

Chapter 5

Test Team Management



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Content

1. Organizational Structure of a Test Team
2. Test Program Tasks
3. Test Effort Sizing
4. Test Engineer Recruiting
5. Roles and Responsibilities

Introduction

Clarifying expectations sometimes takes a great deal of **courage**. It seems easier to **act as though differences don't exist** and to **hope things will work out** than it is to face the differences and work together to arrive at a **mutually agreeable set of expectations**.

—Steve Covey

Introduction

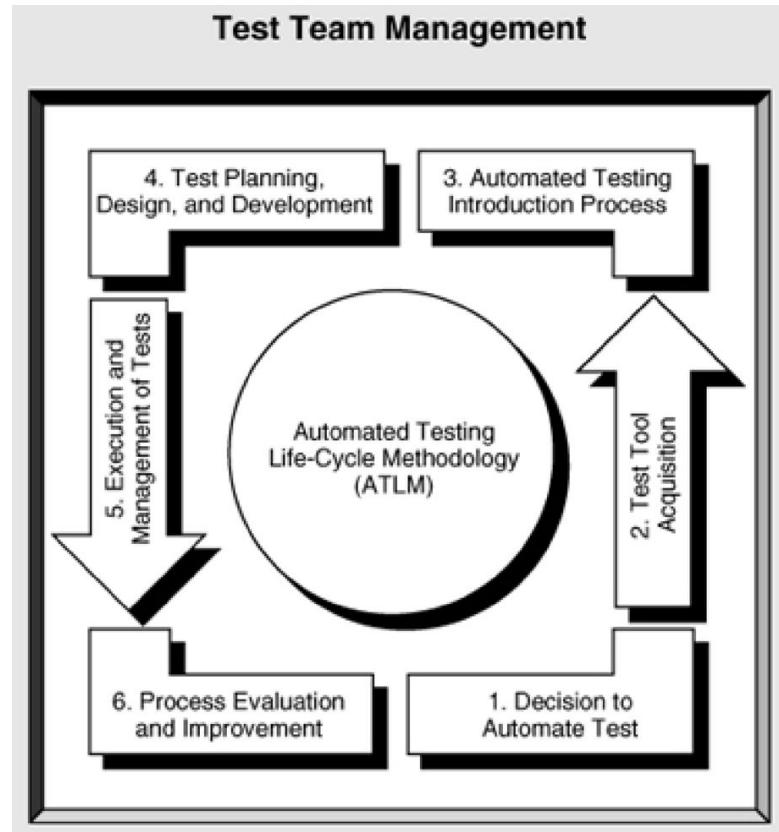
- Automated test tools are **effective** in providing solutions only when the problem at hand is **adequately understood** => identifying the individuals who will be responsible for solving it.
- Test efforts are complex and require a diverse set of skills.
- Experts need to comprehend the scope and depth of the required test effort and to develop a strategy to execute and implement the test program.
- To execute a successful test program, the test team composition needs to be designed, the test team assembled, and the team members' roles and responsibilities defined and assigned.

Introduction

- Experienced people are needed to conduct test planning and write test procedures for manual and automated testing.
- It is important to document the roles and responsibilities assigned to the various test team members.
- The roles and responsibilities should be communicated both verbally and in written form and made available to everyone on the team
 - => everyone will have a clear understanding as to the individual responsible for each particular area of the project.
 - => new team members can quickly determine whom to contact if a problem arises.

Introduction

- A task description should be created.
- Once the scope of the task is understood, the task assigning becomes easier.
- Work packages can be developed and distributed.
- Packages include detail the task organization, technical approach, task schedule, allocation of hours for each individual, and applicable standards and processes.



Introduction

The test team typically takes responsibility for an assortment of test and quality-related tasks

- If project-specific standards are not available, the test team should inquire about organization-level standards.
- The test team should be responsible for knowledge transfer of testing processes, methodologies, and test tools.
- Conducting meetings to discuss and analyze the testing process, discuss the life-cycle approach to testing, provide test tool overviews, and conduct training to achieve goals.
- Test teams need to inform project team members about the test approach defined for the project.

Introduction

The test team typically takes responsibility for an assortment of test and quality-related tasks

- Test program orientation might also include test team participation in technical interchange meetings with end-user customers.
 - The test team should attend requirements and design walkthroughs so that it can verify that requirements are testable.
 - The test team may also decide to post test tool and process information on the organization's intranet.
 - The test team needs to work closely with the development group.
 - The test team should also be proactive in soliciting developer involvement in test activities.
- => The test team can be structured in a variety of ways.

Organizational Structure of a Test Team

Organizational Structure of a Test Team

The structure of the test team will vary from organization to organization

- The depth and makeup also depend on the kind of product being tested and the mission of the test team.
- A test manager may have input in designing a test team, but depend upon the organization's culture and its influence on project team composition.
- 44% - software testing is performed by groups compared to 39% - by a single, centralized department.

