standardization, and knowledge-acquisition.
- Identify incentives and rewards (e.g., cash bonuses) for CASE adoption, creating reusable components, and implementing new technologies.
- Create a risk reduction program/guidelines for mitigating risk in the CASE adoption process.
- Establish a plan for up-front and continued training and incentives for CASE tools.
- Provide adequate schedule flexibility for CASE adoption in the procurement process to ensure adequate lead time and resource availability.
- Establish a CASE tools usage database to provide CASE user community with lessons learned.

5.6.2 Recommendations for the SEI

During brainstorming, several recommendations were made which translated into calls for SEI action. Although none of these recommendations accumulated sufficient votes to qualify as a top-rated recommendation, the workshop participants nevertheless decided to call special attention to the recommendations. These SEI-related recommendations were:

- Modify the SEI Process Assessment program to include two new scalars (tools and metrics) with an eye on the future addition of other scalars (to motivate CASE adoption).
- The SEI should author, distribute, and provide training for a CASE evaluation process to enable tool users and DoD to select CASE versus requirements.
- Form an SEI-sponsored CASE adoption SWAT team.
- Create a follow-up session to allow the group to focus on specific items like a CASE Adoption Plan.

5.7 Session Review

Only one issue of consequence was brought up during the review session. The session leader, Dr. Royce, wanted to emphasize that the current C-language orientation of CASE was a strong inhibitor to CASE adoption and evolution; he said that C is too low-level, and does not support abstraction to the degree to which, for example, C++ and Ada do. He said that he was not

advocating Ada or C++ in particular, but was merely arguing that a migration from C-level semantics to a high-order language would be extremely helpful.

5.8 Conclusion

Participants in this session noted that preconditions and management factors far outweighed technical and tool issues as key factors that are most likely to affect the successful outcome of using CASE on a particular project. While no “silver bullets” were uncovered, the session did help participants identify a number of areas in which more work is required.

6 Developing a Realistic Budget for CASE Tool Adoption

6.1 Theme Description

This session focused on the issue of providing a realistic cost estimate for CASE tool adoption. There are two key motivators for this workshop session:

1. Would-be CASE implementors too often mistakenly focus only on the acquisition cost of a CASE tool. Over the course of a CASE tool adoption, implementors may discover that CASE adoption costs are analogous to an iceberg. Just as the visible tip of an iceberg represents only 1/5 to 1/7 of its true size, the vendor's price of a CASE tool represents only a small portion of the total adoption cost of CASE. In addition to acquisition costs, CASE adoption can include significant people and time resource costs.
2. There is a critical need to inform corporate management about the expected costs of CASE adoption. This is an essential element in managing corporate expectations.

6.2 Goal

To address these issues, the initial goal of this workshop session was to discuss various cost components and prepare a framework for cost estimation to aid others in preparing their detailed CASE budgets. The framework discussed during the workshop attempted to address the following aspects:

- The cost line items that need to be taken into account. These costs include personnel, technology and other resources that must be estimated and budgeted for.
- The actions required by an organization to assimilate the CASE tool successfully, and their associated cost. These actions—training, modifying technology platforms, implementing new methods and standards—depend on the organization's readiness to adopt the CASE tool.
- The strategies available for implementation. Different strategies—gradual introduction, aggressive adoption, etc.—will have different impacts on the timing of costs.

6.3 Session Introduction

The session leader, Mr. Gonzalo Verdugo of Rubin Associates, began the discussion with an overview. His presentation included an examination of practical framework components, a description of three useful frameworks, and several CASE implementation scenarios. Mr. Verdugo reviewed several measures of organizational readiness and reviewed the SEI's Software Process Maturity Framework [22] and [11]. Finally, his presentation provided some raw cost

data from several sources such as [26], [13], [23], and a STARS-sponsored Hughes Initial and Operating CASE Investment Model.

6.4 Session Mission Statement

In the course of session discussion, the following mission statement was agreed upon:

Establish a framework/model for detailed CASE estimate preparation and related issues. The framework should include guidelines in determining the appropriate amounts of people, time, and dollar resources for multiple projects under a single organization for CASE tool implementation.

6.5 Results

There were three main products from this session. First, there was a partial list of issues aimed at promoting topics that should be considered in the economics of CASE adoption. The general topics into which these issues fit were:

- Process
- Management
- Economics
- Organizational
- Technology
- Standards
- Implementation

The second major product was a pair of tables:

- CASE Adoption Life Cycle Estimate Matrix
- CASE Adoption Principle Cost Estimate Matrix

These two tables provide a quick overview of the major factors that affect the economics of CASE adoption. In addition, they attempt to highlight those elements that are primary cost drivers.

The third product was an action plan for further investigation and refinement of this preliminary CASE Adoption Economic Model.

6.5.1 CASE Adoption Issues

Below is a partial list of issues pertinent to the economics of CASE adoption:

6.5.1.1 Process

- Does the CASE technology you are implementing match your process?

- Are you buying a process with the CASE tool?
- Have you defined your software development process before automating it?
- Is there interaction with other processes (i.e., Systems Engineering)?
- How do you get to a certain level of process maturity to implement CASE?
Is this level necessarily level 3?

6.5.1.2 Management

- What is the rationale for adopting CASE?
- What are the CASE adoption alternatives?
- What is an affordable CASE adoption strategy?
- How do you design a CASE adoption strategy to support an organizational or project mission and strategy?
- How do you identify, measure, and harvest the actual benefits or opportunities provided by CASE adoption?

6.5.1.3 Economics

- What is the cost of inaction?
- What is the cost/benefit of action and how do you maximize return on investment?
- How is CASE adoption funded?
- Is there the potential for a self-funding strategy (e.g., fee for service)?
- What is the cost of tool replacement?
- Have you considered the software, hardware, and human skill elements in your costing estimates?
- What are the total costs of a software upgrade? (This may include cost items beyond the software upgrade itself, such as a corresponding hardware upgrade.)
- Where do you get the estimates? Are the estimates (e.g., training estimates obtained from the vendor) valid? Are the estimates phase related?

6.5.1.4 Organizational

- How do you build top level understanding and commitment?
- How do you set appropriate management expectation?
- How do you educate top management?
- How does the organization adapt to technology introduction?
- How do you manage organizational change?
- What are the various roles and responsibilities in the organization?

