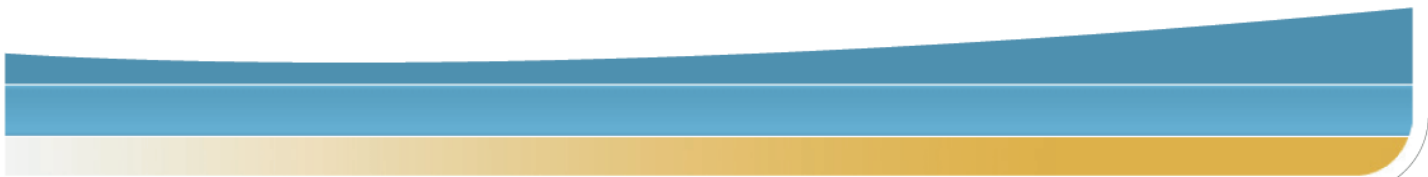


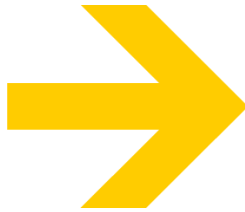


A Rethinking QA White Paper

Test Process Assessments Move into the Real World

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At a Glance

Freed from the classroom, frameworks for measuring the effectiveness of test organizations have been adapted to the real world, and are in use today by development teams looking to continuously improve product release readiness.

Executive summary

Every development organization has a test and quality assurance process -- whether it is an efficient one is a different story. A test team may be saddled with outdated processes from a previous generation of products, lacking a mechanism that encourages continuous improvements in test methodology. Or, a comprehensive QA roadmap may be absent altogether. Previous efforts to systematically measure the efficiency and maturity of a QA/test organization have been largely academic exercises, difficult to apply to real world software development environments. Today, however, new methods are available that enable product developers to assess and improve their quality assurance and test processes, without interfering with day-to-day production demands, using well established frameworks such as the Testing Maturity Model¹ index.

This white paper examines the fresh techniques for assessing the effectiveness of QA organizations. Whether an organization has a dedicated testing team or not, today's testing is being completed more and more often by product managers, business analysts, customers, and programmers in addition to traditional testers. Evaluating all of these testing practices through a unified lens, using a maturity scoring scale that looks at all key testing responsibilities and functions, can be accomplished with the application of tried and true assessment frameworks. Then a record of QA/testing strengths and weaknesses can be drafted with a proscribed improvement plan that has buy-in from all product development stakeholders.

What is test process assessment?

Test process assessment is a structured evaluation of existing testing practices and associated documentation and tools within a development organization. The assessment involves bottom-to-top interviews with product development and test team members, from entry-level test technicians to Engineering VPs.

Artifacts reviewed by assessors may include test planning and strategy documents, quality policies, test tools and frameworks, and individual test cases used on recent projects. Since testing activities are often deeply embedded in many facets of the software development lifecycle (SDLC), a thorough analysis of testing practices involves examination of other development activities such as requirement specification and release management.

¹ Developed by Dr. Ilene Burnstein, et al, at the Illinois Institute of Technology in 1996

The assessment exercise provides a test maturity baseline of the current state of testing practices, one that can be used as a reference for future evaluations, after suggested improvements have had a chance to work.

Why consider test process assessments?

There are several drivers that lead organizations to consider test process assessments. Some developers are motivated by past product quality issues resulting from high escaped-defect rates, and the subsequent customer complaints and poor product adoption patterns. Others are driven by time-to-market pressures; as inefficient testing is often the bottleneck that delays release schedules. A poor record of meeting service and quality level agreements may also prompt development teams to launch across-the-board QA process improvement initiatives. Earning certifications, awards, or industry recognition are also typical reasons to consider following an improvement model.

How can test assessment and improvement models help?

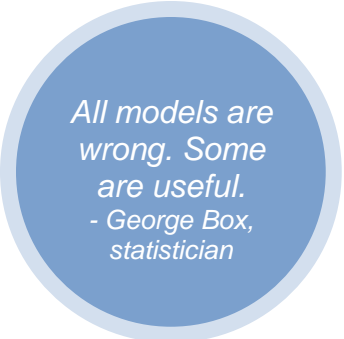
Assessment and improvement models provide a framework for planning and conducting appraisals and defining a manageable and traceable improvement plan. They ensure the right questions are asked of the right stakeholders for each specific area under evaluation. The models guide users in recognizing and prioritizing processes that need improvement, and help identify those which are working better than others, and why. An assessment or improvement model should include a measurement of compliance level, so that progress can be measured on a periodic basis.