Organizational Structure of a Test Team

Some organizations hire and assign test engineers in response to the birth and retirement of projects

- Long-term testing capability is not consciously managed.
- Based entirely upon the particular needs of a specific project.
- Once the project goes away, the test engineers who worked on the project may leave, taking with them:
 - Experience, test tools.
 - Lesson learned, process and procedural insights.

=> ***Stovepipe test teams.***

Organizational Structure of a Test Team

Organizations view professional software testing capability as a strategic investment

- Offering career development paths within a centralized software test department.
- Training and development in automated test tools.
- Mentoring opportunities with more senior test engineers, increased job security by having the test engineer rotate between projects.
- Increase professional development opportunities achieved by the diversity of technology and tools experienced over a multitude of projects.

=> **Centralized test teams.**

Organizational Structure of a Test Team

Test team structure may also differ based on the team's mission

- Some organizations view testing as a last-ditch - at the end of the development cycle and classify it as an independent verification and validation (IV&V) effort.
- Other test teams are seen as a nucleus of internal quality, testing, and process engineering.

=> Testing is carried out by ***System methodology and test (SMT) groups.***

Organizational Structure of a Test Team

Stovepipe (Small)	Stovepipe (Large)	Centralized	IV&V	SMT
Test Lead	Test Manager	Test Director	IV&V Manager	SMT Manager
Test Engineers (1-4)	Test Leads (1-2)	Test Manager	IV&V Lead	Process Lead
	Test Engineers (4-8)	Test Leads (3-5)	IV&V Specialists (1-4)	Test Lead
		Test Engineers (10-20)		Test Engineers (1-4)
				Engineers (1-3)

Organizational Structure of a Test Team

Stovepipe Test Team

- A manager responsible for a particular project will likely interview candidates for the test team and make the hiring decision.
- The test plan document for the project may be developed by the project manager prior to the assignment of test engineers.
- Typically includes two to five test engineers:
 - One of the test engineers will act as a test lead.
 - The other will perform test development and execution activities.

=> The test lead develops a test design.

=> Once the project has concluded, no formal mechanism to ensure lessons learned retained, no way to transfer project related stuff.

Organizational Structure of a Test Team

Centralized Test Team

- The software testing professional is very versatile and as an important asset for the organization.
 - Each test engineer may work on one or more projects at a given time.
 - The centralized test organization may need to be headed up by a test director who has the full-time responsibility of maintaining the professionalism and technical expertise of the group.
 - The test director must ensure that test activities are being performed correctly and within schedule on several projects.
- => Retains the services of test professionals with a variety of technical skills and a mix of skill levels.

Organizational Structure of a Test Team

Centralized Test Team

During the start-up phase for a new project, there are some activities:

- Test effort sizing.
- Development of test engineer job descriptions.
- Test engineer interview support.
- Test automation decision support.
- Test tool evaluation and selection support.
- Test tool introduction support.

=> Assign one or more full-time test engineers to the project from the outset.

Organizational Structure of a Test Team

Centralized Test Team

- The centralized test team offers a great deal of flexibility by being able to perform on a variety of projects.
 - For example, a test engineer could be assigned to a new project on a part-time basis to support the review.
 - Motivate a talented software test professional to join the organization.
 - The availability of training, the diversity of technology and tools across projects, information sharing and technology transfer among the test engineers, and increased job security.
- => The team probably maintains a repository of test processes, methodologies, procedures, test tool evaluation results, and test automation code libraries.

Organizational Structure of a Test Team

IV&V Test Team

- This type of team may consist of personnel who are assigned to a separate group within the software development organization.
 - Or a group that exists outside of the software development organization, such as a subcontractor.
 - Verify that standards are being followed, perform quality assurance reviews of software documentation, and carry out other testing tasks.
- => Focuses on system testing and is not concerned with the application's internal processing.

Organizational Structure of a Test Team

IV&V Test Team

- Responsible for the development of a project test plan.
 - Business knowledge combined with technical knowledge is a must for an IV&V group member.
 - Fitting for a company that performs a significant amount of work in a particular business such as financial, logistics management, or space satellite control systems.
 - Prove advantageous for a large commercial software development organization/large financial services software programs.
- => Lessons learned is retained, processes and procedures are maintained in a repository.

Organizational Structure of a Test Team

Systems Methodology and Test Team

- Often responsible for carrying out test program start-up activities for a multitude of applications being simultaneously developed by the organization.
- Viewed as a group of internal consultants within the organization.
- The SMT staff is responsible for:
 - Promoting knowledge transfer of methodologies and standards.
 - Promulgating guidelines for development and testing.
 - Performing evaluations and training on automated testing tools.
 - Introducing test tools on projects.

=> Should include software professionals.

Organizational Structure of a Test Team

Systems Methodology and Test Team

- Team members should work one on one with the various project development team leads to perform the knowledge transfer and other activities.
- Team members are required to have:
 - Understanding of the complete testing life cycle.
 - The software skills necessary to support test design, development, automation, and execution activities.

