
A Guide to Conducting Independent Technical Assessments

5 March 2003

J. A. Clapp
P. G. Funch

MITRE
Center for Air Force C2 Systems
Bedford, Massachusetts

Table of Contents

Section	Page
1. Introduction	
1.1 Purposes for this Guide	
1.2 Contents of the Guide	1-1
1.3 Background and Overview of the Technical Assessment Process	1-2
1.4 Types of Independent Technical Assessments and Their Outcomes	1-2
1.5 General Guidance for the Independent Technical Assessment Process	1-5
2. The Technical Assessment Process	
2.1 Initiate and Plan the Assessment	2-1
2.1.1 Purpose	2-1
2.1.2 Expected Outcome	2-1
2.1.3 Tasks	2-2
2.1.3.1 Establish a Written Charter	2-2
2.1.3.2 Obtain and Review Initial Program Information	2-3
2.1.3.3 Select a Team	2-5
2.1.3.4 Develop Initial Program Issues	2-7
2.1.3.5 Develop Assessment Plan	2-8
2.2 Perform the Assessment	2-9
2.2.1 Purpose	2-9
2.2.2 Expected Outcome	2-9
2.2.3 Guidance	2-9
2.2.4 Tasks	2-10
2.2.4.1 Plan Site Visits	2-10
2.2.4.2 Conduct Site Visits	2-13
2.2.4.3 Perform In-depth Analysis	2-15
2.3 Integrate and Report Assessment Results and Complete Assessment	2-17
2.3.1 Purpose	2-17
2.3.2 Expected Outcome	2-17
2.3.2 Guidance	2-17
2.3.3 Tasks	2-17
2.3.4.1 Develop the Report	2-18
2.3.4.2 Present the Report	2-19
2.3.4.3 Complete the Assessment	2-20

Appendix A. Independent Assessment Charter Template	A-1
Appendix B. Program Information Checklists	B-1
Appendix C. Taxonomy of Program Issues to Assess	C-1
Appendix D. Risk Checklist	D-1
Appendix E. Sample Questions	E-1
Appendix F. List of Root Causes Commonly Found in Assessments	F-1
Appendix G. Technology Readiness Levels	G-1
Appendix H. Software Development Best Practices	H-1
Appendix I. Recommended Program Management Metrics	I-1
Appendix J. Industry Data on Software Development	J-1
Appendix K. Briefing/Report Template	K-1
Appendix L. References	L-1

Section 1.0

Introduction

1.1 Purposes for this Guide

There are several purposes for this Guide. They are:

- To assist those who need to conduct an independent assessment of the technical and/or management status of a program that is developing or maintaining a large, complex, software-intensive system
- To help those supporting a program to determine whether performing an assessment could be useful. It can also be used to determine what kind of assessment.
- To be a tool for managing programs by reminding managers of the questions to ask about their program and the risks to avoid.

1.2 Contents of the Guide

This Guide provides a complete process for planning, performing, and reporting on an Independent Technical Assessment (ITA). At each step there is a description of the purpose of an activity and its expected outcome. This information is accompanied by guidance based on lessons learned by others. In addition, there are tools and references to help in performing the steps. These tools include the following:

- Checklists of options to be considered
- Templates for products of the assessment steps
- Questionnaires
- Lists of common problems and solutions.

Users of the process documented in this Guide can proceed step by step and task by task or they can tailor this Guide to use only those portions of the process they feel are necessary.

The major steps in the process are compatible with the architecture of the DoD Tri-Service Assessment Initiative [1, 2]. This initiative has defined a process for the conduct of independent assessments that has been used extensively to gather and analyze the root causes of problems in software across the DoD. The DoD Tri-Service Assessment Initiative,

established in FY99 and now sponsored by OUSD (AT&L)/ARA, performs independent assessments on request of Program Managers and Program Executive Officers.

While the process described in this Guide is applicable to most kinds of assessments, there are many variations. For example, some assessments do not allow visits to the stakeholders. Other assessments focus on specific technical issues that require unique kinds of analyses and investigations during the assessment.

1.3 Background and Overview of the Technical Assessment Process

Conducting Independent Expert Reviews (IERs) for Acquisition Category I-III software-intensive acquisitions was a primary recommendation by the Defense Science Board Task Force on Defense Software in their November 2000 final report [3]. The Task Force's recommendation was implemented through a December 2000 USD(A&T) Memorandum to Service Acquisition Executives [4] that established a Working Group to develop a plan and the necessary policy to implement Independent Expert Program Reviews (IEPRs). An earlier USD(AT&L) Memorandum [5] established a requirement for the use of independent software evaluations for ACAT I software-intensive programs. In addition to the above DoD requirements, MITRE has frequently been asked to participate on sponsor-initiated Red Teams, which perform quick independent assessments of serious problems encountered during the development of software-intensive systems.

1.4 Types of Independent Technical Assessments

It is important to know the types of assessments in order to determine when and what kind of assessment might be needed for a program and to reach an agreement on which type is appropriate when an assessment has been proposed. There are two general approaches for performing assessments of any type:

- Self-assessment

The assessors are members of the organization or program being assessed. They usually follow a rigorous assessment process.

- Independent assessment

The assessors are not members of the organization of program being assessed although they may be in another part of the same organization as long as there is no conflict of interest.

Independent assessments are preferable from the point of view of objectivity. However, costs, amount of time available, and political considerations may recommend a self-assessment.

What distinguishes different assessments is their purpose, the scope of areas assessed, how urgent they are, whether solutions and recommendations are expected, and the skills required. The following descriptions are a sample. Many assessments are hybrids or even change purpose, scope, and urgency as they proceed. In general, the scope of an assessment includes both technical and programmatic or management and business aspects of the program’s situation.

Red Team Assessments

- The purpose of a Red Team is trouble shooting. This kind of assessment is often called for when a program has experienced significant unanticipated problems, or has suspected problems or critical risks that need immediate attention to keep the program on track. For example, a Red Team assessment might be called for when a program experiences one or more cost overruns, schedule slips, or performance shortfalls. The purpose of the Red Team can be to determine what the problem is and/or the source of the problem. In many cases, the Red Team may be asked to determine how the program can best recover. Red Teams are usually on a tight schedule (two to three weeks at most), their existence was not anticipated in the program’s plans and therefore not funded, and they must produce a report quickly to validate risks and propose an approach to alleviate or eliminate the problem.

Blue Team Assessments

- Blue Teams are pro-active teams whose purpose is to prevent problems from occurring. They provide a broad assessment of program health and a plan for meeting a future goal. They are scheduled well in advance of milestones for a program, such as reviews or product deliveries, to give a program time to make the recommended changes to prepare for that event successfully. Table 1 compares Blue Teams and Red Teams.

Red Team	Blue Team
Problem has occurred or event is about to happen	Pro-active problem prevention
Team must act quickly	Assessment scheduled in advance <i>before</i> an event or milestone

Team is usually disruptive to program schedule	Team gives program added expertise
It may be too late to solve the problems	Team may prevent the need for a Red Team

Table 1. Comparison of Red Teams and Blue Teams

Baseline or Status Assessments

- Baseline or status assessments are performed when a program has no immediate concerns. They are similar to Blue Teams but do not necessarily anticipate a milestone. Instead, status assessments usually look at a broad set of standard criteria against which the program is measured. For example, ISO standards or Software Engineering Institute (SEI) Capability Maturity Model (CMM or CMMI) standards might be the yardstick against which the program is measured. The outcome may be a list of best practices to continue, identified risk areas and opportunities for improvement. Status assessments may be repeated periodically to observe changes and to make recommendations based on the current program status.

Senior Review Team

- This assessment is a high level review, often during source selection or at the start of a program. During source selection, such a team has been used to identify shortcomings of each bidder. No recommendations are made that compare the bidders. For a contractor, the recommendations may be a strategic plan, or support for a decision. The members are usually highly experienced, highly respected experts who can talk to the management of the bidders or contractors about the business and management aspects as well as the general strategy. The assessment is usually very short, often one day for each bidder during source selection.

Technical Assessment (Tiger Team)

- This kind of assessment is sharply focused on solving a technical problem or supporting a technical decision. The team may even be asked to help implement the technical solution. The team members must be experts in the technology and domain of the system.

Compliance Assessment

- This type of assessment is used to determine how well different organizations are implementing a new policy or process. This is useful when multiple organizations must make similar changes in the same general timeframe. The assessment can determine what changes each has made, as well as collect and disseminate the best ways found in practice to introduce the changes. An example would be a requirement to produce C4I Support Plans (C4ISPs) or Operational Safety, Suitability, and Effectiveness (OSS&E) plans.

Typical Outcomes of Independent Assessments

The outcome(s) of a technical assessment can be any number of the following, depending on the type of assessment performed:

- Recommendations for good technical solutions
- Suggested opportunities for product and/or process improvements
- Identification and prioritization of risk areas
- Identification of root causes of problems
- Recommendations for risk management strategies
- Recommendations for solutions to other program problems
- Highlighting of program successes
- Highlighting of good practices

1.5 General Guidance for the Independent Technical Assessment Process

- Independent assessments are taken seriously, even though they may report what the staff on the program already knows, because the assessment team's messages often carry greater weight and reach higher levels in the organization. Therefore listen carefully to what you are told by staff and

give them an opportunity to tell you what they want you to know.

- Recognize the interdependence of business, management, and technical aspects of a program in contributing to its outcome. What appear to be technical problems, for example, may be due to business issues like not hiring enough qualified people, not paying competitive salaries, or restricting collaboration with others.

The appendices to this Guide provide tools to assist in a number of the tasks performed during program assessments and an annotated list of references with links to the documents.

Section 2.0

The Technical Assessment Process

According to the Tri-Service Assessment Initiative Process Model [1], there are three major steps in a technical assessment process:

- **Initiate and Plan Assessment**
- **Perform Assessment**
- **Integrate and Report Assessment Results**

The purpose and expected outcome of each of these steps is described below, along with guidance and tools, to assist the user who is conducting an independent technical assessment.

2.1 Initiate and Plan the Assessment

This is the first of three steps in the technical assessment process.

2.1.1 Purpose

To prepare for performing the assessment by establishing a Charter, forming the team, gathering initial information, developing initial program issues, and planning how to obtain additional information.