- How does this fit with the CASE opportunity?

6.5.1.5 Technology

- What is the technology life of:
 - software?
 - hardware?
 - human skills?
- What is a reasonable timeframe for a complete technology life cycle?
- What are the differences, if any, in CASE implementation in various domains?
 - MIS versus engineering and real-time CASE domains
- What are the differences between implementation strategies?
 - distributed/centralized
 - platforms focus (mainframes/ workstations/ personal computers).
 - organizational-wide/project-oriented
- Is there a need and/or desire for suite of compatible tools?

6.5.1.6 Standards

- What is the cost of adopting or not adopting standards?
- What level of standards is appropriate?
 - tools
 - interfaces
 - methodologies/processes
 - reusable code

6.5.1.7 Implementation

- How does the organization adapt to technology introduction?
- How do you manage organizational change?
- What are the various roles and responsibilities in the organization?
- How does this fit with the CASE opportunity?
- What are the CASE adoption alternatives?
 - without top-level commitment
 - new starts versus ongoing project/evolution

- How effective are different adoption scenarios?
- Are you in an adoption mode without top-level commitment?

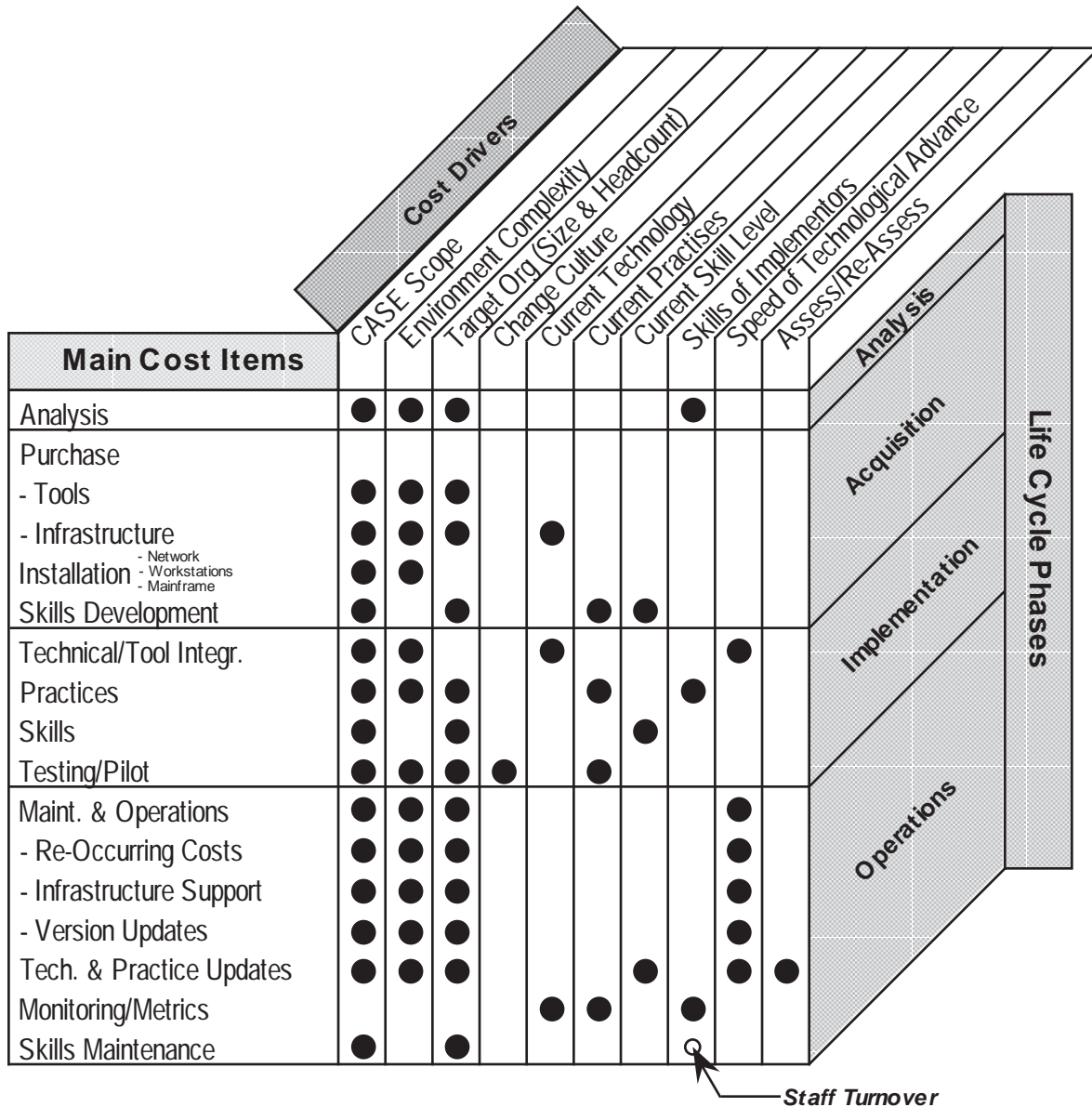
6.5.2 CASE Adoption Estimation Matrixes

The following two tables provide a quick overview of the major factors that affect economic considerations of CASE adoption. In addition, they highlight those elements that are primary cost drivers. The CASE Adoption Life Cycle Estimate Matrix table is organized by Life Cycle Phases (Analysis, Acquisition, Implementation and Operations) and HiTOP categories (Technical, Organization and People, plus an additional Management category). The HiTOP categories were adopted from the workshop keynote address by Dr. Morell of the Industrial Technology Institute. Overall, these tables are designed to motivate potential planners to consider a wide range of factors that can influence the cost of CASE Adoption.