Organizational Structure of a Test Team

Systems Methodology and Test Team

- SMT personnel are heavily involved in project start-up activities as well as test planning and design activities, but take lesser roles during test development and execution.
- Once a project's test development starts, SMT activities will be:
 - researching new test methodologies and tools.
 - attending test tool conferences.
 - maintaining the organization's software, "lessons learned", and repository of test tool evaluation results and test automation code libraries.

Organizational Structure of a Test Team

Test Team Summary

Test Team	Advantages	Disadvantages
Stovepipe Test Team	Complete control over the test effort is retained within the project organization.	The test start-up effort is inefficient.
	Consultants can be applied on a short-term basis to provide support.	There is a limited depth of test skill resources on team.
		The test effort is often not initiated early in development life cycle.
		No formal way exists for the organization to improve upon the test process.
		The organization has a limited ability to transfer process and test tool expertise.

Organizational Structure of a Test Team

Test Team Summary

Centralized Test Team	An individual within the organization is identified to maintain the expertise of the test team.	Increased management oversight is required to rotate test engineers between projects.
	A roster of test professionals is maintained who have a variety of software/test skills.	The organization has an increased cost to retain test engineers on staff between projects.
	A centralized team can often supply personnel to a project on a part-time basis.	
	Test professionals can be applied to the project to support project start-up.	

Organizational Structure of a Test Team

	Senior test engineers can mentor junior test engineers.	
	Test engineers enjoy exposure to a diversity of technology and tools across projects.	
	Information sharing and technology transfer among test engineers are facilitated.	
	Increased long-term job security is available.	
	A repository of test processes, test tool evaluation results, and test automation code libraries is maintained.	
	Less turnover and improved retention of test engineers occur.	
IV&V Team	A depth in niche IV&V skills is developed for the organization.	The test engineer career path can become narrowly focused on IV&V expertise.
	Consultants can be applied on a short-term basis to provide support.	The test engineer's software skills can become outdated.

Organizational Structure of a Test Team

SMT Group	<p>SMT staff become proficient in the latest processes, tools, and techniques.</p> <p>Broad experience across a number of different projects strengthens the test engineer's skills and capability.</p> <p>A repository of test processes, test tool evaluation results, and test automation code libraries is maintained.</p>	<p>Maintaining SMT staff is more costly to the organization than pursuing a simple stovepipe test team organization.</p>
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Organizational Structure of a Test Team

Improved test effort ramp-up on new projects is possible due to training and assistance by SMT staff.

Information sharing and technology transfer among test engineers are facilitated.

The SMT group provides continuous consulting to all project teams within the organization.

Less personnel turnover and improved retention of personnel occur.

Maintaining SMT staff is less costly than the centralized team approach.

Organizational Structure of a Test Team

Top 10 ingredients for a successful test group

1. **Business knowledge.** Test engineers need to have business knowledge and work closely with the users and customers of the system.
2. **Technical knowledge.** Applications are more complex and, to understand the technical intricacies of the application, both automated test tools and a technical background are required.
3. **Task separation.** Business tasks are kept separate from technical tasks.
4. **Resource management.** Business and technical resources can be combined.

Organizational Structure of a Test Team

Top 10 ingredients for a successful test group

5. **Relationship with development team.** Test engineers work hand in hand with the developers.
6. **Early life-cycle involvement.** The test team becomes involved from the beginning of the development life cycle.
7. **Defined test methodology.** Methods, standards, and processes need to be in place, implemented, or modified as necessary.

Organizational Structure of a Test Team

Top 10 ingredients for a successful test group

8. **Flexibility/adaptability.** Each application is different. A testing strategy that has proven itself successful on one project might fail on another.
9. **Metrics.** The team can learn which metrics to collect and then use these metrics to improve the testing process. Metrics are collected throughout the development life cycle.
10. **Process improvement.** The team can strive for continuous improvement of the defined test methodology.

Test Program Tasks

Test Program Tasks

Test Program Work Breakdown Structure

No.	Work Breakdown Structure (WBS) Element
1	Project Start-Up
1.1	Process improvement. Review lessons learned and suggested improvement activities from previous similar projects. Decide which improvement activities to implement.
1.2	Process. Gather understanding of automated test life-cycle methodology (ATLM).
1.3	Scope. Outline preliminary test goals and objectives.
1.4	Sizing. Test effort sizing.
1.5	Team composition. Test team composition analysis and test engineer job description development.
1.6	Recruiting. Development of test engineer recruiting advertisements and conduct of interviews.

1 Project Start-Up

- 1.1 Process improvement. Review lessons learned and suggested improvement activities from previous similar projects. Decide which improvement activities to implement.
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 - 1.3 Scope. Outline preliminary test goals and objectives.
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Test Program Tasks

Test Program Work Breakdown Structure

2 Early Project Support

- 2.1 Goals/objectives. Further define test goals and objectives and review goals/objectives with project management, development group, and test engineers to develop understanding and acceptance of test goals and objectives.
 - 2.2 Constraint examination. Review project constraints such as short time to market and limited resources.
 - 2.3 Testability review. Assure that testability is designed into the application.
 - 2.4 Requirements review. Ensure that requirements are specified in testable terms.
 - 2.5 Review of standards. Identify and become acquainted with applicable standards. Decide whether standards need to be adjusted based on lessons learned. Define missing standards.