Choosing a test assessment or improvement model

When discussing the risks of the following models, the famous quote of statistician George Box comes to mind: “All models are wrong. Some are useful.” There is no such thing as a perfect model for any practice area. The real question becomes, “How wrong must a model be before it is useless?” To remain applicable and relevant, a model needs to evolve. The level to which a model must continuously advance is directly dependent on the number of its prescriptive details.

The development of test improvement models was particularly prolific during the Nineties. At last count, more than ten different models have been developed or proposed. Many of these have academic origins, and some are targeted at specific industry verticals. A sampling of the better known models includes:

- *Test Organization Maturity Model (TOM)*, created by Gerrad Consulting in the U.K. in the late 1990s
- *Testability Support Model (TSM)*, also known as the Testability Maturity Model, created by Dr. David Gelperin in 1996



All models are wrong. Some are useful.
- George Box, statistician

- *Test Improvement Model (TIM)*
- *Testing Capability Maturity Model (TCMM)*
- *Testing Assessment Program (TAP)*
- *Maturity Model for Automated Software Testing (MMAST)*, created in 1994 with a focus on medical devices
- *TPI^{TM2}, Test Process Improvement Model*, was created in 1996 by Tim Koomen and Martin Pol.
- *TMM^{SM3}, Testing Maturity Model*, was created in 1996 by Dr. Ilene Burnstein, et al, at the Illinois Institute of Technology.

All of the above models have been subject to considerable analysis. Typical criteria used to review a model for completeness and utility include:

- **Sufficient information.** A model should have sufficient information to support persistent analyses and findings. Different assessors reviewing the same collateral, and answers to questions and checklists should assign the same maturity levels and recommend similar improvements.
- **Maturity structure.** In order to support continuous improvement with measurable results, a maturity structure based on multi-tiered goal composition is needed. This will allow an organization to benchmark its improvement progress and measure velocity.
- **Improvement suggestions.** In addition to providing a procedure for conducting the assessment, the model should provide a mechanism to derive improvement recommendations to strengthen weakness areas.
- **Adequate maintenance.** As development lifecycles and practices evolve over time, and as more data from following and applying models in different industry verticals are available, test improvement models need to be updated and maintained accordingly. This can be done by standards or special interest bodies or by individual companies using the models for self-assessment.

The two most prevalent and well documented models are the TPI and the TMM. TMM was created in 1996 by a team of researchers headed by Dr. Ilene Burnstein at Illinois Institute of Technology, who published a book on the subject in 2002. TPI was created in 1996 by Tim Koomen and Martin Pol.

² TPI is a registered trademark of Sogeti Nederland B.V.

³ TMM is a registered servicemark of Illinois Institute of Technology

What are the differences between TMM and TPI?

Both TPI and TMM feature a rating system corresponding to an organization's level of maturity. TMM has five maturity levels that include 13 key process areas (KPs). TPI has 13 maturity levels

	TMM	TPI
Type Model	Maturity	Maturity
Year of development	1996	1997
Approach	Conceptual	Practical
Maturity Model Foundation	Gelperin and Hetzel	None
Number of Levels	5	13
Number of KPs	13	20
Assessment Type	Questionnaire	Checklist
Assessment Elements	Assessment Procedure, Questionnaire, Training and Team Selection criteria	Assessment Guideline, Checklist and Test Maturity Matrix
Assessment Foundation	CMM, ISO, SPICE	Practical Experience
Information about Model	Articles, Dissertations and Book	Articles, tools and Book

with 20 KPs. Both models incorporate assessment elements with procedures and guidelines. TMM is based on a questionnaire and maturity rating criteria with foundations in Capability Maturity Model (CMM®⁴), International Organization of Standardization (ISO) and Software Process Improvement and Capability Determination (SPICE) or ISO 15504. TPI uses checklists and a maturity ranking matrix based on practical experiences of Sogeti Nederland, BV.