CASE Adoption Life Cycle Estimate Matrix

		Life Cycle Phases			
		Analysis	Acquisition	Implementation	Operations
Categories	Technical	Assessment - Technology - State of Practice - Needs Establish Requirements Architecture Definition	Selection - Vendor/Tool - Tool Integ. Strategy Purchase - Negotiations - Strategy Tools Infrastructure - Network - Mainframe - Workstations Installation - Site Preparation	Technical - Tool Integration Metrics Analysis Testing - Pilot Infrastructure Support	Maint. & Operations - Re-Occurring Costs -- License Fees -- Personnel -- Facilities - Infrastructure Spt - Version Update Technology Infusion Reassessment <i>go back to</i> <i>Analysis Phase</i>
	Organization	Assessment - Process - Culture	Cultural Change Mgt	Practices - Q/A & Conf Mgt - New/Revised - Documentation Cultural Change Mgt - User's Groups	Practices - Q/A & Conf Mgt - New/Revised - Documentation Cultural Change Mgt - User's Groups
	People	Assessment - Skills	Skills Development - Implementors - Users	Skills Development - Training/Education - Coaching - Hiring	Skills Maintenance
	Mgt	Commitment Building Monitoring	Commitment Maint. Monitoring	Commitment Maint. Monitoring Metrics Review	Commitment Maint. Monitoring Metrics Review

Table 2 CASE Adoption Life Cycle Estimate Matrix



Key Assumption:

There is a commitment to change from management and target users.

Table 3 CASE Adoption Principle Cost Estimate Matrix

6.6 Next Steps

Additional work is necessary to achieve our original mission objectives completely. We need to complete the design of our cost model. In doing so, we need to address the pertinent issues raised in this workshop session. These include development of rules of thumb and algorithms for estimation. We hope that we can develop a set of estimation algorithms structured in a

manner like the COCOMO software cost estimate model [2]. We should also develop a guide book for the estimation process. Next, a number of case studies should be done to verify the accuracy of the model. And finally, the model should be made available for use in a trial period during which important feedback and lessons learned can be incorporated into the model.

6.7 Conclusion

The material included in this section provides essential information to those who must prepare composite estimates for implementing CASE in their organization. It provides a high-end framework that serves as a checklist of elements to consider when developing an organization-specific cost estimate. As described above, the next step in this process is the development of an algorithmic cost model to aid in the CASE adoption estimation process.

In addition to this high-end framework, there still is an important need for detailed information about specific tools and vendors. Those who have this need may refer to Appendix D, CASE Resource Pointers. In this appendix, there are 8 tables that provide a useful set of pointers to different sources of information on CASE tools. While not all-inclusive, this information exemplifies the type of information that is available from commercial and government sectors.

7 Making the CASE Tool Fit the Organization and the Organization Fit the Tool

7.1 Theme Description

All organizations have difficulty coping with change. This concept certainly applies to a company's decision to incorporate CASE. The focus of this workshop session was to examine some of the changes that an organization may need to make if tool adoption is to be successful, and to identify the modifications that may be required of tools and tool vendors.

7.2 Goal

The goal of this workshop session was to identify tool and organizational characteristics that facilitate or inhibit CASE adoption.

7.3 Discussion Topics

In pursuit of this goal, the subsequent discussion focused on four topic areas:

1. Tool characteristics that facilitate CASE adoption
 - Customizable
 - Integratable
 - Vendor support
 - Extensibility
 - Documentation
 - Platform independence
2. Tool characteristics that inhibit CASE adoption
 - Failure to adopt industry trends
 - Poor performance
 - Tool proprietary methodologies
 - Single-user versus multi-user tools
3. Organizational characteristics that facilitate CASE adoption
 - Defined/understood processes and standards
 - Training
 - Communication
 - Management support for implementation
 - Ongoing support
4. Organizational characteristics that inhibit CASE adoption
 - Cost

- Maintenance versus new development
- Heterogeneous development environment

Each topic was discussed in terms of the following factors (as applicable):

- Definition
- Examples
- How to implement
- Risks

7.4 Tool Characteristics That Facilitate CASE Adoption

7.4.1 Customizable

Definition: Ability to tailor the tool's features and functions to the organization's needs.

Examples:

- Report contents and formats.
- User-defined symbols and checking rules.
- Ability to respond to changes in the work flow (e.g., tool that will allow you to "check in" a diagram that is not semantically correct).
- Ability to facilitate the production of documentation.

How to Implement:

- Customization may be done by:
 - group
 - company
 - project
 - user-by-user
 - centralized
 - through a clearing house
- There should be an entity responsible for customization

Risks:

- Maintenance of versions of customized tools and environments
- Providing inadequate support of the process of customization.
- Not fully understanding the complexity of customization.
- Customization may violate a tool-enforced standard.
- Customization may sacrifice a feature of a tool (e.g., can't use consistency checking features if you've redefined what a symbol means)

in a diagrammatic tool).

7.4.2 Integratable

Definition: Information captured by one tool accessible to other tools in Software Development Environment (SDE); ability to initiate and accept information from other tools in SDE.

Examples:

- EIA CDIF CASE data interchange
- Message passing—Softbench Message Server
- Linking—Sun’s link services

How to Implement:

- Many models—outside the scope of this workshop.

Risks:

- Too much faith in immature technology.
- Demonstrated only for programming in the small; questionable scalability.
- Semantic integration—two tools tightly coupled act as third tool, with indeterminate characteristics.

7.4.3 Vendor Support

Definition: Quality training, timely technical support, user groups, support for customization, mechanisms for accepting inputs on enhancements or bugs; provided by vendor.

How to Implement:

- Get an evaluation copy of tool
- Get an evaluation copy of documentation
- Attend vendor training
- Attend user group meetings

7.4.4 Extensibility

Definition: Adding functionality and value to the tool; goes beyond customization.

7.4.5 Documentation

Examples: User manual, reference manual, tutorial, on-line help, meaningful diagnostics, master index, reference card, supplementary texts (for supported methods).

Risks:

- Not enough documentation.
- Not clear enough for user to learn basics of tool quickly.
- Potential “shelf-ware.”

- Updates/change pages do not occur with tool upgrades.

7.4.6 Platform Independence

Definition: Tool has ability to share information and control across platforms (interoperability).
Tool operates on a variety of platforms.

Examples:

- X-windows, NFS (hide platform variations)

How to Implement:

- Tool makes use of X-window interface, or is able to reside on NFS

Risks:

- Buying into a proprietary solution

7.5 Tool Characteristics that Inhibit Adoption

7.5.1 Failure to Adopt Industry Trends

Examples:

- Tool linked to obsolete/restricted platforms and environments.
- Tool can't accommodate evolving methods.

Risks:

- Not tracking standards and trends diminishes tool's ability to interoperate, integrate, and be portable.

