Software Quality Assurance/Process and Product Quality Assurance

With CMM®, “the purpose of Software Quality Assurance is to provide management with appropriate visibility into the process being used by the software project and of the products being built” [1].

With CMMI®, “the purpose of Process and Product Quality Assurance is to provide staff and management with objective insight into the processes and associated work products” [2].

Software quality assurance traditionally measured the quality of the products of the project, including interim deliverables. With the introduction of the CMM®, the focus shifted to process quality, with product quality still being an integral part of project development but outside the scope of the project methodology. With CMMI®, assurance of the quality of the process was maintained, along with product quality.

Organizations that do not practice both aspects of quality assurance increase the risk of serious difficulties. There tends still to be a belief that product quality can be tested in and process quality is unnecessary. Several, but not all, of the problems inherent in that way of thinking are mentioned here:
- Lack of project control—project managers, sponsors, and others do not know where the project stands in terms of budget, schedule, or quality;
- Inability to replicate project success;
- Conversely, inability to prevent repetitive project failure—not monitoring the process prevents management from seeing where mistakes were made;
- Excessive testing time—this can result in missed delivery dates, dissatisfied customers, and lost competitive opportunities;
- Expensive rework;
- Inferior product quality.

In order to begin to make changes in your organization, information will need to be gathered. As stated in previous chapters, much of this information can be obtained in conversations with the following people:

- Project managers;
- Developers;
- Testers;
- Business analysts;
- Sales personnel;
- Marketing personnel;
- Higher level executives.

Ask yourself, and these other key people in your organization, the following questions:

- What are the quality processes in your organization (if any)?
- Is there a quality team?
- Are software reviews and inspections part of every project plan? If so, are they performed?
- Are specific software work products designated for periodic inspection for compliance at predetermined stages during the project life cycle?
• Are testing personnel involved in the project from the earliest stages of the requirements phase?
• Is periodic reporting of quality assurance activities made to upper management? If so, are such reports scheduled at certain times during the project life cycle?
• Do the people charged with quality assurance activities have a specific escalation procedure?
• How is reporting of noncompliance issues handled?
• Who has authority to prevent release of a product or service if it does not satisfy the basic quality requirements?

Determine what your organization usually does in terms of quality assurance. It’s likely that different procedures, however informal, are performed differently from project to project.

6.1 Gap Analysis for Software Quality Assurance/Process and Product Quality Assurance

Table 6.1, which uses the gap analysis template for software quality assurance SQA/process and product quality assurance from Appendix A on the enclosed CD-ROM, is an example only. Although the items listed are common in many organizations, they may not be relevant to yours; these are simply examples to assist you in completing your own gap analysis.

As with all of the gap analysis templates in the appendix, the CMM/CMMI® column is already populated. This column shows the basic standards of the KPA to which the template refers. In Table 6.1, the items in the other two columns, Current Practice and Change Needed, are only examples for illustrative purposes.¹

There are four items listed in the CMM/CMMI® column; there are also three blanks cells for each of the corresponding columns, Current Practice and Change Needed. Depending on the individual organization, for each CMM/CMMI® standard there may be several Current Practice items and several Change Needed items. These should be used as needed. It is not

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¹ Please note that these are not of all the activities and abilities associated with this KPA, but they are the key areas that are frequently most lacking in many organizations.
necessary to have each cell completed; conversely, if there are more than three corresponding items, additional rows of cells can be added.

Note also that the gap analysis refers to a quality assurance group. This is the ideal that is seldom achieved in organizations that are not seeking a specific CMM/CMMI® level. Often quality assurance activities are delegated by default to the project manager. Each of the activities detailed in this chapter can be performed by an individual, although tailoring will be

<table>
<thead>
<tr>
<th>Current Practice</th>
<th>CMM/CMMI®</th>
<th>Change Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 SQA is the responsibility of the test team.</td>
<td>A person responsible for SQA oversight is identified</td>
<td>Identify an individual or group of individuals who will assume SQA oversight responsibilities.</td>
</tr>
<tr>
<td>2 SQA is based on test plans.</td>
<td>An SQA plan that includes specific SQA steps is included as part of the project plan.</td>
<td>Assure that the individual(s) responsible for SQA oversight are involved in the earliest stages of project planning.</td>
</tr>
<tr>
<td>3 Management is advised when problems occur.</td>
<td>Regular reporting to key management stakeholders is performed as stated in the project plan.</td>
<td>Establish specific reporting milestones with identified contingency reporting for emergencies.</td>
</tr>
<tr>
<td>4 If quality is considered adequate by the team, the project moves forward.</td>
<td>A method of dealing with variations from approved quality levels is identified and followed.</td>
<td>Assure that the software quality standards are clearly defined and that a procedure is created to obtain project sponsor approval to proceed if they are not.</td>
</tr>
</tbody>
</table>
required. This discussion will include specifics on how to tailor these items in an organization that does not have a separate quality assurance group.