2.1.2 Expected Outcome

The outcome of the planning step for Red Teams should include a preliminary assessment of the issues and problems to investigate, a preliminary list of potential causes, and a plan for obtaining and verifying the analysis. For other assessments, this step should produce the strategy and plan for tailoring the assessment and obtaining the data to carry out the assessment.

Guidance

- When a sponsor requests a trouble-shooting assessment, the time and expense may not have been planned for. Therefore, plan to make efficient use of the time of those working on the program. They may already be overworked and the assessment may be seen as a further impediment to progress.
- For Blue Teams, it may be just as important to be efficient with the time of those being assessed.

2.1.3 Tasks

There are five tasks to perform in this first step of the technical assessment process, as follows:

- Establish a written Charter
- Obtain and review initial program information
- Select a team
- Develop initial program issues
- Develop technical assessment plan

These five initiating and planning tasks are described in the sections that follow. The order is not precise. In particular, the team lead and several members may be chosen as one of the first steps. Some of the tasks may have to be iterated as more information is obtained in preparation for the assessment.

2.1.3.1 Establish a Written Charter

Purpose

To define, get agreement on, and document the objectives, scope, and requirements for performing the assessment. It is strongly recommended to establish a written charter for these reasons:

- To assure that the assessment team will deliver what is expected by the sponsor of the assessment, when it is expected, and within the constraints imposed on the team

- To convey to those being assessed what are the purpose and scope of the assessment.

Outcome

A clearly stated, written agreement between the sponsor and the team containing what the team must do, by when, and what constraints have been imposed.

Guidance

- Do not perform an assessment until you have agreement on the written Charter by the person(s) who asked for the assessment.
- Ensure that the sponsor of the assessment establishes the proper authority of the team and the level of access to people and documentation.
- Consider asking the sponsor to send a copy of the Charter to those who will be impacted by it.
- Make sure the objectives are achievable by the team.
- Establish an understanding with the sponsor of the assessment about the constraints that are placed on the team and its activities. Constraints may include who may be visited, how much time is available, funding limitations, clearances required.

Tool

Appendix A is a template for writing a Charter. In practice, it may not be possible or necessary to address all the items in the form.

2.1.3.2 Obtain and Review Initial Program Information

Purpose

To collect information that can be used to select the expertise needed on the team, identify topics to assess, identify issues that relate to the objectives of the assessment, and to identify what additional information to request or verify as part of the assessment. This can be done by the team lead or someone who is organizing the team. Appendix B contains a basic Program Information Checklist and an example of a Read-Ahead list of documents to request.

Expected Outcome

A baseline of information available and information needed about the program that explains:

- Facts about the program and its acquisition environment
- What is currently happening on the program

- Any known issues or problems

Guidance

- Ask the sponsor of the assessment or the System Program Office (SPO) to provide relevant documentation. Use it to create a baseline that shows what is known and what information still needs to be collected. Do this as early as possible so the assessment can proceed efficiently.
- Review the Program Information Checklist (Appendix B) to decide what additional information you want to request about the program.
- Do not overlook information that appears to be outside the strict scope of the assessment. For example, even if the focus is on technical problems, do not overlook possible management, cultural, political, legal, and economic contributors to the problems. After technical problems are corrected, these other kinds of problems may persist. Even if the focus is on the contractor, the contractor is not always the only source of problems. Consider all stakeholders.
- Take a historical perspective to understand how the program reached its current state. For example, if there is a cost overrun, information might be collected on the initial budget, the history of meeting the budget over time, and what assumptions were made for the initial budget that have changed or were not properly estimated.
- Use historical information to determine trends and make forecasts. However, understand that past performance is only useful if the people with the past performance are still working on the program.
- Request the schedules and definitions of upcoming milestones.
- Read the contract. Find out what information on status, progress, cost, and metrics each organization is required to deliver to the Government and request what is most useful.
- Determine the current contractual incentives of the various organizations.
- Obtain the organizational chart of each organization being assessed, including IPTs and other working groups, and the end users if appropriate, to determine who are key people and how responsibilities are distributed.
- Try to obtain as much relevant information as possible without disrupting the stakeholders. Ultimately, it is likely that the team will have to meet

with some or all of the stakeholder organizations.

Tool

Appendix B provides a checklist for collecting program information and an example of a Read-Ahead List.

2.1.3.3 Select a Team

Purpose

To choose people with the right expertise who will conduct the detailed information gathering and analysis and who will make decisions about the findings and recommendations in their area(s) of expertise. This may be done before the prior step to help gather program information and afterwards when more is known about the kinds of expertise that will be needed. For some programs, an additional consideration may be the security clearances required of the team members.

Expected Outcome

A list of team members and how to contact them. Since the list will probably be widely distributed, it should also include the affiliation, qualifications (areas of expertise), and area(s) of responsibility of each team member. The list can be added to the Charter to complete the record of the assessment arrangements.

Guidance

- Choose recognized experts in the application domain, in the key technologies, and in the affected acquisition areas (software engineering, contracts, program management, system engineering, testing, etc.). Use the available program information to identify the required areas of expertise.
- Members should be chosen who have a diversity of backgrounds and opinions. This will help in achieving balanced decisions.
- Prior experience with the program or with the developer can be useful in accelerating team read-in and learning what other practices the developer has used on other programs.
- Contact experienced team leaders to get recommendations for team members who have experience with and perform well on assessment teams (e.g., good at asking probing questions, tactful). Knowledge of the assessment process is helpful.
- Consider asking commercial vendors of key products and relevant

technologies to be on the team or to act as consultants if their products are relevant. For example, they may be able to solve technical problems.

- Keep the assessment team small enough to allow easy coordination but be sure to have enough to assure coverage if some team members are not always available. Identify consultants as backups or sources of specific information. There should always be two team members, at least, available for an interview.
- Consider whether to have sponsor and/or contractor representatives on the team or as consultants. They should be from another part of the organization than the one responsible for the program.
 - The advantages are the following:
 - a) They can provide information quickly, which is particularly helpful when the time for the assessment is short.
 - b) They may be able to recognize what actions are achievable and actually take action themselves following the conclusion of the assessment.
 - c) If they are high ranking, they can lend credibility and strength to the recommendations and help implement them.
 - The disadvantages are the following:
 - a) They may have clear conflicts of interest such as responsibility for people and areas within the scope of the assessment.
 - b) They may have strong biases that may complicate the deliberations of the team.
 - In the extreme, if all team members come from the program, this becomes a self-assessment.
- Team members should be chosen who have no potential conflict of interest, such as:
 - Being embroiled in issues on the program
 - Working on another program with the same contractor or program office
 - Potential bidder in a competition with the contractor being reviewed or on other work for this program
 - Being a manager of people, organizations or activities being assessed

- Conduct an initial meeting with the team to cover topics such as:
 - Distribution of a “read ahead” package
 - Introduction of members describing background and areas of expertise. Identify both primary and secondary responsibilities of each member.
 - Explanation of the “rules of the road” on how the assessment will be conducted
 - Provision of the draft outline for the final report
 - Presentation of objectives by the sponsor of the assessment, followed by questions and answers
 - Review of Charter
 - Confirmation of member availability during the period of the assessment
 - Discussion of proposals for strategies to use in conducting the assessment and making member assignments.

2.1.3.4 Develop Initial Program Issues

Purpose

To focus the assessment team on the major program issues based on the available initial program information and the team’s Charter.

Expected Outcome

A manageable prioritized list of potential program issues that require further investigation. For trouble-shooting assessments, they may be potential causes of observed problems. For Blue Teams and other status assessments, they may be common areas of potential risk such as those in Appendix C.

Guidance

- For some assessments, the issues list may be used to focus on and gather best practices that can be shared with others.
- For a Red Team assessment, where the problems are generally known, the List of Root Causes Commonly Found in Assessments (Appendix F) can be useful. It can be tailored to key in on those potential causes that appear

to be related to the particular problems encountered.

- Prioritize the issues that may be causing the known problems or that might be impacting program risk so the team can allocate limited time and resources to those that are likely to be most significant.
- Consider the impact on other programs of problems or risks occurring in this program (e.g., If delivery is delayed, what will happen to the systems it was intended to replace or to supplement? If the system crashes, what is the operational impact?). This can help prioritize risks.
- Identify governing requirements, policies, directives, etc., that might be impacting this program's risk status and ability to make changes.
- Even if the focus is on technical problems, do not overlook possible management, cultural, political, legal, and economic contributors to the problems. Even after technical causes are corrected, these other kinds of problems can persist and create new technical problems.
- See a local demonstration of the system if available and relevant, preferably prior to any site visits.

Tools

For a generic list of issue areas, see the Taxonomy of Program Issues to Assess in Appendix C. This can serve as a checklist for ensuring that all the important aspects of the program have been considered for assessment. A list of potential risk descriptions is provided in Appendix D. This Risk Checklist can be useful in prioritizing areas for investigation.

2.1.3.5 Develop Technical Assessment Plan

Purpose

To plan and document the future information collection activities of the technical assessment.

Expected Outcome

An assessment plan that specifies what information is still needed, what information needs to be verified, where that information is likely to exist, and a method for obtaining it. This can include defining a list of questions for each person who would be interviewed in a site visit.

Guidance

- The assessment plan is the outcome of integrating the issues identified with the existing program information baseline obtained from prior steps.
- The plan may have to be reviewed by the sponsor of the assessment to verify sources and their availability and to make the necessary authorizations.
- If the plan includes interviews, it is beneficial for the assessment team to agree on a list of questions for each set of interviewees. These lists assure consistent coverage during the interviews. If the results are challenged, there is a record of exactly what was asked. Appendix E contains sample questions.

2.2 Perform the Assessment

2.2.1 Purpose

To complete information gathering and perform an in-depth analysis that is sufficient to establish program status and provide evidence to verify findings and recommendations in accordance with the Charter.

2.2.2 Expected Outcome

Findings about any of the following: best practices, risks, prioritized problems and issues, their root causes where known, and the evidence that supports these findings for a troubleshooting assessment (or the status of all relevant issues in a Blue Team or baseline assessment) as well as recommendations in accordance with the Charter for the assessment.

2.2.3 Guidance

- In spite of the Charter, prior analyses, and the plan, it is important to be flexible and open-minded in performing an assessment. There are likely

to be new issues uncovered and corrections to earlier perceptions, especially after first-hand visits and inspections. Problems reported earlier may actually have been corrected.