7.5.2 Poor Performance (of Tool)

How to Implement:

- Plan/manage project growth
- Recognize requirements (tool, platform, software)

Risks:

- Productivity
- Scalability
- Frustration—tool so slow to use, all CASE use is terminated

7.5.3 Tool Proprietary Methodologies

Risks:

- Training & literature may not be readily accessible.
- Client does not readily accept.
- Evolution is restricted.

- Customer may be locked in to one vendor's tool and/or methodology.
- Tool proprietary methodologies may not ever be a *de facto* or official standard.
- Tool can't be re-used or shared.

7.5.4 Single-User Versus Multi-User

Definition: Stand-alone versus cooperative environment (real time).

Risks:

- Single user— isolation, inadequate CPU and disk resources.
- Multiple user—security and configuration management; inadequate network resources, cpu, disk, etc.
- Both—performance, scalability, availability.

7.6 Organizational Characteristics That Facilitate CASE Adoption

7.6.1 Defined/Understood Processes and Standards

Examples:

- 2167/2167A
- Home-brewed cookbook (site-specific)
- Folklore or company culture
- Company proprietary

How to Implement:

- Marry tool with process (nontrivial & generally underestimated).

Risks:

- Conflict between tool and organization structure and process.
- Reliance on tool to set the process—may be beyond tool's capabilities.
- Potential to buy wrong tool set.
- Inconsistent tool use (example: two people using same tool, yet using completely different naming conventions—tool can't enforce a naming convention!).

7.6.2 Training

Definition: Training in methods, tool, and customization

Examples:

- Hands-on training (very important)
- On-line training
- Training assistance from in-house "centers of excellence"

How to Implement:

- In-house support capability
- Consistent vendor-supplied training
- Provided for consultants, new hires, etc.

Risks:

- Misuse and inconsistency.
- Insufficient frequency and/or timeliness (too soon, too late, not often enough for all employees).
- Irrelevance—the examples in the training sessions are far removed from the user's domain
- User frustration.
- Unrealistic expectations—training can't make a person an expert.

7.6.3 Communication**Examples:**

- Promote between champions and coaches
- “Sign-off” & buy-in from all relevant groups (QA agrees in tool's representation, CM agrees tool's objects will be stored, etc.); connect with the multiple disciplines involved in managing project (QA, CM, etc.)
- Pass lessons learned to future projects.
- Use electronic bulletin boards.
- Use tool itself to support structured communication—through project management, conferencing, notes, on-line (extensible) documentation.

Risks:

- Champion with hidden agenda.
- Chaos.
- Excessive or overly formal communication.
- Lack of focus (e.g., 18 different newsletters for one division, no one reads them).
- False perceptions.
- Communication clouded by politics—newsletters seen by customer contain only “happy talk.”
- “Filters” for communications.
- “Blinders”—people don't avail themselves of communication mechanisms available.

7.6.4 Management Support for Implementation**How to Implement:**

- Sanction and support for pilot projects.
- Accommodation— \$\$\$\$ (funding available for purchase).
- Planning, schedules, and ancillary development.
- New infrastructure.

Risks:

- Mandate without buy-in at lower levels (can't get developers to use).
- Grassroots movement without management support.
- Politics & self-fulfilling prophecies (you can try it, but it won't help you anyway).
- Lack of interdepartmental buy-in/support.
- Poor planning of time & resources.
- External customer perspectives—customer should understand the actual cost and schedule impacts of CASE adoption; customer should not expect CASE to revolutionize the organization, but to impact the organization in an evolutionary way.

7.6.5 Ongoing Support

How to Implement:

- Maintenance—track evolution in tools and process.
- System administration of tool—install upgrades.
- Continue training.
- Use coaches.
- Provide feedback loop for future uses of tool.

Risks:

- Tool becomes obsolete.
- Misuse—user expertise lags behind tool/technical capabilities.
- Compatibility—different versions of same tool; can't share data, versions get out of synch.

7.7 Organizational Characteristics That Inhibit Adoption

7.7.1 Cost

- Deferring to “Developing a Realistic Budget for CASE Tool Adoption” session.

7.7.2 Maintenance Versus New Development

Risks:

- CASE not always applicable to existing system (maintenance).

- Reliance on “reverse engineering will solve our problems” (new development).
- CASE tools aren’t used early enough to capture information.
- The state of design automation is not recognized—different types of design.
- Although “reengineering” techniques have been around since the 70’s, automation isn’t available for it yet.

7.7.3 Heterogeneous Development Environment

Definition: Tool and platform choices may be restricted to what has currently been purchased by the organization.

Examples:

- Many machines
- Operating systems (VMS, OS/2, UNIX, etc.)
- Graphical user interfaces (OSF/Motif, OpenLook, Present Manager, etc.)
- Networks (NFS, DECNET, PCNET, etc.)

How to Implement:

- The trend is towards heterogeneous development environment (what vendor is selling the least expensive box this month).

Risks:

- Prediction of future environments and technology is difficult.
- Tool vendors aren’t tracking trends.
- Users are required to know many different systems.

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Appendix B Workshop Session Assignments

B.1 Adoption Roles and the Adoption Life Cycle for CASE

Session Leaders

Priscilla Fowler, Software Engineering Institute
John Maher, Software Engineering Institute

CASE Project Member

Ed Morris, Software Engineering Institute

Scribe

Joseph Morin, Software Engineering Institute

Participants

Odean Bowler, Air Force Software Technology Support Center
Hillary Davidson, Hewlett-Packard
Greg Engledove, Department of the Navy
Roy B. Levow, Florida Atlantic University
Jonathan A. Morell, Industrial Technology Institute

B.2 Can You Get the Benefits of CASE Without Buying?

Session Leader

Ed Averill, Software Engineering Institute

CASE Project Member

Paul Zarrella, Software Engineering Institute

Scribe

Andy Tsounos, Software Engineering Institute

Participants

Jim Hager, HRB Systems, Inc.