Information in the gap analysis refers to the individual or individuals responsible for quality assurance oversight. The cliché that quality assurance is everyone’s responsibility remains true; however, for optimum efficiency someone must have oversight responsibilities. This is the person (or group of persons) who will identify SQA milestones when the project plan is being developed and assure that these SQA milestones are met. This, too, is detailed later in the chapter.

In the first column are examples of pertinent findings. In this example, quality assurance is seen as the responsibility of the test team. This is a common problem in many organizations. The test team (or individual tester in organizations that don’t have a test team) has quality assurance responsibilities, but those responsibilities are not the test team’s alone. Optimally, as stated earlier, SQA is a separate organization outside of the project team, independent of the project manager and project sponsor.

However, as also stated earlier, this ideal is seldom achieved. In those cases, quality assurance oversight is usually the responsibility of the project manager. He must assure that quality milestones are part of the project plan. If a quality assurance initiative is being implemented after the start of the project, the project manager should request a change to the project plan as described in Chapter 7. In many cases, other stakeholders will not perceive the value in doing this; however, implementing the quality steps will still be beneficial. In this case, the project manager can review his chosen quality milestones during regularly scheduled status meetings and seek input from the project sponsor if he feels that the product of the project is not being produced to the needed level of quality.

The example also states that quality assurance is monitored by the test team. If specific milestones are included in the project plan, problems will be identified long before integration testing begins. Defects are easier—in terms of time, money, and complexity—to fix the earlier in the project life cycle that they are found. Building in these milestones is an important quality assurance step.

The third point in this example states that upper management is notified when problems arise. This is a chronic problem on projects; no one wants to give bad news, so its delivery is delayed. This always worsens the problems. If management personnel are notified in a timely manner of lack of progress, they can notify the customer early if there is to be a schedule delay or if additional monies will be needed to complete the project.
customer can then make whatever changes to its budget and implementation schedule may be required. If management does not know when problems arise, the problems will be compounded once the customer is eventually notified of them. For this reason, timely reporting must be performed.

Finally, in this example, the evaluation of quality prior to deployment is left to the project team. With no standards to which the product or service must be held, and with a delivery date fast approaching, a “good enough” decision may be made. This presents a variety of problems, as good enough for the project team may not be acceptable for the customer. Upper management must know the level of quality, as measured by predetermined standards, and make a judgment based on that information.

Like the examples in the previous chapters, this example is oversimplified, but it provides a basis for your work in your own organization.

Once you’ve finished your interviews, complete the first column of the gap analysis, Current Practice. Place your findings in as many rows as you need; remember Table 6.1 is only an example. Use only the level of detail you need to be able to determine the changes that need to be made.

This template shows four critical items in the CMM/CMMI® column. The problems that you identify regarding quality assurance will probably fall into one of those four categories. You may, however, have more than one issue for one or more of the categories. Include as many as you find; you will prioritize from that list.

Having spoken with several people in the organization, you will probably find many commonalities. For example, the project sponsor may complain that she encounters customer complaints or an unacceptable level of defects once the product or service is deployed. She may state that such issues should have been identified and conveyed to her. The project manager may feel that he had inadequate control of the project, not being aware of whether basic quality steps, such as code inspections, were being implemented and, if so, how effective they were. Testers may say that the code they receive is not really ready for testing.

Resistance statement 14: This seems like a separate project just for quality. We’ve had no major complaints. Why should we do all this?

Response: Quality tasks must be part of each project. This will ensure a better product or service and lead to higher customer satisfaction. In today’s market economy, it is vital to get a better product or service to market faster than the competition. Taking these steps will help achieve that goal.
Now you are ready to look at solutions. As with all of the KPAs we will use the CMM/CMMI® as the foundation because it is based on industry best practices. Do not be overly constrained by it, however; remember that it is customizable to suit the particular needs of your organization.

The following is a summary of the abilities and activities that are associated with SQA/process and product quality assurance KPA for CMM/CMMI®.

1. A person responsible for SQA oversight is identified.
2. An SQA plan that includes specific SQA steps is included as part of the project plan.
3. Regular reporting to key management stakeholders is performed as stated in the project plan.
4. A method of dealing with variations from approved quality levels is identified and followed.