2.2.4 Tasks

There are three tasks to perform in this second step of the program assessment process, as follows:

- Plan site visits
- Conduct site visits
- Perform in-depth analysis

These three tasks are described in the sections that follow.

2.2.4.1 Plan Site Visits

Purpose

To make arrangements for getting the rest of the information needed for analysis directly from stakeholders.

Expected Outcome

A plan for visits and other inspections, reviews, demonstrations, etc., agreed to by all stakeholders and the sponsor of the assessment. It should identify:

- Who will be interviewed, when, and in what manner (e.g., singly or in groups)
- What facilities, products, meetings, and tools will be observed
- What will be expected of the stakeholders at each site visited
- A list of the information that will be sought in interviews and by other means.

Guidance

- Understand what information a contractor is required to be report under the contract and what data the contractor does not have to provide to an assessment team.
- For each organization that needs to provide additional information to the assessment team, inform them (verbally, in writing, or both) of the time required for the visit and each interview, the people that should be involved by name or position (e.g., the Chief Architect or the head of Quality Assurance) and the additional documentation desired to whatever is an appropriate level of detail (e.g., software metrics data, system performance data, staff turnover rates, earned value data).
- An organization chart is very useful for deciding which individuals to interview, based on their roles and level in the organization. It is advisable to select people to interview who are at different levels in the program's organization (e.g., the top manager as well as the first level manager, new employees as well as those who have been on the project for a few years). This allows the team to determine how consistent the responses are, who is responsible for what, who makes the decisions, and how well information travels up and down the hierarchy and among organizations and groups that must interact and collaborate.
- Gather, request, and read as much relevant information as possible before you visit to minimize your impact when you do visit.
- If relevant information is missing or cannot be supplied that you think is important, then this itself may be a high risk. Determine who should be producing and using that information and learn why it is not available.
- Give the organization being assessed sufficient time to set up appointments for your visit.
- Plan to talk to the vendor of commercial off-the-shelf (COTS) products and/or to the source of Government off-the-shelf (GOTS) products, if the products themselves may be a source of the current issues.
- Consider planning hands-on access and use of the system, if appropriate (e.g., if the system has user-interface problems or cannot meet performance requirements).
- Strive for at least a system demonstration for team members. There is no substitute for seeing the system in action if it has reached that stage.
- Plan to be efficient with the time you use at a contractor's site as you are

probably interfering with an ongoing process that is already late.

- Interviewing people along with their managers can stifle information flow. Some people may not reveal the “real story” within earshot of their manager. However, it does save time and provides a view of the interaction between them. Whether people with similar status or jobs are interviewed separately or together is again a function of the available time.
- Plan to interview people who represent the different skills that are needed for, or are related to, critical issues. Interview both technical and management staff to determine how knowledgeable they are. For example, speak to the people who made the critical technical decisions or to the people who developed the cost estimates.
- In deciding what to ask, don’t just collect data or information unless you know what you will use it for. Try to think of a few key questions whose answers will confirm or deny a hypothesis the team has about likely problems and potential root causes.
- Plan to ask how managers track progress and identify problems or risks. Find out how they deal with problems in their organization. This shows their personal style as well as their view of the corporate culture for handling risks and problems.
- Plan to interview subcontractors separately if possible, unless they are tightly integrated into the contractor’s teams.
- If possible, plan the visit schedule so that the team can attend key events. Go to where the action is. These events can give first-hand information on program status as well as insight into the ways in which different stakeholders interact.
- Interviews should be scheduled for 45 – 60 minutes. Allow sufficient breaks for the team to consult on what has been learned and changes needed to the plan.
- Numbering the questions that might be asked can save time in recording the answers during the interviews by avoiding recording the question.

Tool

A list of the types of questions that could be asked during a visit is provided in Appendix E. These questions are also useful for a self-assessment also. They should be tailored for each individual's role.

2.2.4.2 Conduct Site Visits

Purpose

To complete information gathering and to verify baseline information in accordance with the visit plan.

Expected Outcome

Completion of information collection and findings. If it is a requirement of the assessment, this step may also involve a presentation of preliminary findings to those visited.

Guidance

- For each individual or group that the assessment team interacts with, provide them with a set of expectations, ahead of time if possible (e.g., what information they should bring to the interview, how much time they should spend preparing for the interview, the scope of the assessment, possibly the Charter itself).
- Make sure each person interviewed knows the Charter and rules of engagement (e.g., non-attribution of information, assessment is of the organization not of individuals, time limits).
- Remember to prioritize the order of the team's questions to supply missing information and to confirm both what was previously provided and the team's initial assessment of issues.
- Be efficient and prepared but also be flexible.
- Be sure to leave time to ask open-ended questions at the end, such as "Do you have anything else you would like to tell us?" or "If you could change one thing, what would it be?" or "What have you done that you would recommend to others as a successful practice?" These questions can often elicit the most valuable information from an interview.
- In general, avoid giving guidance, offering opinions, or trying to solve the problem unless it is appropriate to the charter. However, some teams have found that offering suggestions lends credibility to the team's technical expertise and shows that you really are there to help. In this case, it should

be made clear to the recipient that you are not giving official technical direction.

- Listen and observe. Most people like to talk and share their ideas and opinions because you are a voice from them to upper management – so listen carefully.
- Work to gain trust. Be “user-friendly” and unbiased. Trust of the team by the program personnel is key to getting “buy in” so that they give you useful information and your recommendations will be carried out.
- Try not to line up all of the team on one side of a table opposite the person being interviewed. This can be threatening.
- Prioritize the question lists for each interview so you cover the most important ones in the allotted time.
- Ask the same questions in different parts of the organization and at different levels to see if the responses are consistent. For example, consider the following:
 - Ask whom people think are the individuals responsible for carrying out various activities.
 - Trace how decisions are made throughout organizational components (i.e., what are the lines of authority? who do people at different levels think are the decision makers?).
 - Find information gaps where individuals do not have information about decisions that impact them (e.g., how the schedule for an activity was determined.)
- Preserve the multiple perspectives received from different people.
- Review subcontractors separately and then only as they affect the work and schedule of the others.
- Determine continuity and commitment of individuals to the program. Ask for information on how long key people have been on the program, on how long they have been in their current position, and on turnover in key areas.
- A minimum of two team members should be present at each interview so that information is accurately captured.
- Decide who will do the main questioning for each interview, with others on the team adding their questions after the lead has finished. Use one person or more depending on the size of the team and their areas of expertise.

- Identify those meetings where all team members should be present. It is important for the whole team to hear some individuals.
- Whether or not it is a requirement of the Charter, it is a good idea to review the team's preliminary findings from the site visit with the organization being visited to obtain their feedback and corrections.

2.2.4.3 Perform In-depth Analysis

This step must be carefully done using the available information. There are tools that identify commonly found risks in Appendix D and root causes in Appendix F.

Purpose

Where risks and problems have been found, to perform root cause analyses that lead to and support the assessment team's conclusions and recommendations. Opportunities for improvement should be noted. Where good practices have been seen, these should be acknowledged and encouraged.

Expected Outcome

Identification of current status including good practices, opportunities for improvement, risks, issues and problems, and recommended actions, if requested, together with the supporting evidence and analyses.

Guidance

- Based on the initial program information and the additional information obtained from the site visit(s), construct a linkage between potential root causes and any high risk issues identified or the actual problems encountered. Document the evidence that supports this analysis.
- Strive to present findings and conclusions to the sponsor of the assessment that he/she may not be aware of.
- It is most effective to limit the number of recommendations to four or five and to make sure it is feasible to implement them (e.g., they do not require large amounts of additional funds and resources that are not available.) They should be specific enough to indicate what needs to be done.
- For each issue/deficiency/problem area/cause, the following questions

should be addressed:

- Is the issue/deficiency/problem area/cause recognized by the developer/prime contractor?
- Is there a plan to deal with it?
- What is the effect on technical/cost/schedule risk in this program if it is not resolved?
- What is the impact on other systems if it is not resolved (e.g., legacy systems that should have been replaced by this system, systems that interoperate with this system)?
- Look for areas where the program is successful. Acknowledge and share these findings.
- It is often helpful to use briefing slides as the team develops and documents analyses for the final report. Different team members can be assigned to provide slides in their area of expertise or responsibility and these can then be integrated and edited.
- See Section 2.3.4.1 for guidance on generating recommendations and producing the report during the analyses.
- If multiple organizations were assessed, each recommendation should show which organization is responsible for taking the action.

Tools

Appendix D is a risk checklist that indicates how to assess the severity of the risks.

Appendix F provides a list of root causes for problems that have been identified in program assessments that have been carried out by MITRE staff.

Appendix G briefly describes levels of technology maturity that can be used to assess the risks associated with the technology being used on a program.

Appendix H contains a summary of best practices for software acquisition that can be used to compare with practices found in the assessment and then used to make recommendations for changes and to encourage continuation of successful practices.

Appendix I contains a recommended list of management metrics that are useful for understanding and tracking status. These can be compared to those found in the assessment.

Appendix J contains a reference to quantitative productivity and quality data from industry software development. It can be used to assess the productivity and error rates for a software development organization.

2.3 Integrate and Report Assessment Results and Complete Assessment

2.3.1 Purpose

To generate the final report of this assessment, to present it to the sponsor of the assessment and all other parties specified by the sponsor, and to bring the assessment to closure.

2.3.2 Expected Outcome

The final report of the team's program assessment (as specified in the Charter) and closure for the assessment.

2.3.3 Guidance

- Remember that the report serves as an important record, especially when it is a Red Team assessment. It may become the basis for subsequent legal actions, especially if the findings and recommendations reflect negatively on the performance of any stakeholders or cause significant changes in the program direction. Therefore, make sure that all reported findings can be substantiated and all recommendations are clearly written.
- The report should cover strengths, prioritized issues, root causes of problems, current and potential impacts, and actionable issue-driven recommendations as appropriate to the Charter.

2.3.4 Tasks

There are three tasks to perform in this third step of the technical assessment process, as follows:

- Develop the report
- Present the report
- Complete the assessment

These tasks are described in the sections below.

2.3.4.1 Develop the Report

Purpose

In this step, the team organizes the findings, conclusions, and recommendations into the final report of the assessment as specified in the Charter.