Charles F. Koch, Navy NADC

Laura Wikle, Navy NSWC

B.3 Developing a Realistic Estimate for CASE Tool Adoption

Session Leader

Gonzalo Verdugo, Howard Rubin Associates

CASE Project Member

Clifford Huff, Software Engineering Institute

Scribe

Gibbie Hart, Software Engineering Institute

Participants

Jack Bond, National Security Agency

William J. Brownlow, Boeing Aerospace and Electronics

Anna Deeds, Department of the Navy

Glenn Harmon, USAF

Albert Soule, Software Engineering Institute

John LeBaron, US Army CECOM

Toni Stuart, Department of the Navy

B.4 The CASEability of Projects

Session Leader

Win Royce, TRW

CASE Project Member

Kim Stepien, National Security Agency

Scribe

Kurt C. Wallnau, Software Engineering Institute

Participants

Maurice H. Blumberg, IBM Corporation

Jay Gibbons, HRB Systems, Inc.

Bruce Lewis, US Army MICOM

Roger Moos, Computer Sciences Corporation

Rick T. Turley, Hewlett-Packard

B.5 Making the CASE Tool Fit the Organization and the Organization Fit the CASE Tool

Session Leader

Steven Fried, Computer Sciences Corporation

CASE Project Member

Dennis Smith, Software Engineering Institute

Scribe

Grace Downey, Software Engineering Institute

Participants

Batia Dane, GTE Government Systems Corporation

Jay Pollack, Computer Sciences Corporation

J. A. Rader, Hughes Aircraft Company

Nick Wybolt, Cadre Technologies Inc

Appendix C The CASEability of Projects

C.1 Complete Attributes List from Initial Brainstorm

1. Acceptance by development team.
2. Real demand for the tool (*development team has a need for the tool*).
3. Establish successful processes prior to tool selection (vs. opposite).
4. Strong management commitment.
5. Clear objectives for quality and productivity improvement.
6. General structured methodology acceptance (*not necessarily structured analysis, but any general methodology*).
7. Room for failure; plan for success; mitigate risk (freedom from worth of CASE tools).
8. Neutralizing “not invented here.”
9. Tool cohesion (*the way tools interact with each other*).
10. Customer reinforcement (*the government must have leverage to reinforce the use of CASE*).
11. Enumerated/documents requirements for CASEability of the project.
12. Champion with stature (clout).
13. Desire and motivation for change.
14. Commitment to training and education.
15. Cultural change experts (*to help with the change process vs. technical issues*).
16. Guaranteed tool maintenance, e.g., vendor viability.
17. Real solution to the environment evolution problem—impact of tool evolution on environment.
18. Tool that provides control and productivity gains.
19. Plan to mitigate probability of failure to 0%.
20. Sufficient lead time and resources committed plus adequate schedule.
21. Capturing and storing lessons learned.
22. Feedback loop for improvements and lessons learned.
23. Real cost estimation and ROI (*return on investment*) justification (tool/process/implementation).
24. Adequate schedule and management attention to keep schedule adequate.

25. Metric/measurement program in place plus feedback loop for improvements and lessons learned.
26. Commitment to well-defined standards and procedures.
27. Reward and recognize success.
28. Commitment to developing in-house tools to help with integration of tools.
29. Commitment to spending time studying environment.
30. Openness to COTS/NDI (*commercial off-the-shelf/non-developmental items*).
31. Flexibility to absorb new unforeseen developments (*integrate change*).
32. Viable measure of tool quality (i.e., CASE consumer reports).
33. Manager mindset change from hardware to software orientation.
34. Support organization impacted accounted for (e.g., CM (*Configuration Management*), data, QA (*Quality Assurance*), training)
35. Availability of/access to CASE experts.
36. Staffed process group.
37. Commitment from tool vendors to incorporate user feedback.
38. Organizational and technical support for needed future abstractions and methods for reuse, maintainability, auto-documentation, auto-design, integration of software packages, reengineering, etc.
39. Tool composability (syntactic and semantic).
40. Flexibility to update tool for new methods and methodology improvements.
41. Adequate hardware platform resources.
42. Skills/experience/attitude of technical team.
43. Recognizing the difference between MIS and real-time environments.
44. Openness/access to tool vendor code.
45. Monitoring the use of tools by QA enforcement.
46. Multiple access paths to tool features.
47. Financial (i.e., longevity) assurance of vendors.
48. Extent of the cultural change of the organization.
49. Commitment to educate customer/procurement regarding CASE technology.
50. Standard interface across tools.

51. Nationwide standardization of tool control, data passing.
52. Management mandate for tool usage and its products.
53. Proof of the adoption life-cycle.
54. Access to CASE environments, tools evaluation data (consumer union for tools).
55. Overcome “camcorder syndrome” (i.e., just pick a tool, don’t wait for all the features).
56. Identification of and commitment to incentives for CASE adoption, plus rewards for/recognition of success.
57. Don’t expect it to be easy.
58. How to create incentive for tool vendors to provide tool cohesion.
59. Tailorability to project users.
60. Require market pressures for open systems.
61. Evaluate more than the software, but rather the quality of the engineering attributes (of products).
62. Inject academic programs with the CASE notion.
63. Previous experience (*of developers*) with CASE tools/methods.
64. Get the government to stop the “paper game.”
65. Why does the DoD think they have to invent tools and environments?
66. Size, complexity, documentation requirements must be handled by CASE.
67. Sensitize your customer or investor to CASE prior to “the eleventh hour.” (*waiting until the last minute when it’s too late*)
68. Establishment of a dedicated tools/methods/process group.
69. Organizational commitment to utilize CASE technology for re-engineering and maintenance.
70. Set organizational/customer expectations re. productivity/quality for CASE use.
71. Recognize language independence for most CASE situations.
72. Encourage CASE “skunkworks” (*projects experimenting on their own initiative*).
73. SEI assessment program for tool users and tool vendors for their maturity ala the process assessment program.
74. Dispel job loss fears from the adoption of CASE.

- 75. Use all possible communication paths to sell CASE.
- 76. Create non project-specific learning groups/skunkworks to investigate the CASE domain.

C.2 Attribute Classification

A rudimentary classification scheme was proposed to identify clusters of related attributes. This classification scheme originally consisted of the following classes, with their associated attributes. Attributes can appear in more than one class.