 - 2.6 Test process analysis. Analyze organization's current test process.
 - 2.7 Customer involvement. Assure customer involvement from beginning to end of testing life cycle.
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Test Program Tasks

Test Program Work Breakdown Structure

3 Decision to Automate Test

- 3.1 Test objectives/strategies. Refine definition of test objectives for the project and develop test strategies.
 - 3.2 Test tool value. Outline the expected value/benefits derived from incorporating an automated test tool.
 - 3.3 Test tool proposal. Develop a test tool proposal to acquire management support.
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4 Test Tool Selection and Evaluation

- 4.1 Systems engineering environment. Review organization's systems engineering environment.
- 4.2 Test tools available. Review types of test tools available.
- 4.3 Test tool candidates. Research, evaluate, and score test tool candidates.
- 4.4 Define evaluation domain.
- 4.5 Conduct hands-on tool evaluation.
- 4.6 Test tool evaluation report. Report and document tool selection and the results of evaluations.
- 4.7 Test tool purchase. Develop purchase order in coordination with the purchasing department.

Test Program Tasks

5 Test Tool Introduction

- 5.1 Test process. Implement (or modify existing) testing process, methodologies, and “life-cycle” approach to testing to allow for the introduction of automated testing tools. Assure that test effort is scheduled to perform in parallel with development effort. Maintain test tool introduction process (see ATLM).
- 5.2 Defect removal activities. Attend inspections and walkthroughs and conduct other defect removal activities.
- 5.3 Test tool expertise. Have test engineers participate in formal test tool training, review test tool tutorials, and practice with test tool. Hire tool experts, if deemed necessary.
- 5.4 Test tool validation. Validate new test tool releases to ensure that the tool performs according to specification and that the tool works in a particular operating environment.
- 5.5 Test consultation. Test engineer supports a test support hotline, answering questions within the organization pertaining to the test process and tools. Document all tool issues and solutions for future reference. Provide mentoring and coaching on automated software test discipline.
- 5.6 Test tool orientations. Test engineer provides presentations and demonstrations to orient project personnel on the use and application of test tools.
- 5.7 Relationship building. Develop a working relationship with development group and facilitate communications among project team members.

Test Program Tasks

- 5.8 Network environment setup. Consult on the setup of an automated test tool repository on the local area network. Request additional network storage space where necessary.
 - 5.9 Defect management process. Establish a process (workflow) for defect reporting and resolution for a project. Outline applicable standards and formats.
 - 5.10 Defect management training. Provide training on the process for defect reporting and resolution.
 - 5.11 Test tool reporting. Determine the types of automated test reports that are applicable for a project.
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6 Test Planning

- 6.1 Test requirements. Document the application-under-test test requirements, as derived from the system requirements.
- 6.2 Examination of constraints. Identify and outline constraints such as short time to market and limited engineering resources.
- 6.3 Test goals/objectives. Document goals and objectives for test (such as scalability and regression) within the test plan. Include goals pertaining to end-user involvement in the test process.
- 6.4 Test strategy. Document the test strategies and the types of test tools that apply on the project.

Test Program Tasks

- 6.5 Test program activities. Develop a test strategy that incorporates test activities early within the development life cycle.
- 6.6 Deliverables. Identify the product deliverables on the project that will be reviewed or tested by test personnel.
- 6.7 Critical success functions. Work with the project team and business users to identify critical success functions and document them within the test plan.
- 6.8 Test program parameters. Define test program parameters such as assumptions, prerequisite activities, system acceptance criteria, and test program risks, and document them within the test plan.
- 6.9 Level of quality. Work with the project team and business users to determine the level of quality for the project and document it within the test plan.
- 6.10 Test process. Document the test process within the test plan, including considerations related to the test tool introduction process and the defect management process.
- 6.11 Test training. Document test training requirements and plans within the test plan.
- 6.12 Decision to automate test. Document the assessment outlining the benefit of using an automated test tool on the project and the ability to incorporate an automated test tool given the project schedule.

Test Program Tasks

- 6.13 Technical environment. Document the technical environment in which the application-under-test will be developed and eventually operate. Identify potential application design or technical automated testing tool issues that may need to be resolved.
 - 6.14 Test tool compatibility check. Document the results of the test tool compatibility check. Where an incompatibility problem occurs, document work-around solutions and alternative test methods.
 - 6.15 Quality gates. Plan for the incorporation of quality gates and checks.
 - 6.16 Risk assessments. Perform risk assessments in support of project management reviews and reporting requirements.
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- 6.17 Test readiness reviews. Perform planning and analysis activities necessary for supporting test readiness reviews. Develop presentation slides and perform presentations where required.