Expected Outcome

A final report that is ready for presentation to the sponsor of the assessment and potentially to all stakeholders.

Guidance

- The Charter should indicate if the report is a briefing (usually annotated), a report, or both.
- The report should contain findings and conclusions. *Findings* are facts. *Conclusions* are the team's judgments based on the facts.
- If recommendations are expected, consider the kinds of recommendations you are making:
 - Are they the kind that was agreed upon in the Charter?
 - Can they be implemented in a timely and practical way?
 - Who would have to carry them out? Do they have the authority?
 - Are they in scope for the contract?
 - What would their cost be?
 - What would be the delay if they were implemented?
 - What would be their impact to other related programs?
- Consider prioritizing the recommendations both in terms of their urgency and the feasibility of their implementation within time, budget, and resources.
- It helps to divide recommendations into near-term ones and longer term ones.
- As much as possible, the report should have the consensus of the team. Differences should probably be documented.
- The report should have an executive summary at the front for audiences that are not interested in or involved in the details.

- Individual team members should contribute summaries in their areas of expertise or the areas to which they were assigned.
- It is important to consider a preview report to allow response and verification by organization(s) being assessed before reporting to the sponsor of the assessment.

Tool

The Briefing/Report Template provided in Appendix K can be used as a guide for the organization and contents of the final report.

2.3.4.2 Present the Report

Purpose

To present the report to the requester and to any other interested and affected parties named in the Charter.

Expected Outcome

The final report of the technical assessment should be presented to the sponsor to give them the results of the assessment and to get feedback. If appropriate, it should first be presented to those who were assessed to get their verification before presenting the report to the sponsor. It may also be provided to other stakeholders who may be affected by the findings and recommendations.

Guidance

- The report should be presented to the sponsor and whoever else was designated in the Charter.
- The team should not present or give access to the report to any others without the permission of the sponsor of the assessment.
- It is important to consider giving a preview to those who were interviewed to allow verification by the organizations being assessed before reporting to the sponsor.
- Try to give the report face-to-face rather than via a teleconference or submitting a written report. The interaction and body language of the audience are important to assuring there is understanding.

- There may be follow-on actions as a result of the report. Be prepared to record and deal with them.

2.3.4.3 Complete the Assessment

Purpose

To conduct any immediate follow-on actions affecting the final report as a result of the presentation of the results and to acknowledge those who contributed to the assessment. This step is intended to provide closure for the independent technical assessment process.

Expected Outcome

The assessment is completed. Any additional work assigned to any team members should be designated as follow-on work or as the beginning of corrective action. A follow-on review should be scheduled.

Guidance

- Perform any actions assigned to complete the assessment as a result of the presentation of the assessment results.
- The final report should incorporate all requested modifications or annotations so that it can stand alone.
- The team leader may wish to acknowledge the contributions of the team members directly to them and also to their management.
- The team leader may wish to thank the management of the organization(s) that were assessed for their cooperation and availability. Support from helpful staff should also be recognized.
- The team should consider extracting the lessons learned and reporting them to any centralized knowledge database in their organization(s). In this way, best practices and common problems can be shared, with the goal of improving the performance of other programs.
- The team should propose a re-visit at a later date to see what impact the recommendations have had and to give a course correction on the direction that resulted from the assessment.

Appendix A

Independent Assessment Charter Template

The following information should be considered for incorporation into an assessment team's Charter. The completed charter should be reviewed and approved by the sponsor of the assessment and conveyed to the team members. It may also be shown to those being assessed, if appropriate.

1. Assessment requested by:

Date:

2. Approximate date of Assessment:

3. Program Name:

4. Specific Program Event triggering independent assessment (e.g., general status, review, product delivery, process milestone, change in stakeholders, risk prevention)

5. Objective(s):

6. Team Members

6a. Recommended types of expertise:

6b. Specific organizations or recommended names to include:

6c. Someone from the Program ___ (Y/N) If so, which organization and who?

6d. Clearances required:

7. Scope

7a. Organization(s) to be assessed: (select one or more):

_MITRE

_SPO

_User(s)

_Contractor(s) (Name which and locations)

_Other(s) , e.g., IV&V (Specify names)

7b. Issues to be addressed:

7c. Issues NOT to be addressed

8. Authority

8a. Team reports to:

8b. Access is allowed to:

People/organizations (suggest names):

Documentation sources (name useful ones, e.g., risk management info, metrics, SEI CMM or CMMI assessment results, other prior assessments):

8c. With the following restrictions:

8d. Approval(s) required for access:

9. Time allowed for assessment:

10. Due date for final report:

11. Funding Estimate for MITRE (jointly estimated):

Staff months: _____

Other costs (e.g. travel):

12. Products

Reports(s) _____ Y/N

To whom:

Briefing(s) _____ Y/N

To whom:

Other (specify):

13. Date for followup on impact/lessons learned:

Appendix B

Program Information Checklist

This is a list of facts and artifacts about a program that can be used initially to make a selection of team members, as a guide to request a Read-Ahead package, and to plan any site visits. It also asks for the program's history and current status. Its emphasis is on programmatic information. It should be tailored and augmented by the Assessment Team Lead before being given to the sponsor of the assessment. Acronyms are defined at the end of the checklist. Following it is an example of a Read-Ahead list.

Date: _____

Point of Contact for additional information: _____

General Program Information

- Program Name:
- Acquisition Organization and Points of Contact:
- User Organization(s) and Points of Contact:
- ACAT Level:
- Brief Project Summary
 - Mission Area:
 - Operational Domains:
 - Operational Specialties involved:
 - Technology Specialties involved:
- **SPO Information**
 - Organization chart
 - List of IPTs and other Government organizations

Contractor Information

- Prime Contractor
 - Name:
 - Location:

- Role:
- Program Organization Chart
- Subcontractor(s) Name(s):
 - Location:
 - Role:
 - Program Organization Chart
- IV&V Contractor’s Name
 - Location
 - Role
 - Organization Chart
- Other stakeholders/Relevant Organizations
 - Name(s):
 - Location (s):
 - Role(s):
 - Organization Chart(s):

Contract Information

- Type of Contract:
- Type of Incentive(s)
 - Award Fee
 - a) Award Fee Periods:
 - b) Award Fee Pool:
 - c) Basis for Award:
 - Incentive Fee
 - a) Basis for Awarding Fee:
 - b) Incentive Award Fee Amounts:
 - Other
- Funding Level
 - Development (3600):

- Production (3400):
- Other:
- Acquisition Reform Initiatives Involved
 - CAIV (Cost as an Independent Variable)
 - TSPR (Total System Performance Responsibility)
 - IPTs (Integrated Product Teams)
 - GOTS/COTS-based (Government off-the-shelf/Commercial off-the-shelf)
 - DII-COE (Common Operating Environment)
 - Other:
 - Other important features of contract or contracting process:

Acquisition Strategy

- Primary Purpose of the Acquisition (Specify)
 - New functionality for new system
 - Upgrading functionality of existing system
 - Upgrading technology of existing system
 - Modification of existing product line to produce new system
 - Integration of existing components/systems to create new system
 - Other:
- Type of Acquisition Strategy
 - Evolutionary
 - Spiral
 - Incremental
 - Other:
- Multiple Builds/Deliveries? For each build, specify:
 - Date of delivery:
 - Capability:
 - Status if under development (what phase?)
- Current Phase(s) of the Program:

Schedule Information (either current schedule and prior modifications or use the table below)

- What is the current schedule of upcoming events?
 - Integrated Master Plan
- Have there been major replans? If so, describe for each:
 - When was it announced?
 - Cost change (how much):
 - Schedule change (how much):
 - Other:
 - Primary reason:

This information can be presented in a format such as the table below:

Review or Milestone	Original Start Date	Original Finish Date	Current Actual or Planned Start Date	Current Actual or Planned Finish Date
Contract Award				
Etc.				

Documentation

What documentation is available?

- **Metrics Information**
 - List of metrics
 - Metrics reports
- **Government documents**
 - Contract
 - CONOPS
 - MNS

- ORD
- SOO
- SRD
- TEMP
- SAMP
- Other:

- **Contractor documents**

- CDRL (list of required deliverable documents)
- SSS
- SRS
- SDD
- ICD(s)
- IERs
- SDP
- Other:

Reviews/Briefings/Reports

- Milestone reviews
- Risk management reports

- **Current Status of the program**

- Problems:
- Risk Areas:

ACRONYMS

ACAT	Acquisition Category
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CONOPS	Concept of Operations
DT&E	Development Test and Evaluation
ICD	Interface Control Document
IER	Information Exchange Requirement
IOT&E	Initial Operational Test and Evaluation
IPT	Integrated Product Team
MNS	Mission Need Statement
ORD	Operational Requirements Document
PDR	Preliminary Design Review
SAMP	Single Acquisition Management Plan
SDD	Software Design Document
SDP	Software Development Plan
SDR	System Design Review
SOO	Statement of Objectives
SRD	System Requirements Document
SRS	Software Requirements Specification
SSR	System Specification Review
SSS	System Segment Specification
SW	Software
TEMP	Test and Evaluation Master Plan
TRR	Test Readiness Review

An Example of a Read-Ahead List

The actual list will depend on the current phase(s) of the program

Information	From SPO	From Contractor	From IV&V Contractor	From Other Organizations
Contract/Statement of Work	X			
Integrated Master Schedule		X		
Integrated Master Plan		X		
Build Plan(s)		X		
Organization Charts, including IPTs, Working Groups, etc.	X	X	X	X
Software Architecture/SDDs		X		
Metrics Reports	X	X	X	
Software Development Plan		X		
System Test Plan		X		
Risk Management Plan	X	X		
Current Risk Status	X	X		
Software Design and Test Process		X		
Verification Plan			X	
IV&V Statement of Work and reports			X	
List of Software Deliverables, Dates Due, and Status	X			
Other Assessments, Reports	X	X	X	X

Appendix C

Taxonomy of Program Issues to Assess

This table has been modified from the Tri-Service Assessment Initiative Information Model [2]. There are explanations of what to determine for many of these issues at the website http://tai.pica.army.mil/AIM_Description.pdf. This list may be tailored and prioritized for an assessment.