Key process areas of TMM and TPI

The key process areas for both TMM and TPI are shown in the following table. While all the process areas of TMM are covered by TPI, TPI includes

TMM	TPI
Test Planning	Test Strategy
Testing/Debugging Policies/Goals	Life-cycle Model
Basic Testing Techniques/Methods	Moment of Involvement
Controlling and Monitoring Tests	Estimating and Planning
Integration of Test	Test Specification Techniques
Test Training	Static Test Techniques
Test Organization	Metrics
Software Quality Evaluation	Test Automation (tools)
Test Measurement	Test Environment
Review Program	Office Environment
Test Process Optimization	Commitment and Motivation
Quality Control	Test Functions and Training
Defect Prevention	Scope of Methodology
	Communication
	Reporting
	Defect Management
	Testware Management
	Test Process Management
	Evaluation
	Low Level Testing

⁴ CMM and CMMi are registered trademarks of Carnegie Mellon University

several KPAs that are not explicitly and in detail analyzed by TMM. These areas are Test Environment, Office Environment, Reporting, Defect Management, and Testware Management.

Test environment is the least covered by TMM. Because of its importance to successful test execution, TMM followers need to include review of test environment attributes' management and control procedures.

The remainder of this paper will focus on the Testing Maturity Model, including details on how to apply its assessment methods to identify strengths and weaknesses of testing practices and to suggest test improvement recommendations.

Assessing TMM levels

The TMM level structure is illustrated in Figure 1.5. With the exception of TMM level one, each level has a set of goals that need to be met in order to reach level maturity. Each goal supports a set of testing capabilities that are examined through analysis of several sub-goals that provide specific practice details. This sub-goal analysis is guided by examining testing Activities, Tasks, and Responsibilities that are abbreviated within the TMM framework as ATRs.

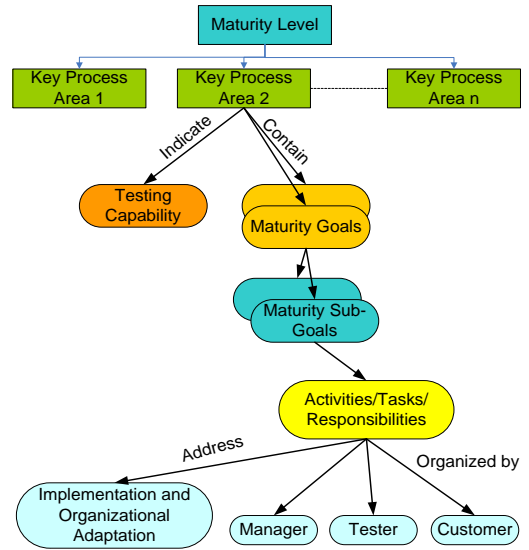


Figure 1: TMM KPA Maturity Goal Assessment⁵

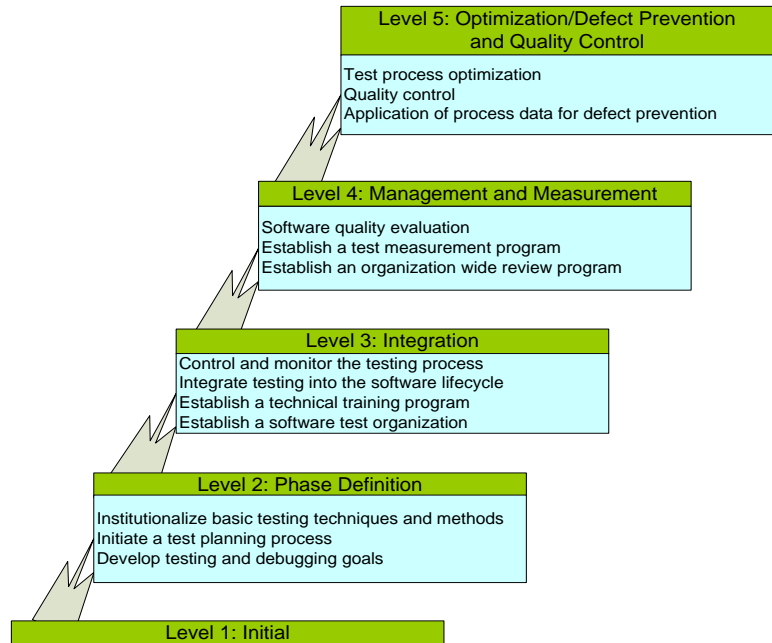


Figure 2: TMM Five Maturity Levels⁵

⁵ Source: "Practical Software Testing" by Ilene Burnstein

Testing activities and tasks are suggested to improve test management and execution capabilities for the key test process area maturity sub-goals. The responsibilities of these activities and tasks are assigned to three groups within a development organization: test and development managers, testers and developers, and customers/users/clients. The involvement of all three groups is essential to structuring organizational adaptation and customization of the testing maturity framework.