Pre-conditions:

1	2	3	4	6
7	10	13	14	19
20	24	26	48	57

Change Process:

8	12	13	15	33
34	35	49	52	53
55	67	69	70	72
75	76			

Implementation Phase - Tool

9	11	16	17	18
28	31	32	37	38
39	40	41	43	44
46	47	50	51	54
58	59	66	71	

Implementation Phase - Process/Feedback

3	5	10	21	22
24	25	26	29	32
36	45	53	54	61
68				

Implementation Phase - People

1	27	42	63	74
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Economics

23	41	56	66	
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Other

30	50	51	58	60
62	64	65	73	

C.3 Attribute Agglomeration

Of the original 73 attributes, several were merged. In the following merge table, the leftmost attribute number indicates the main attribute into which other attributes have been merged.

Main Attribute	Merge
1	8
52	4
5	70
6	19
16	47
32	54
50	51
58	9, 39
70	5
76	72

The following attributes were merged or removed from consideration because of obvious overlap with other attributes: 6, 21, 22, 23, 24, 27.

C.4 Attribute Voting

The following table summarizes the voting on the attributes. It was decided by acclamation that those attributes receiving fewer than 5 votes would not be considered further.

Votes	Attributes
9	12, 14, 25, 52, 68
8	38, 56
7	1, 7, 20,
5	10, 26, 73
4	2, 3, 30, 50, 70
3	13, 28, 32, 44, 59, 66
2	11, 17, 41, 42, 58
1	16, 35, 37, 46, 48, 49, 60, 75

C.5 Recommendation from Initial Brainstorm

1. Establish a dedicated process, methods, and tools group.
2. Establish a management mandate for automated process, methods, and tools (i.e., CASE Adoption).
3. Create a risk reduction program/guidelines for mitigating risk in the CASE adoption process.
4. Establish a plan for up-front and continued training and incentives for CASE tools.
5. Educate users on change management.
6. Use SEI process evaluation to motivate CASE Adoption.
7. Provide adequate schedule flexibility for CASE adoption in the procurement process to ensure adequate lead time, resources, budget are applied by contractors.
8. Create a metrics program to provide feedback for process evaluation and continuous improvement.
9. Develop a plan for CASE Adoption which includes: establishment of project standards and procedures, training in tools and methods, tool selection, installation, and customization.
10. Modify the SEI Process Assessment program to include two new scalars (tools and metrics) with an eye on the future addition of other scalars (to motivate CASE adoption).
11. Create rewards program related to CASE.
12. Write CASE Adoption plan; tie CASE Adoption to revenue producing activities; compute ROI goals.
13. Establish a CASE Tools usage database to provide CASE user community with lessons learned.
14. Government contracts and program management should support CASE Adoption and use throughout the lifecycle.
15. Modify MIL STD DIDS (e.g., SD, CM QA Plans) to focus on methods and plans for CASE utilization.
16. Establish data standards working group at time of implementation.
17. Cause corporate leadership (CEO or equivalent) to designate a VPGM (or other with "clout") to be the CASE adoption leader with a mandate for action.
18. Suggest to tool vendors: provide for extensibility to provide for software reuse, re-engineering, and maintenance.

19. Consider development culture as an important aspect of tool selection.
20. CASE tools must be extensible and open to provide for future methods, abstractions, reuse, maintainability, etc., to avoid obsolescence.
21. Commit to up-front costs for time and training for CASE adoption.
22. Develop a plan for new technology insertion to allow for methods and tools enhancements as CASE technology evolves.
23. The SEI should author, distribute, and train a CASE evaluation process to enable tool users and DoD to select CASE vs. requirements.
24. Inform development team on what will change and not change.
25. Use a CASE Adoption corporate newsletter to build the team, advance mandate, et. al.
26. Create an SEI-sponsored CASE adoption SWAT team.
27. Create non-project-specific related CASE working groups.
28. Expect to help projects risking first usage of CASE; motivate them by support to accept some risk (e.g., through contractual mechanisms).
29. Create ongoing CASE training program with incentives for project involvement.
30. Identify incentives and rewards for CASE adoption and creating reusable components and implementing new technologies (e.g., cash bonuses).
31. To “jump-start” CASE experience acquisition offices should use a front-end CASE tool to generate in total the software procurement packages.
32. Contractor organizations should use a front-end CASE tool to develop a proposal package in total.
33. Establish or join CASE adoption societies (internal or external) for mutual support, standardization, and knowledge-acquisition.

C.5.1 Recommendations Agglomeration

Main Recommendation	Merge
4	29
9	12, 19, 21, 22
15	14
20	18
33	27

C.5.2 Recommendations Traceability

The following table describes the traceability of recommendations to requirements.

Recommendation	Attribute
1	68
2	52
3	7
4	14
5	1, 14
6	12, 52
7	20
8	25
9	14, 26
10	12, 52, 73
11	56
12	12, 52
13	17
14	10
15	10, 12, 52
16	7, 26
17	12, 52
18	38
19	1
20	38
21	14, 20
22	38
23	vbvb10, 38, 73
24	1
25	1
26	10
27	7
28	1, 7, 56
29	14, 56
30	38, 56
31	10
32	14, 56
33	1, 26, 38, 68

C.5.3 Recommendations Votes

It was decided by acclamation that recommendations receiving fewer than four votes would not be considered further. It was demonstrated that all attributes were satisfied by the recommendations receiving four or more votes.

Votes	Recommendation
11	9
9	8
6	1, 2, 10, 15, 17, 33
5	30
4	3, 4, 7, 13
2	5, 18, 23, 25, 26, 28, 32

C.6 Observations on Brainstorming

The brainstorming technique was a great technique to get the issues out in the open for discussion. However, it was difficult to “remove” an issue once it was listed. Even if several people disagreed with an issue, it remained on the list and was voted on. Voting weeded out most of the nonessential issues, but there should have been time to argue for removal of items.

The participants in this session worked very effectively. Within the first 10 minutes of the session, each group member had some responsibility to the group (timekeeper, scribe, etc.). This helped to break down the initial group apprehensiveness and allowed the group to focus on its tasks. The brainstorming technique also allowed group members to participate without being subject to rejection.

The topic for this session was actually very broad and a large amount of time was spent simply listing the issues. The session leader, Dr. Royce, commented that he was very surprised that the group had over 70 attributes from the initial brainstorm and it was unusual to have such a high number.