Test Program Tasks

- 6.18 Test plan document. Assemble and package the test planning documentation into a test plan. Incorporate changes to the test plan as a result of test plan reviews by project management and end-user customers. Maintain the test plan document throughout the test life cycle.
- 6.19 Test data. Document test data requirements and plans for developing and maintaining a test data repository.
- 6.20 Test environment. Identify requirements for a test laboratory or test environment and identify personnel responsible for setting up and maintaining this environment.
- 6.21 Reporting requirements. Define reporting requirements and document them within the test plan.
- 6.22 Roles and responsibilities. Define and document team members' roles and responsibilities for the test effort.
- 6.23 Test tool system administration. Define all tools used during the testing life cycle. Outline the requirements for setting up and maintaining the automated test tools and environment and identify personnel responsible for setting up and maintaining the test tools. Administrative tasks include the setup of tool users and various privilege groups.

Test Program Tasks

7 Test Design

- 7.1 Prototype automated environment. Prepare and establish a test laboratory environment to support test design and development.
 - 7.2 Techniques and tools. Identify test techniques/strategies and automated tools to be applied to the project application and its interfaces.
 - 7.3 Design standards. Prepare and establish test procedure design standards.
 - 7.4 Test procedure/script design. Develop a list and hierarchy of test procedures and test scripts. Identify which procedures and scripts are to be performed manually and which are supported by an automated test tool. Decide on and define other test verification methods (such as analysis and demonstration).
 - 7.5 Test procedure/script assignments. Assign test team personnel to the various test procedures and scripts.
 - 7.6 Inputs/outputs. Develop test procedure/script design inputs and expected outputs.
 - 7.7 Test automation script library. Identify test automation scripts contained with the organization's script library that can be applied to the project.
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Test Program Tasks

8 Test Development

- 8.1 Best practices/standards. Develop/tailor best practices and standards for testing of the project.
- 8.2 Test procedure development standards. Implement test procedure development standards (for example, provide comments on each automated testing tool scripting step, fill in test procedure header file information, enforce modularity, and so on).
- 8.3 Script execution standards. Implement test procedure execution standards (for example, a consistent environment, test database backup, and rollback).
- 8.4 Test setup. Implement test procedure scripts during various testing phases (for example, during the regression test phase or performance test phase).

Test Program Tasks

- 8.5 Test procedure pseudocode. Prepare step-by-step pseudocode for the test procedures.
Consider including test procedure pseudocode as an appendix to the test plan.
- 8.6 Work-around solutions. Develop work-around solutions for tool/application-under-test incompatibility problems.
- 8.7 Develop test procedures/scripts for various testing phases and testing subtypes.
 - 8.7.1 Unit test phase test procedures/scripts. Witness execution of unit test procedures and scripts.
 - 8.7.2 Integration test phase test procedures/scripts. Witness execution of integration test procedures and scripts.
 - 8.7.3 System test phase test procedures/scripts. Develop test procedures and automate scripts that support all phases of the system test cycle (that is, regression, performance, stress, backup, and recoverability).
 - 8.7.3.1 Develop a test procedure execution schedule.
 - 8.7.3.2 Conduct automated test reuse analysis.
 - 8.7.3.3 Conduct analysis to determine which tests to automate.
 - 8.7.3.4 Develop a modularity relationship matrix.
 - 8.7.4 Acceptance test phase test procedures/scripts. Develop and maintain test procedures and scripts.

Test Program Tasks

- 8.8 Database group coordination. Work together with database group to develop test database environment. Baseline and maintain test data to support test execution.
 - 8.9 Test procedure peer reviews. Compare test procedures with design and development standards (comments for each test tool scripting step, header file information, modularity, and so on). Document and manage defects and action items to closure.
 - 8.10 Reuse library. Develop and maintain a test procedure reuse library for the project.
 - 8.11 Test utilities. Support the creation/modification of in-house test support utilities that improve test effort efficiency.
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Test Program Tasks

9 Test Execution

- 9.1 Environment setup. Develop environment setup scripts.
 - 9.2 Testbed environment. Develop testbed scripts and perform testbed development logistics.
 - 9.3 Test phase execution. Execute the various test phases—strategic execution of automated testing. Monitor software defects to closure.
 - 9.4 Test reporting. Prepare test reports.
 - 9.5 Issue resolution. Resolve daily issues regarding automated test tool problems. If necessary, contact the test tool vendor for support.
 - 9.6 Test repository maintenance. Perform test tool database backup/repair and troubleshooting activities.
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Test Program Tasks

- 10.5 Defect management. Define defect tracking workflow. Perform defect tracking and reporting. Attend defect review meetings.
 - 10.6 Metrics collection and analysis. Collect and review all metrics to determine whether changes in the process are required and to determine whether the product is ready to be shipped.
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11 Test Process Improvement

- 11.1 Training materials. Develop and maintain test process and test tool training materials.
- 11.2 Test process assets. Maintain a repository of test process assets, such as standards, processes, and procedures, test tool proposals, tool evaluation reports, historical test

Test Program Tasks

- effort sizing records, test effort lessons learned database, test automation script library, and test effort metrics and analysis reports.
- 11.3 Lessons learned. Conduct “lessons learned” sessions throughout the testing life cycle and gather test life-cycle benefits information.
- 11.4 Metrics analysis and reporting. Perform analysis of test process metrics across the organization and report the results of this analysis.
- 11.5 Test team intranet. Develop/maintain a test team intranet Web site to communicate with the rest of the organization.
- 11.6 Customer support surveys. Conduct surveys for projects supported by the test team to identify ways to improve test process and test team support.
- 11.7 Continuous process improvement. Refine test process assets based upon lessons learned, survey feedback, metrics analysis, and experience with new test tools. Verify that improvement suggestions are implemented.
- 11.8 Test conferences and professional associations. Participate in test tool user groups, test conferences, and meetings of other professional associates that promote information sharing and professional networking.