TMM, like CMM, follows a staged approach for process improvement. The TMM five maturity levels, and their corresponding level KPAs, are shown in Figure 2. As the test maturity goals of each KPA are met, the test process improves and the organization moves up to higher test maturity levels—away from level one and closer to level five. Each level provides a rich set of testing practice details that, once applied, can incrementally increase the quality of testing practices.

A maturity goal's satisfaction is calculated based on the satisfaction of 50% or more of its maturity sub-goals. Test maturity sub-goals are initially evaluated based on the answers to a set of associated questions. Possible answers to each TMM ranking question are: Y (Yes), NO, NA (Not Applicable) and NK (Not Known). Maturity goals can receive one of four possible ratings:

Satisfied	Percentage of its "Satisfied" Subgoals is ≥ 50
Not Satisfied	Percentage of its "Satisfied" Subgoals is < 50
Not Applicable	Percentage of its "Not Applicable" subgoals is ≥ 50
Not Rated	Percentage of its "Not Known" subgoals is ≥ 50

A TMM maturity level is "Satisfied" if all of its testing maturity goals and all maturity goals of each lower level are "Satisfied." TMM Level 1 does not have maturity goals. The maturity goals for all TMM levels 2 through 5 are listed below:

- **TMM Level 2: Phase Definition**
 - Develop software testing and debugging goals and policies
 - Initiate a test planning process
 - Institute basic testing techniques and methods
- **TMM Level 3: Integration**
 - Create a test organizational structure
 - Institute a technical training program
 - Integrate testing into the software lifecycle
 - Control and monitor the testing processes
- **TMM Level 4: Management and Measurement**
 - Establish organization-wide review programs
 - Institute a test measurement program
 - Create software quality evaluation methods

- **TMM Level 5: Optimization/Defect Prevention and Quality Control**

- Defect prevention
- Quality control
- Test process optimization

Three phases of test process assessment

Test process assessment is performed in three phases: planning and review phase, interview and analysis phase, and reporting phase. During each phase, assessors navigate toward several milestones with defined deliverables. A general description of these is provided below.

Phase 1 (planning and review)

Assessors confirm assessment objectives, collect process and project documentation, and select organization stakeholders that are to participate in the assessment.

Milestones

- Define assessment scope/goals
- Assemble assessment team
- Collect documentation to be reviewed
- Notify stakeholders to be interviewed
- Define expected deliverables
- Publish assessment questionnaire
- Define and distribute interview schedule

Deliverables

- Assessment project plan
- Presentation to stakeholders
- Notification email to stakeholders
- Assessment questionnaire
- Interview schedule

Phase 2 (interview and analysis)

Assessors analyze test processes, practices, and tools and conduct interviews.

Milestones

- Review received collaterals
- Evaluate questionnaire answers
 - Validate collaterals presence and awareness
 - Confirm process usage and consistency
- Solicit missing or alternative documentation
- Generate additional questions

Deliverables

- Updated assessment project plan
- Updated interview schedule
- Additional requests for information
- Progress reports

Phase 3 (reporting)

Assessors analyze questionnaire answers and study supporting (newly submitted) collateral and produce reports.

Milestones

- Review interview questionnaire answers
- Analyze additional documentation
- Score all received answers
- Identify strengths and weaknesses
- Provide improvement recommendations

Deliverables

- Assessment findings report
- Improvement recommendation detailed report
- Improvement roadmap
- Findings and recommendations presentation to stakeholders

Test maturity rating criteria and procedure

A test maturity level rating is based on assigning satisfaction levels to the maturity subgoals for the various TMM key process areas.