Appendix D CASE Resource Pointers

The following tables provides a useful set of pointers to a number of different sources of information on Computer-Aided Software Engineering (CASE) tools. This information, while not all-inclusive, does exemplify the type of information that is available from commercial and government sectors.

The 8 tables that follow are:

- Table D-1 U.S. Government CASE Information Sources
- Table D-2 CASE Industry-specific Reports/Directories
- Table D-3 CASE Industry-Specific Magazine-Based Buyer's Guides
- Table D-4 General Software Industry Reports/Directories
- Table D-5 Consulting Groups/Conferences
- Table D-6 Case Industry Newsletters
- Table D-7 CASE Trade Shows
- Table D-8 CASE User's Groups

Name	Contact/Source	Comment
GSA CASEbase	Judith Andrews GSA/OSDIT 5203 Leesburg Pike Suite 1108 Falls Church, VA 22041 (703) 756-4500	<i>CASE database of vendors/ tools and government users/ evaluators</i>
STSC CASE Database/ Toolbox PC	Air Force Software Technology Support Center Reuel Alder OO-ALC/TISAC Air Force Software Technology Support Center Hill AFB, UT 84056 AV 458-8045 (801) 777-8045	<i>Also contact for Joint Software Support Conference April-1992 Salt Lake City, UT Sponsored by HQ USAF/SC and the Pentagon</i>
Systems Engineering Tools for Computer-Aided Design of Ultra-Reliable Systems	Appendix A, Table A-10 CASE Tools BATTELLE Tactical Technology Center 505 King Avenue Columbus, OH Sponsored by DARPA Available thru Defense Technical Information Center (202) 274-6847	<i>Table of 173 CASE tools</i>
Reviews of Selected System and Software Tools for Strategic Defense	Institute for Defense Analyses IDA Paper P-2177 Alexandria, VA Defense Technical Information Center Session Number ADA226 982 (703) 274-7633	<i>Covers Software through Pictures, Teamwork, TAGS, Auto-G, DCDS, RDD, Statement, Refine, Design/ IDEF, 001, Foresight, Virtual Software Factory & Adagen</i>
Evaluation of Existing CASE Tools for Tactical Embedded System	CECOM Center for Software Engineering US Army CECOM AMSEL-RD-SE-AST-SE Ft. Monmouth, NJ 07703 (908) 532-2342	<i>Covers Teamwork, ProMod, EPOS, Software through Pictures, Statemate, Autocode, Model, CCC, Foresight, T & SuperCASE</i>
Software Engineering TOOLS CATALOG	The Aerospace Corporation ATR-0089(8115)-1 El Segundo, CA 90245-4691	<i>Covers Anatool, DataViews, Design Aid, Docwriter, Excelerator, FDM, Nexpert Object, PIES, P-NUT, PowerTools, Software Size Estimator, Software through Pictures, Statemate, Teamwork, TekCASE</i>

Table D-1 U.S. Government CASE Information Sources

Source	Address/Phone	Title	Price
ACM SIGSOFT Software Engineering Notes vol 15 no1 'Jan 1990 Page 79	Project SYTI Dept of Computer Science University of Jyväskylä Seminaarinkatu 15 SF-40100 Jyväskylä FINLAND	<i>An Annotated CASE Bibliography</i>	n/a
BIS CAP International	POB 68 Newtonville, MA 02160 (617) 893-9130	<i>Implementing CASE: A Manager's Guide</i>	\$595
CASE Consortium	Center for Study of Data Processing Washington University Campus Box 1141 Prince Hall 224 One Brooking Drive St. Louis, MO 63130-4899 (314) 889-4792	<i>CASE Studies Annotated Software/Systems Bibliography</i> (over 400 citations in 20 categories) <i>CASE Studies Consortium MIS Industry Survey</i>	unknown unknown
CASE Consulting Group, Inc.	11830 S.W. Kerr Parkway Suite 315 Lake Oswego, OR 97035	<i>An Introduction to CASE: The Best of CASE OUTLOOK</i> <i>Annual CASE Directory</i> <i>The Executive's Guide to CASE</i>	\$225 \$195 \$95
CASE Research	155 108th Ave. N.E. Suite 210 Bellevue, WA 98004 Note: CASE Research recently merged with Ernst & Young For more information contact: Ernst & Young's Center for Information Technology Strategy (617) 742-2500	<i>"The Strategic Impact of CASE" - Volume I Video</i> <i>"The Strategic Impact of CASE" - Volume II Video</i> <i>Annual CASE Survey 1988</i> <i>CASE Bulletins</i> <i>CASE in Practice reports</i> <i>Product Profiles</i> <i>The Second Annual Report on CASE</i>	\$125 \$225 \$150 \$125 \$225 \$225 \$595
German National Research Center For Computer Science (GMD)	Western US Office 1942 University Avenue Berkeley, CA 94704 Publication	<i>The CASE Products '90</i> (Macintosh HyperCard-based Public Domain Database) available on Internet, anonymous FTP sumex-aim.stanford.edu:/info-mac/card/case-product-11.hqx	Free
Ovum Ltd	7 Rathbone Street London W1P 1AF England	<i>Analysis Techniques for CASE: a Detailed Evaluation</i> <i>CASE Analyst Workbenches: a Detailed Evaluation</i> <i>CASE: the Next Steps</i> <i>Real-time CASE: the Integration Battle</i> <i>Reverse Engineering: Markets, Methods and Tools</i>	\$995 \$995 \$995 \$995 \$1,850
P-Cube Corporation	572 East Lambert Rd Brea, CA 92621 (714) 990-3169	<i>CASEbase (a PC-based CASE database)</i>	\$495
Foresite Systems	For information contact: Digital Consulting, Inc. 204 Andover Street Andover, MA 01810 (508) 470-3880	<i>1990 CASE Evaluation Report</i>	unknown
Software Productivity Group, Inc.	POB 294-MO Shrewbury, MA 01545-0294 (508) 842-4500	<i>CASE Trends Industry Guide</i>	\$179