Test Effort Sizing

Test Effort Sizing

Level 1 Test Maturity

- Testing is often limited to debugging.
- A programmer writes and debugs the product's software until everything appears to work correctly.
- Test costs often remain hidden within the cost of development.
- The potential benefits of better test practices are hidden in field-support and product upgrade costs.
- Historical costs pertaining to level 1 testing may be difficult to ascertain.

Test Effort Sizing

Level 2 Test Maturity

- Testing is recognized as a separate function.
- Test plans and scripts are generally developed by experienced product users or support personnel (may not have test automation experience)
- The test team may consist of a group of more junior.
- The test effort may also include the services of one or more high-level support people (writing, supervise the test engineers, and edit the results).
- Test scripts are reused => providing a huge labor saving with regard to script development and execution.

Test Effort Sizing

Levels 3–5 Test Maturity

- The test engineer should participate in product development meeting to build testability into the product.
- Background and familiarity with the product address the weakest aspects of the product.
- If the test tool has white-box test capabilities => specify automated parts.
- At least one experienced member to develop a structured set of programming instructions.

=> significant labor savings with regard to test execution and management.

Test Effort Sizing

Test Team Sizing Methods: An Overview

- Historically, software development programs have focused on estimating the required development effort and overall project effort.
- Efforts related to product quality assurance, such as software testing, have then been sized in relation to the amount of anticipated development effort or overall project effort.
- Some commercial tools:
 - COCOMO, PriceS, and SLIM

=> Quality depends on input data and a number of variables.

Test Effort Sizing

Development Ratio Method

- Determine how many test engineers are needed based upon the number of software developers assigned to the project.
- The size of the test team is calculated by designating a desired ratio of developers on a project to test engineers.
- “Developers” include who performs the design, development, compilation and unit-level testing.
 - NOT who work on functional analysis, requirements management, configuration management, quality assurance, process improvement, project management, software test, training material development, and user manual documentation.

Test Effort Sizing

Development Ratio Method

Development Type	Developers		Test Team Size
	Planned	Ratio	
Commercial Product (Large Market)	30	3:2	20
Commercial Product (Small Market)	30	3:1	10
Application Development for Individual Client	30	6:1	5
Development and Heavy COTS Integration for Individual Client	30	4:1	7
Government (Internal) Application Development	30	5:1	6
Corporate (Internal) Application Development	30	4:1	7

Development Ratio Method

Test Effort Sizing

Percentage Method

“Process improvement” means that personnel supervise the effort to tailor organization processes to the specific project, provide project personnel with requisite training, and collect and analyze project performance metrics.

Development Type	Project Staffing Level	Test Team Size Factor	Test Team Size (People)	Product Assurance Team Size Factor	Product Assurance Team Size
Commercial Product (Large Market)	50	27%	13	37%	18
Commercial Product (Small Market)	50	16%	8	28%	14
Application Development for Individual Client	50	10%	5	20%	10
Development and Heavy COTS Integration for Individual Client	50	14%	7	23%	11
Government (Internal) Application Development	50	11%	5	20%	10
Corporate (Internal) Application Development	50	14%	7	23%	11

Test Effort Sizing

Test Procedure Method

- Using the number of test procedures planned for a project to estimate the level of effort required.
- Need to develop a historical record of
 - Development projects.
 - Development sizing values.
 - Number of test procedures required.
 - The resulting test effort measured in terms of man-hours.
- Lines of code (LOC), lines of code equivalent, function points, or number of objects produced need to be documented.
=> Can determine the past relationship of the sizing values vs the number of test procedures vs the number of team man-hours
=> Reflect culture and test maturity

Test Effort Sizing

Test Procedure Method

	Number of Test Procedures	Factor	Man- Hours	Per- formance Period	Test Team Size (People)
Historical Record (Similar Project)	860	6.16	5,300	9 months (1,560 hours)	3.4
New Project Estimate	1,120	6.16	6,900	12 months (2,080 hours)	3.3

Example of the use of the test procedure

Test Effort Sizing

Task Planning Method

- Involves the review of historical records about the number of man-hours expended to perform test program tasks for a similar type of test effort.
- Need to perform time recording in accordance with a work breakdown structure.
- Highlight the effort required to perform the various tasks.
- Compare the estimated number of test procedures for the new project with the historical sizing baseline.