Satisfaction levels are assigned based on reviewing questionnaire answers, interview data, and test project and process documentation. In order to cross-check the consistency and correctness of multiple data sources and to resolve any data-related issues, Lionbridge suggests constructing a rating traceability matrix for each of the maturity goals. Such a matrix would display information about the satisfaction of maturity sub-goals for each maturity goal.

A maturity goal's satisfaction is calculated based on the satisfaction of 50% or more of its maturity sub-goals. A maturity sub-goal is satisfied if 50% or more of its questions receive YES answers and if the supporting documentation, such as process and product documentation, is available and is followed by testing staff. A maturity sub-goal with less than 50% YES answers or with missing supporting process/product documentation would receive a Not Satisfied rating. A maturity sub-goal that

Steps to determine a TMM rating

- 1) Rate the maturity sub-goals by collecting answers to corresponding questions and reviewing the test process and product documentation and any additional data collected from interviews.
- 2) Rate all the maturity goals by summing up the maturity results of corresponding sub-goals.
- 3) Determine the TMM maturity level based on maturity results of corresponding goals.

receives 50% or more NA ratings would receive a “Not Applicable” rating. A maturity sub-goal with 50% or more NK ratings would receive a “Not Known” rating.

TMM assessment case study

Lionbridge was contracted by a product engineering organization to examine and analyze its current quality assurance testing practices and processes and to deliver improvement suggestions based on industry best practices. Lionbridge conducted the test assessment following the “Lionbridge Test Maturity Assessment Process,” based on the Testing Maturity Model Assessment Model (TMM-AM).

The organization under review had grown over the preceding five years in both staff headcount and product complexity. Its software development models have evolved to incorporate Agile methods, which are practiced alongside traditional Waterfall models. The test department reports into the engineering vice president. More than half of the testing staff members are contractors who are brought in on a project basis, and who stay with the organization for less than six months on average.

Over the next two years, the organization is planning to introduce new products to several new markets that would more than double its product portfolio and market reach. There is a perception at the executive level that the current test department practices and structure cannot support the new expanded test coverage and increased project count. The engineering VP would like to move to higher productivity and efficiency levels while increasing overall product quality levels.

Assessment Findings Summary

After conducting the test process assessment, Lionbridge found that the test department within the organization under review has characteristics of TMM Level 1.7; which means that it started to implement some testing fundamentals but lacks consistency, structured test planning, and quality measurement. The maturity assessment results are listed below.

TMM Level 2	Not Satisfied
Develop Testing and Debugging Goals and Policies	Not Satisfied
Initiate a Test Planning Process	Satisfied
Institutionalize Basic Testing Techniques and Methods	Satisfied
TMM Level 3	Not Satisfied
Establish A Test Organization	Satisfied
Establish A Technical Training program	Not Satisfied
Integrate Testing Into The Software Life Cycle	Not Satisfied
Control and Monitor the Testing Process	Satisfied
TMM Level 4	Not Satisfied
Establish an Organization Wide Review Program	Satisfied
Establish a Test Measurement Program	Not Satisfied
Software Quality Evaluation	Not Satisfied
TMM Level 5	Not Satisfied
Defect Prevention	Not Satisfied
Quality Control	Not Satisfied
Test Process Optimization	Not Satisfied

As part of the evaluation, Lionbridge provided improvement recommendations that, once implemented, will enable the organization to achieve higher TMM maturity levels. In other words, implementing the proposed improvements would result in defined and repeatable test processes, including quality monitoring and control, fully integrated testing process into various software development lifecycle, established training protocols, and some degree of consistent and justifiable software quality evaluation and metrics.