Table D-2 CASE Industry- Specific Reports/Directories

Source	Issue	Vol/No	Page No. (#pgs)	Title
Computer Decisions	1 Oct 88	v20 n10	p81(3)	<i>Change control meets CASE</i>
Computerworld	27 Mar 89	v23 n13	p77(5)	<i>CASE software products</i>
DEC User	1 May 89		p52(4)	<i>Vendors pack functionality into Case</i>
Digital Review	21 Nov 88	v5 n22	p61(7)	<i>CASE: tech toolkits for solid software.</i>
Digital Review	24 Jul 89	v6 n29	p37(7)	<i>Diverse CASE offerings deliver solid applications with speed and finesse</i>
Digital Review	23 Apr 90	v7 n16	p37(5)	<i>Project management packages offer sophisticated features</i>
Government Computer News	7 Aug 89	v8 n16	p56(4)	<i>CASE tools: timely assistance for PC-based software designers</i>
IEEE Software	1 May 90	v7 n3	p14(57)	<i>Tools Fair</i>
Macintosh Buyer's Guide	Fall 1989		p72	<i>Fall 1989 - Desktop Engineering Directory</i>
PC Week	21 Aug 89	v6 n33	p100(1)	<i>Education clearing the way for implementing CASE</i>
PC Week	21 Aug 89	v6 n33	p95(1)	<i>CASE spurs the re-engineering of users' hearts and minds</i>
PC Week	21 Aug 89	v6 n33	p98(1)	<i>CASE brings order to complex development efforts</i>
Software Magazine	1 Oct 90	v10 n12	p41(10)	<i>The race is on for tools enabled to IBM repository</i>
Software Magazine	1 Apr 89	v9 n5	p33(8)	<i>The CASE way of life; to each his own method</i>

Table D-3 CASE Industry-Specific Magazine-Based Buyer's Guides

Source	Address/Phone	Title	Price
Data Decisions, Inc.	Cherry Hill, N.J.	<i>Data Decisions software</i>	unknown
DATA Sources	Ziff Communications Company One Park Avenue New York, NY 10016 (212) 503-5398	<i>DATA Sources</i>	\$495
Datapro	McGraw-Hill Info. Sys. Co. Computers & Comm. Info. Group 1805 Underwood Blvd. Delran, NJ 08075	<i>Datapro directory of microcomputer software</i> <i>PC Digest Ratings Report</i> <i>Software Digest Ratings Report</i> <i>Software Digest Macintosh Ratings Report</i>	\$779 unknown unknown unknown
NTIS	5285 Port Royal Rd. Springfield, VA 22161	<i>A directory of computer software</i>	unknown

Table D-4 General Software Industry Reports/Directories

Name	Address/Phone	Conferences
Digital Consulting, Inc.	204 Andover Street Andover, MA 01810 (508) 470-3880	<i>Accelerating Applications Development (Using RAD, CASE...)</i> <i>Analyzing User Requirements</i> <i>Capers Jones: Software Measurement & Estimation</i> <i>CASE: The Next Generation</i> <i>Computer-Aided Software Engineering Symposium</i> <i>Data Modeling and CASE</i> <i>Evaluating CASE Tools</i> <i>IBM's AD/Cycle</i> <i>Implementing Software Engineering and CASE</i>
Extended Intelligence, Inc. (Associated with Dr. Carma McClure)	25 East Washington Street Suite 600 Chicago, IL 60602 (312) 346-7090	<i>CASE for the 1990s</i> <i>Re-Engineering, Repositories, Reusability</i>
Software Development Concepts (Associated with Dr. Paul Ward)	424 West End Avenue Suite 11E New York, NY 10024 (212) 362-1391	<i>The CASE/Real Time Curriculum</i>

Table D-5 Consulting Groups/Conferences

Name	Source	Price
American Programmer	American Programmer 161 West 86th Street New York, NY 10024-3411	\$395/year
C/A/S/E Outlook Industry Report	CASE Consulting Group, Inc. 11830 S.W. Kerr Parkway Suite 315 Lake Oswego, OR 97035	\$395/year
CASE Strategies	Cutter information Group 1100 Massachusetts Avenue Arlington, MA 02174 (617) 648-8700	\$275/year
CASE Trends	Software Productivity Group, Inc. POB 294-MO Shrewbury, MA 01545-0294 (508) 842-4500	\$49/year
CASE World News & Digest	Digital Consulting, Inc. 204 Andover Street Andover, MA 01810 (508) 470-3880	Free
Software Engineering Tools, Techniques, Practice	Auerback Publishers 210 South Street Boston, MA 02111 (800) 950-1216	\$145/year

Table D-6 CASE Industry Newsletters

Name	Sponsor/Contact
CASE World	Digital Consulting, Inc. 204 Andover Street Andover, MA 01810 (508) 470-3880
CASExpo	CASExpo Suite 1210 5203 Leesburg Pike Falls Church, VA 22041-3401 (703) 284-7330
Tri-Ada	Daniel & O'Keefe Associates, Inc Conference Management 75 Union Aveue Sudbury, MA 01776 (1-800-833-7751)
CASELab '90	Research & Technology Institute 301 West Fulton, Suite 718 Grand Rapids, MI 49504 (616) 771-6626

Table D-7 CASE Trade Shows

Name	For information contact
International CASE User's Group	Computer & Engineering Consultants, Ltd. 18620 West Ten Mile Road Southfield, MI 48075-2667 Sponsored by CASE Research
CASE User's Network	Digital Consulting, Inc. 204 Andover Street Andover, MA 01810 (508) 470-3880 Sponsored by Digital Consulting, Inc.

Table D-8 CASE User's Groups

Appendix E Keynote Speech: CASE Implementation Dynamics Through The Technology Life Cycle

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified		1b. RESTRICTIVE MARKINGS None														
2a. SECURITY CLASSIFICATION AUTHORITY N/A		3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for Public Release Distribution Unlimited														
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A																
4. PERFORMING ORGANIZATION REPORT NUMBER(S) CMU/SEI-91-TR-14		5. MONITORING ORGANIZATION REPORT NUMBER(S) ESD-TR-91-14														
6a. NAME OF PERFORMING ORGANIZATION Software Engineering Institute	6b. OFFICE SYMBOL (if applicable) SEI	7a. NAME OF MONITORING ORGANIZATION SEI Joint Program Office														
6c. ADDRESS (City, State and ZIP Code) Carnegie Mellon University Pittsburgh PA 15213		7b. ADDRESS (City, State and ZIP Code) ESD/AVS Hanscom Air Force Base, MA 01731														
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