The following discussion can be used as the basis for your process. Remember always to tailor it to the needs of your organization. The first area mentioned is as follows:

6.1.1 A Person Responsible for Quality Assurance Oversight Is Identified

As stated earlier, in optimum situations there will be a person in charge of a quality assurance team. However, often budget or other constraints prevent this from occurring. In any case, someone must be charged with this oversight. This is frequently the project manager, but could be any other team member who is knowledgeable about project quality standards. A business analyst can usually serve in this capacity. The specific responsibilities of this person, in addition to her other role on the project, should be documented. They include the following:

- Provide input regarding quality standards to project planning;
- Define quality milestones to be reviewed during the project life cycle—this could include code reviews and demos;

Please note that these are not all inclusive; the purpose is to provide you with the basics of process improvement. For more detailed information, please see [3].
• Assure that specified quality steps are being implemented by monitoring code reviews, attending demos, and assuring that quality levels are met;

• Issue periodic quality reports to identified management stakeholders;

• Escalate quality deviations to management;

• Recommend “go/no go” depending on the quality of the finished product or service.

Ideally, the person responsible for quality assurance will be independent of the project. This is to ensure that there can be no negative repercussions as a result of reporting product or process shortcomings. A person or group who can evaluate a project’s process and products without any concern that a negative finding will impact his performance review is in a stronger position to assure quality. However, many organizations perform quality assurance functions without this independence. It is mentioned here as the ideal, but it is not an absolute necessity by any means. Any organization with an effective project manager can successfully implement these steps.

6.1.2 An SQA Plan That Includes Specific SQA Steps Is Included As Part of the Project Plan

An SQA plan should be part of the project plan. If there is no formal plan, specific steps should still be included in the project plan.

The following are some basic quality assurance steps that will assist in achieving the goal of improved process and product quality. Tailor this list to suit the needs of your organization. It is pointless to include steps that no one will perform; start where your organization is comfortable and make incremental improvements in quality assurance steps over time.

Assure that the project plan includes the following components:

• Project charter (see Chapter 3);

• Schedule based on the WBS;

• Budget;

• Project tracking milestones;

• Code reviews—specify at what points they will be held and describe the format, such as who (or what functional group) must be represented;
• Demos (if applicable)—specify when and what they (it) should include;

• Quality standards—these will be based on the product or service being produced and may include an acceptable number of defects identified in each phase or maximum acceptable downtime.

This list is not exhaustive; draw on your own experience with the applications being used to establish quality assurance steps.

As with all process steps, having them in the plan is not enough; they must be performed. The person who is designated responsibility for quality assurance oversight must assure that these tasks are implemented. For example, having a project schedule as part of the plan is vital; assuring that the project schedule is managed is the purpose of having the schedule. Other items can and should be scheduled in, such as code reviews. In all likelihood it will be the project manager who facilitates these reviews. Some of these items, such as reviewing milestones, can be incorporated into the weekly status meetings. Like code reviews, product demos will need to be scheduled outside of status meetings.

6.1.3 Regular Reporting to Key Management Stakeholders Is Performed As Stated in the Project Plan

Reporting quality assurance findings serves two purposes:

1. Identified stakeholders—those with a need to know—are kept informed about the progress of process and product quality.

2. Team members know that performance will be reported, thus helping to ensure improved performance.

Early in the planning stages of the project, the people who need to know quality updates should be identified. At a minimum, this will be the project sponsor. However, some others who should receive these reports are the following:

• Development lead;

• Test lead;

• Business analyst(s).
Reports to these people should include summary information about the quality team’s (or individual’s) efforts. An example follows in Table 6.2.

This simple report assures that stakeholders who need information about the quality of the project are receiving it. For example, upon receiving this, the development lead may recognize that Module 456 is a particularly complex one, but one with which he is familiar. His assistance at this point in the project may prevent a costly schedule delay.

See Appendix G on the enclosed CD-ROM for a template for this report.

6.1.4 A Method of Dealing with Variations from Approved Quality Levels Is Identified and Followed

The role of the quality assurance team or individual is to assure that quality standards are being met and quality steps are being performed to ensure a high-quality product or service. As deviations are identified, they must be documented and resolved. How this is done should be documented in the quality assurance plan.

When deviations from process or product quality are identified, the first level for resolution is the project team. The project manager has the responsibility of documenting the issue, assigning it to a team member (or herself), and following up to assure resolution. Table 6.3 is a sample template for tracking identified quality issues.