Issue Category	Issue	Sub-Issues	
1. Environment	___ Regulatory Environment	___ <i>Legal</i>	
		___ <i>Environmental</i>	
		___ <i>Safety</i>	
	___ Workplace Environment	___ <i>Policy</i>	
		___ <i>Reviews / Audits / Assessment</i>	
		___ <i>Cooperation</i>	
	___ Political Environment	___ <i>Morale</i>	
		___ <i>Culture</i>	
		___ <i>Legislative Agendas</i>	
2. Mission Requirements	___ Operational Requirements	___ <i>Customer's Agenda</i>	
		___ <i>Supplier's Agenda</i>	
		___ <i>Reasonableness</i>	
	___ Funding	___ <i>Stability</i>	
		___ <i>Dependencies, Interoperability</i>	
		___ <i>Change Tolerance</i>	
	3. Financial	___ Budget	___ <i>Sufficiency</i>
			___ <i>Timeliness</i>
			___ <i>Continuity / Stability</i>
___ Funding		___ <i>Flexibility</i>	
		___ <i>Allocation</i>	
		___ <i>Variance</i>	

		<input type="checkbox"/> <i>Control</i>
4. Resources	<input type="checkbox"/> Personnel	<input type="checkbox"/> <i>Qualifications</i>
		<input type="checkbox"/> <i>Staffing</i>
		<input type="checkbox"/> <i>Availability</i>
	<input type="checkbox"/> Facilities	<input type="checkbox"/> <i>Capital Equipment</i>
		<input type="checkbox"/> <i>Infrastructure</i>
	<input type="checkbox"/> Tools	<input type="checkbox"/> <i>Support Tools</i>
		<input type="checkbox"/> <i>Information Systems</i>
	<input type="checkbox"/> Government Furnished	<input type="checkbox"/> <i>Equipment</i>
		<input type="checkbox"/> <i>Information</i>
	<input type="checkbox"/> Supplier Furnished	<input type="checkbox"/> <i>COTS</i>
		<input type="checkbox"/> <i>Non-Developed Items (NDI)</i>
		<input type="checkbox"/> <i>Developed Items (DI)</i>
	<input type="checkbox"/> Prime Contractor / Supplier	<input type="checkbox"/> <i>Integrity</i>
		<input type="checkbox"/> <i>Longevity</i>
	<input type="checkbox"/> Subcontractors / Vendors	<input type="checkbox"/> <i>Integrity</i>
		<input type="checkbox"/> <i>Longevity</i>
		<input type="checkbox"/> <i>Dependencies</i>
5. Management	<input type="checkbox"/> Acquisition Strategy/Process	<input type="checkbox"/> <i>Acceptability</i>
		<input type="checkbox"/> <i>Feasibility</i>
		<input type="checkbox"/> <i>Suitability</i>
	<input type="checkbox"/> Project planning	<input type="checkbox"/> <i>Acceptability</i>
		<input type="checkbox"/> <i>Feasibility</i>
		<input type="checkbox"/> <i>Suitability</i>
	<input type="checkbox"/> Program & Project Management	<input type="checkbox"/> <i>Organization</i>
		<input type="checkbox"/> <i>Suitability (managing to plans)</i>
		<input type="checkbox"/> <i>Change Tolerance</i>

	__ Contracting & Subcontracting	__ <i>Conditions / Constraints</i> __ <i>Cost Accounting</i> __ <i>Progress Tracking</i> __ <i>Arrangements</i> __ <i>Timeliness</i> __ <i>Change Management</i>
	__ Communication	__ <i>Interfaces</i> __ <i>Openness</i> __ <i>Teamwork</i>
	__ Configuration Management	__ <i>Process</i> __ <i>Quality</i>
	__ Earned Value Management System	__ <i>Acceptability</i> __ <i>Control</i>
	__ Risk Management	__ <i>Suitability</i> __ <i>Effectiveness</i>
	__ Enterprise Management	__ <i>Communication</i> __ <i>Effectiveness</i>
6. System Engineering	__ Requirements Management	__ <i>Quality</i> __ <i>Effectiveness</i> __ <i>Certifications</i>
	__ Integration	__ <i>Coordination</i> __ <i>Quality</i>
7. Testing	__ Resources/Assets	__ <i>Adequacy</i> __ <i>Availability</i>
	__ Planning	__ <i>Adequacy</i> __ <i>Requirements Traceability</i>
	__ Procedures	__ <i>Adequacy</i> __ <i>Accuracy</i>

	__Certifications	__Coordination
8. Logistics	__Depot	__Capability
		__Capacity
9. Technical Process	__Conformance	__Compliance
		__Performance Consistency
		__Process Consistency
	__Capability	__Fitness for Purpose
		__Efficiency
		__Enhancement
10. Technical Product	__Product Line	__Architecture
		__Scale
		__Complexity
		__Technology Effectiveness
		__Interoperability
		__Planning
		__Coordination
		__Disclosures
		__Certifications
	__Product Requirements	__Completeness
		__Correctness
		__Feasibility
		__Stability
		__Size
		__Technical requirements
		__Complexity
	__Quality	__Usability
		__Performance (Response time)
		__Correctness
		__Certifications
		__Dependability / Reliability /Availability

		<i>__Supportability / Maintainability</i>
		<i>__Certifications</i>
		<i>__Reusability</i>
		<i>__Portability</i>
		<i>__Efficiency</i>
		<i>__Reserve Capacity</i>
		<i>__Survivability</i>
		<i>__Interoperability</i>
	<i>__Product Risk</i>	<i>__Human Factors</i>
	<i>__Security</i>	<i>__Safety</i>
		<i>__Complexity</i>
		<i>__Accreditation/Certification</i>
11. Schedule	<i>__Progress</i>	<i>__Estimation Accuracy</i>
		<i>__Visibility</i>
		<i>__Progress Performance</i>
		<i>__Rework</i>
	<i>__Dependencies</i>	<i>__Complexity</i>
		<i>__Contingency</i>
12. Maintenance Planning	<i>__Depot Resources</i>	<i>__Software</i>
		<i>__Capability</i>
		<i>__Capacity</i>
		<i>__Hardware</i>
		<i>__Capability</i>
		<i>__Capacity</i>
		<i>__Tools</i>
		<i>__Adequacy</i>
		<i>__Testing</i>
		<i>__Resources</i>
		<i>__Capability</i>
		<i>__Planning</i>

		<i>__ Execution</i>
		<i>__ Certifications</i>
		<i>__ Parts Availability</i>
		<i>__ Configuration Management</i>
	<i>__ Funding</i>	<i>__ Adequacy</i>
		<i>__ Long-Lead Item Planning</i>
	<i>__ Logistics</i>	<i>__ Adequacy</i>
		<i>__ Technical Orders</i>
		<i>__ Adequacy</i>
		<i>__ Completeness</i>
	<i>__ Training</i>	<i>__ Capability</i>
		<i>__ Capacity</i>
		<i>__ Quality</i>
13. User/Customer	<i>__ Satisfaction</i>	<i>__ Involvement</i>
		<i>__ Usability</i>
	<i>__ Transition</i>	<i>__ Transition Support</i>
		<i>__ Training</i>
14. Project Specific		
	<i>__ User Defined</i>	<i>__ User Defined</i>

Appendix D

Risk Checklist

This checklist is from the *Information Management and Telecommunications (IM&T) Risk Management Handbook* [6].

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
1	Project fit to Customer Organization	Directly supports customer organization mission and goals	Indirectly impacts one or more goals of customer	Does not support or relate to customer organization mission or goals
2	Project fit to provider Organization	Directly supports provider organization mission and goals	Indirectly impacts one or more goals of provider	Does not support
3	Customer perception	Customer expects this organization to provide this product	Organization is working on project not expected by customer	Project is mismatch with prior products or services of this organization
4	Work flow	Little or no change to work flow	Will change some aspect or have small impact on work flow	Significantly change the work flow or method of organization
5	Goals conflict	Goals of projects are supportive of or complementary to each other	Goals of projects do not conflict but provide little direct support	Goals of projects are in conflict, either directly or indirectly
6	Resource conflict	Projects within the program share resources without any conflict	Projects within the program schedule resources with some conflicts	Projects within the program often need the same resources at the same time (or compete for the same budget)
7	Customer conflict	Multiple customers of the program have common needs	Multiple customers of the program have different needs, but do not conflict	Multiple customers of the program are trying to drive it in different directions

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
8	Directorship	Program has active major project director who coordinates projects	Program has person or team responsible for the program, but unable to spend enough time to lead effectively	Program has no director or major project director concept is not in use
9	Major project director experience	Major project director has deep experience in the domain	Major project director has some experience in the domain, is able to leverage subject experts	Major project director is new to the domain
10	Definition of the program	Program is well-defined, with a scope that is manageable by the organization	Program is well-defined but unlikely to be handled by this organization	Program is not well defined or carries conflicting objectives in the scope
11	Political Issues	No particular politically-driven choices being made	Project has several politically motivated decisions, such as using a vendor selected for political reasons, rather than qualifications	Project has a variety of political influences or most decisions are made behind closed doors
12	Convenient date	Date for delivery has been set by reasonable project commitment process	Date is being partially driven by need to meet marketing demo, trade show, or other mandate not related to technical estimate	Date is totally driven by need to meet marketing demo, trade show, or other mandate; little consideration of project team estimates
13	Use of Attractive Technology	Technology selected has been in use for some time	Project is being done in sub-optimal way, to leverage the purchase or development of new technology with inadequate planning and testing	Project is being done as a way to showcase a new technology or as an excuse to bring new technology into the organization
14	Short term solution	Project meets short term need without serious compromise to long-term outlook	Project focussed on short-term solution to a problem with little understanding of what is needed in the long term	Project has been explicitly directed to ignore the long term outlook and focus on the short term deliverable