Test Effort Sizing

Task Planning Method

	Number of Test Procedures	Factor	Man-Hours
Historical record (similar project)	860	6.16	5,300
New project estimate	1,120	6.16	6,900

New project man-hours estimation

Test Effort Sizing

Task Planning Method

No.	WBS Element	His-torical Value	Per-cent-age	Pre-liminary Estimate	Adjusted Estimate
1	Project startup	140	2.6	179	179
2	Early project support	120	2.2	152	152
3	Decision to automate test	90	1.7	117	—
4	Test tool selection and evaluation	160	3	207	—
5	Test tool introduction	260	5	345	345
6	Test planning	530	10	690	690
7	Test design	540	10	690	690
8	Test development	1,980	37	2,553	2,553
9	Test execution	870	17	1,173	1,173
10	Test management and support	470	9	621	621
11	Test process improvement	140	2.5	173	—
Project Total		5,300	100%	6,900	6,403

Test Effort Sizing

Task Planning Method

	Number of Test Procedures	Man- Hour Estimate	Adjusted Estimate	Per- formance Period	Test Team Size
New Project Estimate	1,120	5.71	6,403	12 months (2,080 hours)	3.1

Test team size

Test Effort Sizing

Test Effort Sizing Factors

1. **Organization.** This factor includes the culture or test maturity of the organization.
2. **Scope of test requirements.** Different types of test to be done.
3. **Test engineer skill level.** This factor encompasses the technical skill levels of the individuals performing the testing.
4. **Test tool proficiency.** Experienced or inexperienced.
5. **Business knowledge.** Test team personnel must have familiarity with the application business area.

Test Effort Sizing

Test Effort Sizing Factors

6. **Test team organization.** This factor includes the type of test team organization supporting the test effort.
7. **Scope of test program.** Goal planning, test requirements definition, analysis, design, and coding.
8. **Start of test effort.** Test activity and test planning should be initiated early in the project such as requirements, design etc.
9. **Number of incremental software builds planned.** Savings are realized in subsequent builds of a software application.

Test Effort Sizing

Test Effort Sizing Factors

10. **Process definition.** Test team utilization of defined (documented) processes can improve the efficiency of test engineering operations.
11. **Mission-critical applications.** The scope and breadth of testing for mission-critical software applications will be greater than that for software applications that do not pose a high risk.
12. **Test development/execution schedule.** Short timeframes to perform test development and execution may interject inefficiency into test engineering operations and require that additional test engineering effort be applied.

Test Engineer Recruiting

Test Engineer Recruiting

The manager likely has several questions in mind:

- What kind of person makes a good test engineer?
- What kind of skills should the test engineer have?
- How do I know which test engineer candidates are the best for the job?

Good software developers => make things work with work-around.

Test engineers => make things fail vs work-around.

=> analytical, attentive to detail, and organized, and, given the complexities of automated testing, possess a creative and planning-ahead mindset.

=> Need a broad range of technical skills and experience.

=> Be familiar with the script programming language.

Test Engineer Recruiting

Test Engineer Qualities

- Be comfortable with performing a variety of different tasks, often in parallel.
- Be able to pick up new technology quickly.
- Have good conceptual skills to be able to understand the technical intricacies of the application.
- Be familiar with development techniques, network, database, middleware.

=> The skills required by the test team will depend on the kinds of tests performed and the test tools applied.

Test Engineer Recruiting

Test Engineer Qualities

1. **Adaptability** - able to perform in a variety of different technical environments, and familiar with different processes, tools, and methodologies.
2. **Quick learner** - enjoy performing a variety of different kinds of tasks, learning new things, and touching many different products.
3. **Conceptual skills** - aptitude for conceptualizing complex activities and articulating thoughts and ideas.
4. **Organizational skills** - understand complex test requirements and be able to formulate test planning and design approaches to support requirements; able to perform multiple responsibilities concurrently.

Test Engineer Recruiting

Test Engineer Qualities

5. **Problem solving** - be able to develop work-around solutions to problems encountered during test development and execution.
6. **Creativity** - mindset to be able to think of a multitude of ways to exercise a system or application to ensure that it works in all circumstances; able to identify all conditions under which the software or system could fail.
7. **Analytical/programming skills** - training, experience, and skill to be able to develop automated test scripts.
8. **Application business area knowledge** - familiarity or understanding of the required functionality of the business application.

Test Engineer Recruiting

Test Engineer Qualities

9. **Diplomatic/cooperative** - able to work closely and effectively with software developers; includes strong verbal communication skills.
10. **Software professional** - proficient at exercising the system and skillful in identifying and communicating problems to the developer.
11. **Technical expertise** - ability to setup, develop, maintain etc
12. **Test experience** - level of test program experience.
13. **Detail-oriented** - pays attention to detail.
14. **Process-oriented** - skilled in the ability to understand inputs, logical sequences of steps, and expected output.
15. **Writing/grammar skills** - ability to improve specification and documentation.