Table 6.3 can be part of the regular report sent to management. A template can be found in Appendix G on the enclosed CD-ROM.

Some issues cannot be resolved at the project level. Either they require an upper management decision (e.g., the delivery date simply cannot be met if the steps needed to assure the required level of quality are performed) or the problem exceeds the technical expertise of the team members. Once an issue has been identified, the decision as to whether it can be

<table>
<thead>
<tr>
<th>QA Task</th>
<th>Date Performed</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Code review—Module 123</td>
<td>August 5, 200X</td>
<td>Accepted.</td>
</tr>
<tr>
<td>2 Code review—Module 456</td>
<td>August 10, 200X</td>
<td>A second review, not initially scheduled, will be held on August 24 due to problems identified.</td>
</tr>
</tbody>
</table>
resolved within the project team must be made. If it cannot, it needs to be escalated immediately.

In some cases, a problem may appear to be within the scope of the project team. In that case, it will be assigned by the project manager as indicated earlier. At any time from the point at which it was identified to the projected resolution date (“Due Date” in Table 6.3) that the person to whom it was assigned recognizes that it is outside of his expertise, the project manager should be notified for immediate escalation.

The escalation path should be defined in the quality plan. If an issue cannot be resolved within the project team, to whom should it be reported? At a minimum, it must be reported to the project sponsor, but often she is not the person to resolve it. Each organization must identify those people to whom issues should be reported if they cannot be resolved within the project team. It may include the following:

- Designated subject matter expert;
- Development lead from another group within the organization;
- Test lead from another group within the organization;
- Subcontractor management (if a portion of the project is outsourced and the problem is identified in that portion);
- Business analyst.

The key is to identify people who can be relied on to assist with the resolution of the problem, in addition to whoever—usually the project sponsor—can work with the customer to make any adjustments that may be required. Determining who these people are will require some

Table 6.3
Sample Quality Issues Register

<table>
<thead>
<tr>
<th>Date</th>
<th>Issue</th>
<th>Assigned To</th>
<th>Due Date</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/10/0x</td>
<td>Demo crashed when X users were logged on.</td>
<td>Mary Williams</td>
<td>7/10/0x</td>
<td>Open</td>
</tr>
<tr>
<td>6/14/0x</td>
<td>Code review for Module XYZ not held.</td>
<td>Peter Johnson</td>
<td>6/20/0x</td>
<td>Open</td>
</tr>
<tr>
<td>6/15/0x</td>
<td>(Issue)</td>
<td>(Name)</td>
<td>(Due date)</td>
<td>(Open or closed)</td>
</tr>
</tbody>
</table>
discussion within the organization. This should be done during project planning. If a quality assurance program is being implemented after the project has begun, it will still be necessary to speak to those people in a position to know the following:

- Who are the subject matter experts in the organization, or elsewhere in the company, on the applications being created or enhanced?
- Who has the most frequent contact with the customer? This could be the product managers, project sponsor, or someone else within the organization.
- Ultimately, who is the person who could best deliver bad news to the customer?
- Who in the organization needs to know about any proposed budget or schedule changes?

Identify these resources as early as possible.

Resistance statement 15: How can we identify who can solve a problem before the problem exists?

Response: You can’t. But you can identify who in your organization, even people not on the current project, are experts in that field.

Resistance statement 16: At times we are working on something completely new. No one in the organization has any experience with it.

Response: This is more challenging and is a common problem. However, you still need to identify those people who could be most helpful if a problem arose. For example, if you are automating your company’s accounts receivable system for the first time, the accountant should know how she wants things to run. This will not provide technical (i.e., coding) help but can assist developers in clarifying what is needed and determining whether it is possible with the current resources, budget, and schedule.

Measurement and Analysis

For SQA/process and product quality assurance, two main areas are to be measured and analyzed:

- Cost of process efforts;
- Number of process tasks.
6.1.4.1 Cost of Process Efforts

The amount of time spent performing the following activities should be documented:

- Quality planning;
- Code reviews;
- Milestone reviews;
- Demo reviews;
- Report creation;
- Meetings to present quality findings.

Table 6.4 is a suggested format. Be aware that this is only a suggestion. The only right way of capturing and documenting this information is the way that makes sense for your organization. This will depend on who needs to see the information. If the project sponsor wants to see this as part of his reports, you will need to tailor it to suit his needs.