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
15	Organizational stability	Little or no change in management or structure expected	Some management change or reorganization expected	Management or organization structure is continually or rapidly changing
16	Organizational roles and responsibilities	Individuals throughout the organization understand their roles and responsibilities and those of others	Individuals understand their roles and responsibilities, but are unsure who is responsible for work outside their immediate group	Many in the organization are unsure or unaware of who is responsible for many activities of the organization
17	Policies and standards	Development policies and standards are defined and carefully followed	Development policies and standards are in place, but are weak or not carefully followed	No policies or standards, or they are ill-defined and unused
18	Management support	Strongly committed to success of project	Some commitment, but not total	Little or no support
19	Executive involvement	Visible and strong support	Occasional support, provides help on issues when requested	No visible support; no help on unresolved issues
20	Project Objectives	Verifiable project objectives, reasonable requirements	Some project objectives, measures may be questionable	No established project objectives or objectives are not measurable
21	User involvement	Users highly involved with project team, provides significant input	Users play minor roles, moderate impact on system development	Minimal or no user involvement; little user input
22	User experience	Users highly experienced in similar projects; have specific ideas of how needs can be met	Users have experience with similar projects and have needs in mind	Users have no previous experience with similar projects; unsure of how needs can be met
23	User acceptance	Users accept concepts and details of system; process in place for user approvals	Users accept most of concepts and details of system; process in place for user approvals	Users do not accept any concepts or design details of system

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
24	User training needs	User training needs considered; training in progress or plan in place	User training needs considered; no training yet or training plan is in development	Requirements for training not identified or not addressed
25	User justification	User justification complete, accurate, sound	User justification provided, complete with some questions about applicability	No satisfactory justification for system provided by user
26	Project size	Small, non-complex, or easily decomposed	Medium, moderate complexity, decomposed inconsistently across subsystems	Large, highly complex, or not decomposed sufficiently
27	Reusable components	Components available are compatible with approach	Components available, but need some revision	Components identified, need serious modification for use
28	Supplied components	Components available and directly usable	Components work under most circumstances	Components known to fail in certain cases, likely to be late, or incompatible with architecture selected
29	Budget size	Sufficient budget allocated	Questionable budget allocated	Doubtful budget is sufficient
30	Budget constraints	Funds allocated without constraints	Some questions about availability of funds	Allocation in doubt or subject to change without notice
31	Cost controls	Well established, in place	Cost control system in place, weak in areas	Cost control system lacking or nonexistent
32	Delivery commitment	Stable commitment dates	Some uncertain commitments	Unstable fluctuating commitments
33	Development schedule	Team agrees that schedule is acceptable and can be met	Team finds one phase of the plan to have a schedule that is too aggressive	Team agrees that two or more phases of the schedule are unlikely to be met
34	Requirements stability	Little or no change expected to approved set (baseline)	Some change expected against approved set	Rapidly changing or no agreed-on baseline

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
35	Requirements completeness and clarity	All completely specified and clearly written	Some requirements incomplete or unclear	Some requirements still only in the head of the customer
36	Testability	Product requirements easy to test, plans underway	Parts of product hard to test, or minimal planning being done	Most of product hard to test, or no test plans being made
37	Design difficulty	Well defined interfaces; design well understood	Unclear design, or aspects of design yet to be decided	Interfaces not well defined or controlled; subject to change
38	Implementation difficulty	Content is reasonable for this team to implement	Content has elements somewhat difficult for this team to implement	Content has components this team will find very difficult to implement
39	System dependencies	Clearly defined dependencies of the project and other parts of the system	Some elements of the system are well understood and planned; others are not yet comprehended	No clear plan or schedule for how the whole system will come together
40	Response or other performance factors	Readily fits boundaries needed; analysis has been done	Operates occasionally at the boundary	Operates continuously at or outside boundary levels
41	Customer service impact	Requires little change to customer service	Requires minor change to customer service	Requires major changes to customer service approach or offering
43	Pilot approach	Pilot site (or team) available and interested in participating	Pilot needs to be done with several sites (who are willing) or with one who needs much help	Only available pilot sites are uncooperative or in crisis mode already
44	Alternatives analysis	Analysis of alternatives complete, all considered assumptions verifiable	Analysis of alternatives complete, some assumptions questionable or alternatives not fully considered	Analysis not completed, not all alternatives considered, or assumptions faulty
45	Commitment process	Changes to commitments in scope, contents of schedule are reviewed and approved by all involved	Changes to commitments are communicated to all involved	Changes to commitments are made without review or involvement of the team

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
46	Quality assurance approach	QA system established, followed, effective	Procedures established, but not well followed or effective	No QA process or established procedures
47	Development documentation	Correct and available	Some deficiencies, but available	Nonexistent or poor
48	Use of defined Development process	Development process in place, established, effective, followed by team	Process established, but not followed or is ineffective	No formal process used
49	Early Identification of defects	Peer reviews are incorporated throughout	Peer reviews are used sporadically	Team expects to find all defects with testing
50	Defect tracking	Defect tracking defined, consistent, effective	Defect tracking process defined, but inconsistently used	No procedure in place or used to track defects
51	Change control for work products	Formal change control process in place, followed, effective	Change control process in place, not followed or is ineffective	No change control process used
52	Physical facilities	Little or no modification needed	Some modifications or additions needed; some existent	Major modifications needed, or facilities nonexistent
53	Tool availability	In place, documented, validated	Available, validated, some development needed (or minimal documentation)	Not validated, proprietary, or major development needed; no documentation
54	Vendor support	Complete support at reasonable price and in needed time frame	Adequate support at contracted price, reasonable response time	Little or no support, high cost, and/or poor response time
55	Contract fit	Contract with customer has good terms, communications with team is good	Contract has some issues which could interrupt team work efforts	Contract has burdensome requirements or causes excessive extra work to comply
56	Disaster recovery	All areas following security guidelines; data backed up; disaster recovery system in place; procedures followed	Some security measures in place; backups done; disaster recovery considered, but procedures lacking or not followed	No security measures in place; backup lacking; disaster recovery not considered

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
57	PM approach	Product and process planning and monitoring in place	Planning and monitoring need enhancement	Weak or nonexistent planning and monitoring
58	PM experience	PM very experienced with similar projects	PM has moderate experience with different types of projects	PM has no experience with this type of project or is new to project management
59	PM authority		Has line management or official authority that enables project directorship effectiveness	Has little authority from location in the organization structure and little power to influence decision making resources
60	Support of the PM	Complete support by team and of management	Support by most of team, with some reservations	No visible support; manager in name only
61	Team member availability	In place, little turnover expected; few interrupts for fire fighting	Available, some turnover expected; some fire fighting	High turnover, not available; team spends most of time fighting fires
62	Mix of team skills	Good mix of disciplines	Some disciplines inadequately represented	Some disciplines not represented
63	Team communication	Clearly communicate goals and status between the team and rest of organization	Team communicates some of the information some of the time	Communications are rare or unclear within the team or with others who need to be informed
64	Application engineers	Extensive experience in team with projects like this	Some experience with similar projects	Little or no experience with similar projects
65	Experience with application area (domain)	High experience	Average experience	Low experience
66	Experience with project tools	High experience	Average experience	Low experience
67	Experience with project process	High experience	Average experience	Low experience
68	Training of team	Training plan in place, training ongoing	Training for some areas not available or training planned for the future	No training plan or training not readily available

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
69	Team spirit and attitude	Strongly committed to success of project; cooperative	Willing to do what it takes to get the job done	Little or no commitment to the project; not a cohesive team
70	Team productivity	All milestones met, deliverables on time, productivity high	Milestones not all met, some delays in deliverables, productivity acceptable	Productivity low, milestones not met, delays in deliverables
71	Technology match to project	Technology planned for project is good match to customers and problem	Some of the planned technology is not well suited to the problem or customer	Selected technology is a poor match to the problem or customer
72	Technology experience of team	Good level of experience with technology	Some experience with the technology	No experience with the technology
73	Availability of technology expertise	Technology experts readily available	Experts available elsewhere in organization	Will need to acquire help from outside organization
74	Maturity of technology	Technology has been in use in the industry for quite a while	Technology is well understood in the industry	Technology is leading edge, if not "bleeding edge" in nature
75	Design complexity	Easily maintained	Certain aspects difficult to maintain	Extremely difficult to maintain
76	Support personnel	In place, experienced, sufficient in number	Missing some areas of expertise	Significant discipline or expertise missing

Appendix E

Sample Questions

The following are the types of questions that might be asked prior to or during a visit in order to determine program status. They are roughly organized around the major issues in the Tri-Service Initiative Assessment Information Model [2] as modified in Appendix C. They should be tailored based on what is already known and what is relevant to the objectives and scope of the assessment.

- **Environment**

- What is the acquisition strategy, e.g., spiral, evolutionary, incremental and how has it affected this program?
- Are there any political, acquisition, or technical constraints, such as TSPR or use of the DII COE, levied by higher level organizations that have affected this program?
 - a) Is so, what has been the impact?

- **Mission Requirements**

- Is there a Concept of Operations?
- Have the requirements been baselined? Who controls the baseline?
- What are the key requirements?
- How are changes in requirements determined?
- How many user organizations or systems must this system's requirements satisfy, including legacy systems and their users?
 - a) How frequently are the user(s) and other stakeholders consulted about requirements and their implementation?
 - b) Do they see prototypes?
 - c) How do they reach agreement?
 - (1) Are they all represented when decisions are made about requirements (e.g., is there an IPT)?

- (2) How well does that decision process work (e.g., the time it takes to reach a decision)?
 - Are the requirements changing? If so, how frequently? Has any adjustment been in the cost and schedule?
 - Are there performance requirements? If so, what are they based on?
 - How unprecedented are the requirements (e.g., how close are they to requirements for which there are known, successful designs in other systems)?
 - If this system has to integrate with legacy systems:
 - a) Are they stable or are they undergoing modification?
 - b) At what level is the integration (e.g., data, message passing, shared data, shared applications)?
 - Does this program have any certification requirements?
 - a) If so, are there plans? Have any certifications been obtained?

- **Financial**

- When and how are expenditures reported?
- How do the expenditures to date compare with the planned expenditures? What has been the trend?
- Have there been any replans? If so, what are the specifics?
- Is there an overrun?
 - a) If so, what is the stated cause? Has the problem been corrected?
 - b) Is the developer/contractor organization spending its own funds?
- Have there been any breaks in funding?
- Have any of the assumptions used for the original cost estimate changed significantly? For example,
 - a) Has the size of the effort grown?
 - b) Have the labor rates increased?
 - c) Have sources of parts/equipment raised their rates?

- What are the conditions for and sizes of any incentives that are available to the contractor?
 - a) Have they received any? If not, why not?