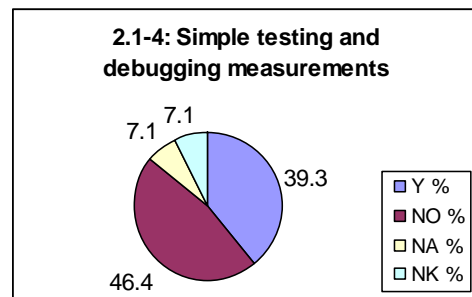
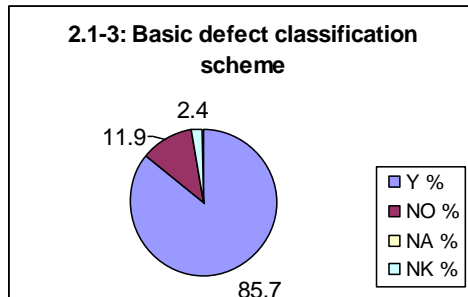
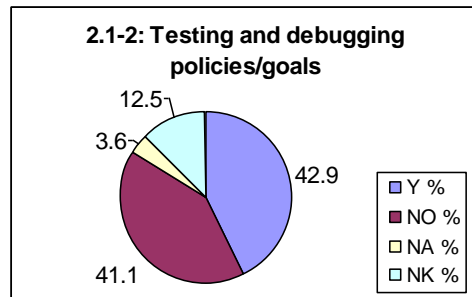
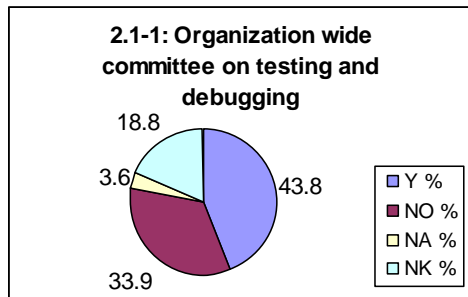
A sample of test maturity goal satisfaction results for Level Two is shown later in this paper. A suggested test improvement roadmap is also provided.

TMM Level Two Sample Findings

In order to be satisfied, the TMM Phase Definition level (Level 2) need to satisfy three key process area goals. They are “Develop Testing and Debugging Goals and Policies,” “Initiate a Test Planning Process,” and “Institutionalize Basic Testing Techniques and Methods.” Analysis results for two of these goals are shown below.

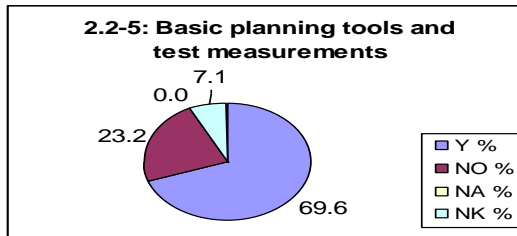
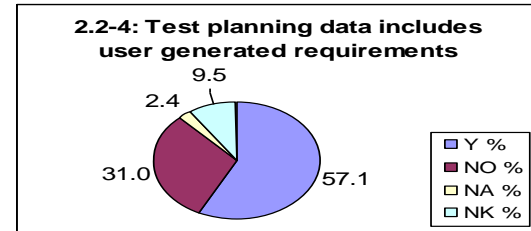
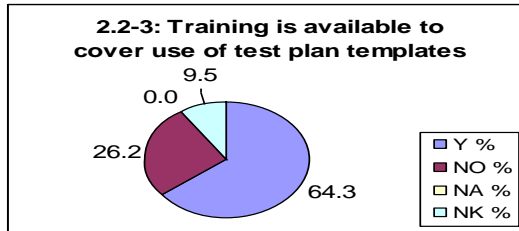
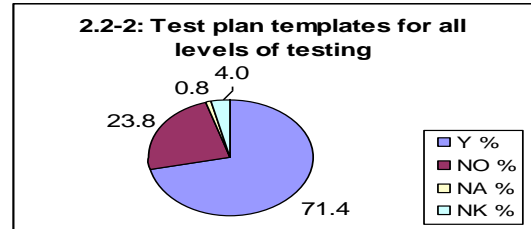
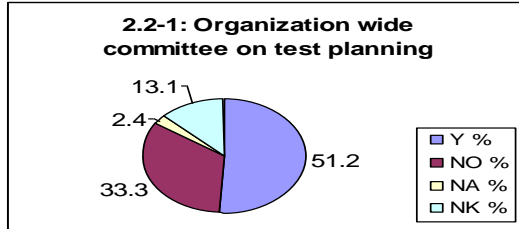
TMM Level 2 Goal 1: *Not Satisfied*

Three of the four subgoals shown in the figure below were not satisfied. TMM results suggest a percentage level of satisfaction scoring. A level above 80% should generally be sought after.