Be aware of the need to exercise good judgment. For example, one can probably estimate with some degree of accuracy how much time was spent in the quality assurance aspect of project planning. If quality assurance is an integral component of the plan, then a significant amount of time was

<table>
<thead>
<tr>
<th>Item</th>
<th>Time Spent</th>
<th>No. of Times Performed</th>
<th>Cost Each Time</th>
<th>Total Cost</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project planning</td>
<td>12 hours</td>
<td>N/A</td>
<td>X</td>
<td>12 * X</td>
</tr>
<tr>
<td>2</td>
<td>Code review—Module XYZ</td>
<td>4 hours</td>
<td>3</td>
<td>X</td>
<td>12 * X</td>
</tr>
<tr>
<td>3</td>
<td>Code review—Module ABC</td>
<td>6 hours</td>
<td>4</td>
<td>X</td>
<td>24 * X</td>
</tr>
</tbody>
</table>
probably spent, especially if this is the first time the organization has focused on quality planning. However, as this quality planning was probably part of every project planning meeting and possibly of early requirements meetings, it may be difficult to quantify how many times this planning was performed. An activity such as a code review is performed alone; it is not part of status meetings, planning meetings, or requirements reviews. Therefore, the number of times a code review for a particular model has been performed can be documented.

See Appendix G on the enclosed CD-ROM for a template.

6.1.4.2 Number of Process Tasks
The information contained in Table 6.5 can be obtained from Table 6.4, but while that measure focuses on cost, this focuses on activity.

As with cost of process efforts, the person responsible for these measurements must exercise good judgment. A quick hallway conversation with the project sponsor cannot be considered a meeting to present findings. However, if that conversation was lengthy, or if a 10-minute hallway conversation occurred each day, this is time that should be accounted for.

See Appendix G on the enclosed CD-ROM for a template.

This is the basis of an SQA/process and product quality assurance process. On the following pages you will find a flowchart for SQA/process

<table>
<thead>
<tr>
<th>Activity</th>
<th>No. of Times Performed</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality planning</td>
<td></td>
<td>This was part of all planning activities.</td>
</tr>
<tr>
<td>Code reviews</td>
<td>12</td>
<td>One additional review was performed at the request of the development lead.</td>
</tr>
<tr>
<td>Milestone reviews</td>
<td>8</td>
<td>Milestone reviews held midway through the phase were particularly helpful in preventing problems later in the life cycle.</td>
</tr>
<tr>
<td>Demo reviews</td>
<td>4</td>
<td>First phase demo was held too late; this caused a delay in initial acceptance testing.</td>
</tr>
<tr>
<td>Report creation</td>
<td>12</td>
<td>The report template saved time each reporting period.</td>
</tr>
<tr>
<td>Meetings to present findings</td>
<td>4</td>
<td>The written reports reduced the need for face-to-face meetings.</td>
</tr>
</tbody>
</table>
and product quality assurance and a checklist. There is also a flowchart for a change control procedure. Chapter 8 has a sample SQA/process and product quality assurance process and Appendix I on the enclosed CD-ROM has a template to use in developing your own.

6.2 SQA/Process and Product Quality Assurance Flowchart

The SQA/process and product quality assurance flowchart shown in Figure 6.1 provides an overview of this discussion. As stated, this comprises the foundation of an effective SQA/process and product quality assurance process.

The change control procedure remains the same regardless of the item being changed. Figure 6.2 depicts a recommended change control procedure. It is included here for your convenience.

![Flowchart](image_url)

Figure 6.1 SQA/process and product quality assurance flowchart.
The SQA/process and product quality assurance checklist can be used by both the person responsible for process improvement and the team (see Table 6.6). While the person responsible for process improvement has ultimate responsibility to assure that these steps are performed, other team members can refer to the checklist so they will know what is expected in the performance of SQA.

The templates used in this process are:

- SQA/process and product quality assurance gap analysis (see Appendix A on the enclosed CD-ROM);
- Sample quality report (see Appendix G on the enclosed CD-ROM);

Figure 6.2 Change control procedure.

6.3 SQA/Process and Product Quality Assurance Checklist

The SQA/process and product quality assurance checklist can be used by both the person responsible for process improvement and the team (see Table 6.6). While the person responsible for process improvement has ultimate responsibility to assure that these steps are performed, other team members can refer to the checklist so they will know what is expected in the performance of SQA.

The templates used in this process are:

- SQA/process and product quality assurance gap analysis (see Appendix A on the enclosed CD-ROM);
- Sample quality report (see Appendix G on the enclosed CD-ROM);
• Sample quality issues register (see Appendix G on the enclosed CD-ROM);
• Cost of process efforts register (see Appendix G on the enclosed CD-ROM);
• Number of process tasks performed register (see Appendix G on the enclosed CD-ROM).

References