- **Resources (Staffing and Facilities)**

- Do the contractor and the government have the proper expertise to do the job?
 - a) What are the qualifications and experience of the key people (Program Manager, Chief Engineer or Architect, Software Manager, etc.) and the other staff on this project?
 - (1) With the application domain?
 - (2) With the development methodology?
 - (3) With the programming environment?
 - (4) With their role in the organization (e.g., first time as a manager, worked on similar-sized programs with similar costs and schedules)?
 - b) Are all critical technical and application areas covered?
 - c) Has the staff received sufficient training? When? How much? From whom?
- Is there a staffing plan? If so,
 - a) How was the planned level of staffing determined?
 - (a) How does the actual level of staffing compare?
- What has been the turnover in staff? Do the contractor and the government have sufficient staff with continuity on the job?
- Where are the staff located?
 - a) Are they geographically dispersed?
 - b) If so, how do they communicate and coordinate?
- Do they have sufficient facilities to do the job?
 - a) Are development facilities adequate (e.g., enough assets, available when needed, sufficient tools)?
 - b) Are the test facilities adequate?
 - c) How different is the development configuration versus the test configuration versus the operational configuration? Does this create a problem?

- d) Is there any government-furnished equipment or software? If so,
 - (1) Has it been delivered when expected?
 - (2) Does it perform as expected?

- **Management**

- What is the management structure and how is communication maintained among partner organizations, between the prime and subcontractors, and among the project teams in the developer's organization?
 - a) Are teams made up of integrated representatives of different organizations (e.g., prime and subcontractors, contract hires) or are there formal subcontracting relationships?
- How stable have the organization and the key managers been?
- What is management's view of the greatest risks on the program? How do these views differ among government organizations and contractors?
 - a) How were they determined?
 - b) Who identified them?
 - c) How often are the risks reviewed?
- Is there a risk management plan? How often is it reviewed and updated?
- Are there risk tracking procedures?
- How are risks communicated within and outside your organization?
- How is action taken to deal with risks? Give examples.
- How is progress tracked (e.g., earned value metrics)?
 - a) What metrics are collected and how are they used?
- What are your incentives? Are they adequate? Have any awards been given? If so, for what?

- **Schedule**

- Have there been any replans? If so, what are the specifics?
 - a) Have there been reschedules of milestones? If so, which one(s), and how close to the milestone was the rescheduling done?
 - b) What changed to make the reschedule more credible?
 - c) Have there been any major changes in the assumptions used for the schedule estimates?
- How is the schedule determined?
 - a) Is it bottom-up, top-down, or both (i.e., do the people who perform the work have input into the schedule)?
 - b) Has this changed over time?
- How often are status and plans updated?
- How current are the data that are reported?
 - a) How accurate are the data?
- How correct are forecasts?
- How well is progress tracking to the schedule?
- Is critical path analysis performed and used to detect early and correct scheduling and resource allocation problems?
- How is a build plan developed? How could it be improved?

- **Logistics**

- Is logistics planning being done in time?
- Are the plans adequate?
- Does it include training for operators?

- **Technical Process**

- What is the development process (e.g., COTS-based, object-oriented, integration only)?
- Is there a defined process? Is it documented?
 - a) Have team members and managers been trained in the process?
 - b) Do they have experience in the process?
- Has there been a CMM, CMMI or other independent assessment?
 - a) If so, when was it? Was it for this team or for another part of the company? What were the rating, strengths, and weaknesses?
 - b) If not, why not?
- Are people adhering to the process?
- Is some portion of the software reused or furnished by the Government?
 - a) If so, how is the quality assured?
- What is the Quality Assurance process that is used?
 - a) Do they use peer reviews? For what products? Who attends? Are they effective?
- What kinds of errors do they make, what is the rate, and in what phases are they discovered?
 - a) Are they recorded (e.g., system/software trouble reports)?
 - b) How long does it take to fix the errors?
 - c) Are the errors used as a basis for making changes in the development process?
- What kind of vendor support is provided for the COTS equipment and software?
 - a) Are they responsive and able to find problems quickly?
- Is there any data on productivity of the team?
 - a) If so, how productive are they and does their productivity match future predictions of progress?
- What changes would you recommend to increase productivity (people, tools, facilities, processes, etc.)

- **Technical Product**

- How large and complex is the product?
 - a) How are size and complexity measured?
 - b) Does it have many interfaces to other systems or equipment?
 - c) Does it have stringent real-time constraints?
- How many (or what percentage) of the system components are reused?
 - a) Has the predicted reuse changed over time?
 - b) Is the quality of the reused components satisfactory? How was this determined?
 - c) If the reused components are government furnished, have they been provided in time?
 - d) What is the process for incorporating reused components into this system?
- How mature is the technology being used, including the COTS products?
- How familiar is the project team with the technology or products?
- What criteria were used for selection of COTS products?
- How and when is quality of the product determined?
 - a) Are there test plans and procedures?
 - b) Has the user reviewed them?
 - c) Are they adequate?
- What is the approach for regression testing?
- What is the role of Quality Assurance staff in testing?
- What is the quality of the product in its current state?
- What metrics are collected on the product? How are they used?
- Is there a performance engineering plan?
 - a) Do they deal with performance issues early enough to make necessary changes?
 - b) When are performance measures collected, analyzed, and reported?
- Has the architecture been defined?
- Has it been reviewed and assessed?
- Is it well understood by the entire team of developers?

Appendix F

List of Root Causes Commonly Found in Assessments

The following represents a summary of root causes determined on recent MITRE program assessments. Within each of the major categories, they are listed in no particular order.

- **Program management**
 - Plans were not followed and this led to replans that were not successful either.
 - The decision chain was not clear and effective within and among organizations.
 - Government priorities were schedule and performance while contractor's priority was profit. This situation led to different assessments and prioritizations of risks.
 - Risks were not always identified or reported. That is, there was no effective formal risk management process used on the program.
 - Even when metrics and measures were reported that showed risks, there was no action by government or contractor to correct incipient problems
 - Poor granularity of metrics and measures did not reveal problems until they had already occurred.
- **Multi-organizational collaboration**
 - No effective communication or collaboration occurred along the following lines:
 - a) Between units within the organization, as well as up and down the organization's hierarchy
 - b) Between sub and prime contractors
 - c) Between Government and developer
 - d) Between developer and operators
 - e) Among Government organizations (e.g., in different services)
 - Different interpretations of the requirements were made by different organizations. These were not uncovered until system integration and test.

- There were large variations in performance and ability to meet schedules among organizations. Some organizations had to wait for others, and uneven quality in their products created problems when they were integrated.
- Prime contractor was missing a key expertise that was provided by a subcontractor but the prime could not properly oversee the subcontractor’s performance.
- System integration failed between related programs because they had independent funds and schedule and no motivation or Charter to coordinate their integration.
- **Requirements/Systems Engineering**
 - Lack of sufficient user input during the requirements development process led to requirements problems.
 - Lack of early systems engineering resulted in missing and/or incomplete requirements.
 - No realistic concept of operations was defined and agreed to by operator and developer.
 - Impact of addressing legacy data was not recognized.
 - New requirements were added after initial definition without adjustments in schedule, cost, and documentation.
 - Integration with or replacement of legacy systems caused problems when legacy systems were changing during development of the replacement system.
 - Systems engineers were not fully integrated into the software development process.
 - Systems engineers were not adequately trained in software design methodology.
- **Funding**
 - Budget cuts or interruptions in funding caused the development team to break up with the consequence that experience and momentum were lost.
 - Initial funding was inadequate and led to inevitable overruns early in the program.
 - Cross-program funding boundaries did not allow collaboration and coordination.
- **Staffing (of both Government and contractor)**
 - Insufficient number of qualified staff in the organization.
 - High turnover occurred at management and/or worker levels.
 - People worked overtime but could not make up for the shortage of staff.

- **New technology**
 - Time and cost of inserting new technology was not anticipated and estimated. The contributors to overruns included the following:
 - a) Lack of trained personnel
 - b) Instability of new products
 - c) Complexity of development
 - d) Performance impacts due to additional layers of software
 - Integration of COTS products was not recognized as expensive.
 - Replacing hardware, compilers, and operating system caused latent defects in legacy software to appear (e.g., timing, deadlock, error checking).
- **Development Processes**
 - Too many processes were conducted in parallel, causing increased rework.
 - Too many concurrent baselines were in existence.
 - The product line was of poor quality but products were reused anyway.
 - Rate of defect reports was too high because quality assurance prior to testing was not adequate.
 - Engineering discipline was dropped to keep the program on schedule, which led to increased errors and rework.
 - Software-hardware integration delays were caused by lack of hardware parts availability.
 - Adoption of a new software development process caused increased time and increased errors during the learning period.

- **Schedule**

- Poor schedule estimation techniques or data led to unrealistic program schedule being baselined.
- Program had success-oriented schedule, with no time allotted for unanticipated problems (e.g., correcting errors and re-testing).
- Difficult tasks were pushed downstream to give program the illusion of being on schedule.
- Schedule was unrealistic from the start so slips occurred early and accumulated.
- Use of subcontractors and/or development at different locations added to unplanned schedule delay.
- Late delivery of hardware for development, integration, and test, due to poor planning or supplier problems, caused process delays and expensive workarounds (viz., simulations) for conducting software-hardware integration testing.

Appendix G

Technology Readiness Levels (TRLs)

The following are based on NASA Civil Space Technology Readiness Levels taken from NASA's 1991 Integrated Technology Plan and a GAO report [7] advocating the use of TRLs. They can be adapted to roughly assess the relative maturity of a given technology. When used in an assessment, determine the technologies critical to achievement of the program's objectives and estimate their maturity. According to the GAO report, achieving level 7 is an important determinant of program success.

Basic Technology Research:

Level 1: Basic principles observed and reported. Research to Prove Feasibility:

Level 2: Technology concept and/or application formulated

Level 3: Analytical and experimental critical function and/or characteristic proof of concept

Technology Development:

Level 4: Component and/or breadboard validation in laboratory environment, shows technology is technically feasible

Technology Demonstration:

Level 5: Component and/or breadboard validation in relevant environment, integrated with reasonably realistic supporting elements so the technology can be tested in a simulated environment

Level 6: System/subsystem model or prototype demonstration in a relevant environment (ground or space)

System/Subsystem Development:

Level 7: System prototype demonstration in a space environment

System Test, Launch and Operations:

Level 8: Actual system completed and "flight qualified" through test and demonstration (ground or space)

Level 9: Actual system "flight proven" through successful mission operations

Appendix H

Software Development Best Practices

The following is a list of 9 best practices taken from the Software Program Managers Network at http://www.spmn.com/best_practices.html.