TMM Level 2 Goal 2: *Satisfied*

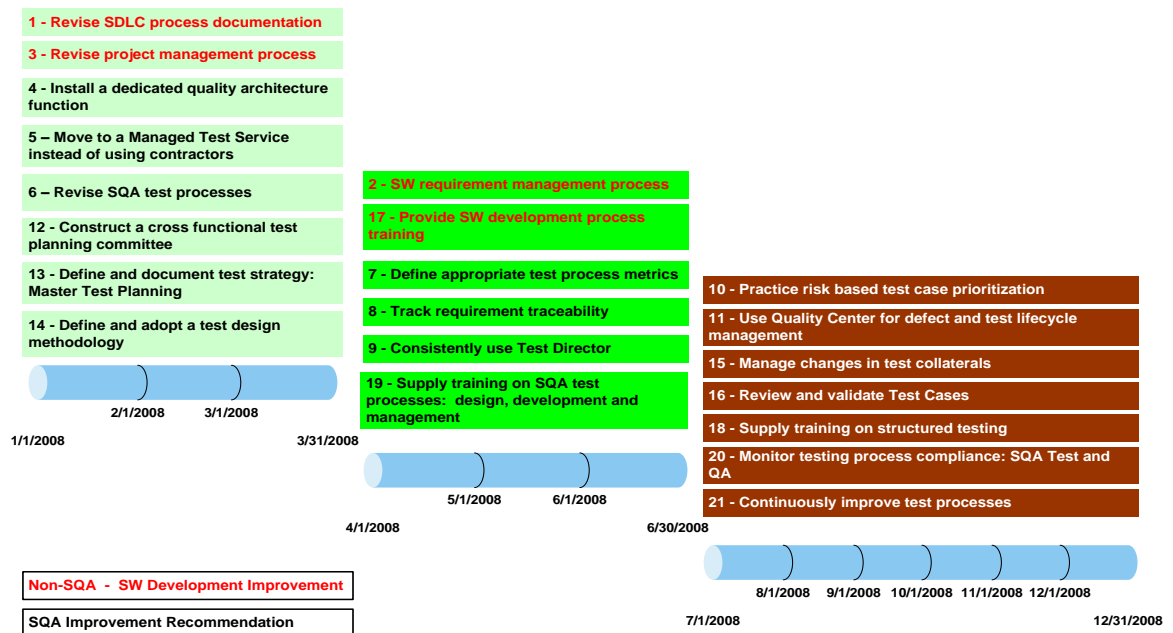
All five of the subgoals of the “Initiate a Test Planning Process” goal have been met. None of the satisfaction levels are above 80%. Subgoals 1 and 4 that reflect the lowest satisfaction levels (51.2% and 57.1%) require close attention during continuous process improvement efforts.



Test Improvement Roadmap

Implementation of shown recommendations 1, 3, 4, 6, 12, 13, and 14 would result in satisfaction of TMM Maturity Level 2 within the next six to twelve months. Implementation of suggestions 1 through 19 would satisfy TMM Maturity Level 3 within the next 12 to 24 months and would provide the following benefits:

- Justifiable and Defendable Strategies
- Prescriptive Guidelines and Policies
- Consistent Test Planning and Execution
- Defined Product Quality Attributes
- Quality Audit Guidelines
- Monitoring and Control Policies
- Fully Integrated Testing Activities into SDLC
- Established Training Protocols
- Consistent Quality Evaluation Metrics



Conclusion

Reaching and maintaining high maturity levels in testing practices ties directly to finished-product quality. It improves the effectiveness and accuracy of measuring product release readiness based on static and dynamic testing results. No matter which test process improvement model is used, it needs to be continuously reviewed and evaluated for applicability to the organization's overall development processes and organizational structure. Incorporating test assessments as part of the corporate continuous test improvement policy increases internal support, funding, and recognition of the assessment activities.

Contact Information

About Lionbridge

Lionbridge Technologies, Inc. (Nasdaq: LIOX) is a leading provider of globalization and testing services. Lionbridge combines global resources with proven program management methodologies to serve as an outsource partner throughout a client's product and content lifecycle — from development to globalization, testing and maintenance. Global organizations in all industries rely on Lionbridge services to increase international market share, speed adoption of global products and content, and enhance their return on enterprise applications and IT system investments. Based in Waltham, Mass., Lionbridge operates across 26 countries, including India, China, and Poland, and provides services under the Lionbridge and VeriTest® brands.

Corporate Headquarters

Lionbridge
1050 Winter Street
Waltham, MA 02451
USA
www.lionbridge.com