“1. FORMAL RISK MANAGEMENT

The discipline of risk management is vital to the success of any software effort. A formal risk management process requires corporate acceptance of risk as a major consideration for software program management, commitment of program resources, and formal methods for identifying, monitoring, and managing risk.

“2. AGREEMENT ON INTERFACES

To deal with the chronic problem of vague, inaccurate and untestable specifications, the Council proposed that a baseline use interface must be agreed upon before the beginning of implementation activities, and that such user interface must be made and maintained as an integral part of the system specification. For those projects developing both hardware and software, a separate software specification must be written with an explicit and complete interface description.

“3. FORMAL INSPECTIONS

Inspections should be conducted on requirements, architecture, designs at all levels (particularly detailed design), on code prior to unit test, and on test plans.

“4. METRIC-BASED SCHEDULING AND MANAGEMENT

Statistical quality control and schedules should be maintained. This requires early calculation of size metrics, projection of costs and schedules from empirical patterns, and tracking of project status through the use of captured result metrics. Use of a parametric analyzer or other automated projection tool is also recommended.

“5. BINARY QUALITY GATES AT THE INCH-PEBBLE LEVEL

Completion of each task in the lowest-level activity network needs to be defined by an objective binary indication. These completion events should be in the form of gates that assess either the quality of the products produced, or the adequacy and completeness of the finished process. Gates may take the form of technical reviews, completion of a specific set of tests which integrate or qualify software components, demonstrations, or project audits. The binary indication is meeting a predefined performance standard (e.g., defect density of less than four per function point). Activities are closed only upon satisfying the standard, with no partial credit given. Quality gates can be applied at any time during the project--- including solicitation.

“6. PROGRAM-WIDE VISIBILITY OF PROGRESS VS. PLAN

The core indicators of project health or dysfunction---the Control Panel indicators---should be made readily available to all project participants. Anonymous channel feedback should be encouraged to enable unfavorable news to move freely up and down project hierarchy.

“7. DEFECT TRACKING AGAINST QUALITY TARGETS

Defects should be tracked formally at each project phase or activity. Configuration management (CM) enables each defect to be recorded and

traced through to removal. In this approach there is no such thing as a private defect, that is, one detected and removed without being recorded. Initial quality targets (expressed, for example, in defects per function point) as well as to counts defects removed in order to track progress during testing activities.

“ 8. CONFIGURATION MANAGEMENT

The discipline of CM is vital to the success of any software effort. CM is an integrated process for identifying, documenting, monitoring, evaluating, controlling, and approving all changes made during the life-cycle of the program for information that is shared by more than one individual or organization.

“9. PEOPLE-AWARE MANAGEMENT ACCOUNTABILITY

Management must be accountable for staffing qualified people (those with domain knowledge and similar experience in previously successful projects) as well as for fostering an environment conducive to high morale and low voluntary staff turnover.”

Appendix I

Recommended Program Management Metrics

A list of recommended metrics can be found at <http://www.psmc.com/> along with a guide to their use. The table below is based on those top-level metrics. This is useful as a checklist when performing an assessment and when making recommendations.

Issue Area	Measurement Category	Measures
Schedule and Progress	Milestone Performance Work Progress	Milestone Dates Critical Path Performance Work Units completed
Resources	Personnel Financial Status Environment Resources	Effort Experience Turnover Earned Value Expense Allocated vs Spent Resources utilized Spares available
Product Size and Stability	Physical Size and Stability Functional Size and Stability	Database Size Lines of Code Components Interfaces Requirements or Function Points
Product Quality	Correctness Supportability Efficiency Portability Usability	Defects Performance Time to restore Complexity Adaptability to change Throughput Timing Standards Compliance User satisfaction

	Reliability	User errors Failures
--	-------------	-------------------------

Appendix J

Industry Data on Software Development

To determine if productivity and software developer team performance are issues, go to <http://www.software.org/library/pubBenchmarking.asp>,* where you can find sources of data on industry performance. These data are primarily ranges such as the following examples:

Productivity	85 – 275 source lines of code per month
Code reuse	20% of effort to develop new code
Defects	5 -10 defects per 1k lines during testing 2.5 defects/hour during inspections

* Card, David N., Published Sources of Benchmarking Data, Software Productivity Consortium, March 2002

Appendix K

Briefing/Report Template

A format for a Program Assessment final report is provided below.

Title, Date, Presenter/Author(s)

- Charter
 - Objective(s) – taken from the charter
 - Ground Rules and Assumptions – any conditions of the assessment that are stated in the Charter including distribution limits
- Team Members
 - Name and affiliation
- Context
 - Brief summary of the background and history of the program
 - Event that triggered the assessment
- Approach
 - Meetings held and dates
 - Sources of information (may not include specific names for interviews to preserve anonymity)
- Findings Summary
 - Observations about status of the program – good and problematic
- Conclusions Summary – based on findings
 - Good News – successful practices and products
 - Issues, risks, problems, potential causes
- Recommendations Summary – (up to five is advised)
 - Near Term – can be implemented immediately or within a year
 - Long Term – plans for future implementation

- Detailed Assessment Findings and Recommendations[Note: organize by issue; can include one or more of the following, as appropriate]
 - Description of Issue
 - Findings
 - Risks – or benefits if good news
 - Recommendations – actions and responsible organization(s)

Appendix L

References

Independent Program Reviews of Software Intensive System Acquisitions

- [1] “OSD Tri-Service Assessment Initiative, Assessment Architecture, Assessment Process Model Description,” Version 2.2, December 6, 1999
<http://tai.pica.army.mil/>

“The Assessment Process Model defines the activities and tasks required to effectively implement and improve software and system assessments across the diverse base of DoD programs” It consists of the following seven key activities:

- Establish and Improve Assessment Capability
- Initiate and Plan Assessment
- Perform Assessment
- Integrate and Report Assessment Results
- Evaluate Assessment Process and Results - Conduct Enterprise Analysis
- Program Technical and Management Actions
- Enterprise Technical and Management Actions

- [2] “OSD Tri-Service Assessment Initiative, Assessment Architecture, Assessment Information Model Description,” Version 2.3, February 7, 2000
<http://tai.pica.army.mil/>

The Assessment Information Model consists of the following three components:

- Program Issue Structure – This is a “...typology of program issues...” that defines “...a framework that provides a consistent approach for assessing program issues: risks, problems and uncertainties or concerns caused by a lack of information. It is used in conjunction with the Assessment Process Model to ensure that applicable issues are identified and assessed throughout all process activities, providing increasing insight into the issues that exist on a given program.”
- Library of Assessment Tools and Techniques – This is currently under development. It will be “a collection of assessment tools, techniques, and references that support the detailed analysis of one or more program issues.”

- Issue Analysis Guidelines – This is currently under development. It will be “guidance for prioritizing, analyzing, and relating identified program issues” and for generating actionable recommendations.

- [3] OUSD(A&T), “Report of the Defense Science Board Task Force on Defense Software,” November 2000.
<http://dodsis.rome.ittssc.com/resources.html>

“The Task Force recommends conducting Independent Expert Reviews (IERs) for all DoD Acquisition Category (ACAT) I-III programs. These reviews are intended to help the program team ensure that: disciplined processes and methodologies are in place, that the program is adequately resourced, that the technical baseline is understood and solid with attendant risks and opportunities identified and managed, and that adequate progress is being achieved...To be effective, the IERs must be integrated into the program development process. Reviews should be held at key program milestones or at least every six months. Review findings should be reported and actions tracked until closure. IERs are common in industry and have led to significant improvements where used.”

The Task Force’s recommendation for IERs is directed at two issues. “The first issue is to ensure that software-intensive programs are being appropriately executed and that cost, schedule, technical, resource, and process issues are being adequately addressed. The second is to share scarce technical resources across a broader set of programs.”

The Task Force recommended that “IERs should occur at selected program events, starting prior to the release of the request for proposal and occurring one month prior to key project milestones. An IER should be held at least every six months and not be longer than 1-2 days in length. IER teams may require a half-day of training prior to the review.”

- [4] USD(A&T) Memorandum, “Independent Expert Program Reviews of Software Intensive System Acquisitions,” 21 December 2000.

This memorandum began implementation of the recommendation by the Defense Science Board Task Force [3] to institutionalize Independent Expert Program Reviews (IEPRs) for ACAT I-III software intensive programs. It states that “It is important to implement IEPRs within your Service such that they support your individual programs and integrate with your acquisition processes and organizational responsibilities. It is of equal importance that the results of these reviews contribute to the greater understanding of the risks, problems and best practices across DoD.” It

thus established a working group to “...develop a plan and necessary policy to implement IEPRs, coordinate IEPR activities, promote IEPR consistency, and coordinate the collection, analysis and distribution of non-attributable IEPR information.”

Software Evaluations for ACAT I Programs

- [5] USD(AT&L) Memorandum, “Software Evaluations for ACAT I Programs,” 26 October 1999.
<http://web1.deskbook.osd.mil/reflib/MDOD/070DV/070DVDOC.HTM>

This memorandum states that each contractor performing software development or upgrade for use in an ACAT I program will undergo an evaluation using tools developed by the Software Engineering Institute (SEI) or approved by the DoD Components and the DUSD(S&T). The contractor must demonstrate capabilities equivalent to SEI’s Capability Maturity Model Level 3.

Risk Management

- [6] *Information Management and Telecommunications (IM&T) Risk Management Handbook*, Draft, 1999, Information Management and Telecommunications Project Office, The Pentagon Renovation Project Office, 100 Boundary Channel Drive, Arlington, VA 22202-3712.

Technology Readiness Levels

- [7] GAO-02-949T, “Knowledge-Based Process Would Benefit Airborne Laser Decision-Making,” Robert E. Levin, July 16, 2002

This document describes and recommends the use of Technology Readiness Levels to assess the risk of employing technology in a program. The approach was developed by NASA for space technology but is easily adapted to other areas of technology. For a more complete description of Technology Readiness Levels, see a White Paper at http://www.trecc.org/partners/TRL_paper.pdf.