Test Engineer Recruiting

Test Team Composition

Position	Duties/Skills	Test Experience (years)	SQA Tool (years)
Test manager	Duties: Responsible for test program, customer interaction, recruiting, test tool introduction, staff supervision, test planning/design/development and execution Skills: MS Project, C/C++, SQL, MS Access, UNIX, test tool experience	6+	1+
Test lead	Duties: Supports customer interaction, recruiting, test tool introduction, staff supervision, cost/progress status reporting, test planning/design/development and execution Skills: QA Partner, Purify, SQL, SQA Basic, UNIX, MS Access, C/C++, SQL Server	4+	2+

Test Engineer Recruiting

Test Team Composition

Test engineer	Duties: Responsible for performing test planning/design/development and execution Skills: Test tool experience, health care system experience	2+	Some
Test engineer	Duties: Responsible for performing test planning/design/development and execution Skills: Test tool experience, health care system experience	2+	Some
Test engineer	Duties: Responsible for creating and controlling test tool environment, network and middleware testing, and performing test planning/design/development and execution Skills: Visual Basic, SQL, CNE, UNIX, C/C++, SQL Server	1+	—
Junior test engineer	Duties: Responsible for performing test planning/design/development and execution Skills: Visual Basic, SQL, UNIX, Java, CGI/Perl, HTML, MS Access	—	—

Test Engineer Recruiting

Job Requisition

Armed with an understanding of the desired qualifications for a test engineer candidate as well as a mental framework for the composition of the test team, the test manager can initiate the recruiting process.

Samples of SQA test engineer job description.

Test Engineer Recruiting

Locating Test Engineers

The individual responsible for screening and hiring test engineers must know how to locate job candidates.

- Résumés for test engineers can be solicited or located via several means.
 - (1) Review the organization's recruiting or résumé repository.
 - (2) Solicit résumés in a job advertisement in a newspaper or magazine.
 - (3) Query Internet résumé sources or to advertise open positions with test tool user groups or test-related newsgroups.

=> Referral programs, special promotions etc.

=> The manager must then screen the candidates in person.

Test Engineer Recruiting

Test Engineer Interviews

- The hiring managers should develop a list of relevant questions.
- Distribute to all staff members participating in the interview process.
- The individuals conducting an interview should document or summarize the responses to each question.
- The interviewer should also jot down notes pertaining to observations about the candidate.

Test Engineer Recruiting

Test Engineer Interviews

Some questions:

1. Start the interview off with an open-ended question.

Example: “Could you summarize your test background and interest in the test profession?”

2. Problem-solving ability.

Example: “Could you describe how you’ve overcome technical problems and the kinds of results that you have had?”

3. Familiar with the test life cycle.

Example: “Could you outline your perspective of the test engineering life cycle?”

Test Engineer Recruiting

Test Engineer Interviews

Specific topics to consider when interviewing a test engineer are:

1. Analyzing system requirements for testability.
2. Understanding the testing life cycle.
3. Deriving test requirements and test strategies.
4. Using an automated testing tool.
5. Evaluating an automated test tool.
6. Modifying automated test scripts.
7. Verifying automated test tool compatibility with the application-under-test.
8. Finding work-around solutions to test tool incompatibility problems.
9. Planning for test tool introduction on a project.

Test Engineer Recruiting

Test Engineer Interviews

10. Planning test activities.
11. Planning, tracking, and managing test environment setup activities.
12. Understanding the importance of baselining the testbed and test environment.
13. Identifying the kinds of tests to be performed.
14. Developing a test design.
15. Developing test data and refreshing the test database during test execution.
16. Performing data validation tests.
17. Inserting comments when recording scripts with an automated test tool.
18. Performing test readiness reviews.
19. Being able to break the system or make the application fail, and identifying and communicating the problem to the developer.

Test Engineer Recruiting

Test Engineer Interviews

20. Documenting, tracking, and obtaining closure on trouble reports.
21. Fostering a close working relationship between developers and test engineers.
22. Performing test activities within the technical environment planned for the project.
23. Demonstrating the technical skills required for the position as reflected in the published job requisition.
24. Performing a variety of different kinds of tasks, learning new technologies, and performing multiple responsibilities concurrently.
25. Understanding the required functionality of the business application.

Test Engineer Recruiting

Test Engineer Interviews

26. Working closely and effectively with software developers and users.
27. Understanding that users need to be involved from the beginning of and throughout the system development life cycle.
28. Understanding common network, database, and middleware issues.
29. Being familiar with the project-specific operating system, database, network, and development language.
30. Understanding metrics collection and metrics analysis.

Test Engineer Recruiting

Distinguishing the Best Candidate

1. Assess how the candidate asked questions and took the initiative during the interview.
2. Determine whether the candidate listened well and showed interest in the position and the company.
3. Listen for comments and responses that indicate that the candidate is a team-oriented person.
4. Listen for comments and responses that indicate that the candidate is a hard worker and committed to doing an excellent job.

Test Engineer Recruiting

Distinguishing the Best Candidate

5. Assess for how well the candidate is able to make important distinctions and share important insights with regard to an effective test process, design, and execution.
6. Assess how well the candidate answers questions. Are the answers brief and to the point, or do they go off on tangents, becoming incoherent or disorganized?
7. Inquire about how well the candidate performs programming.
8. Note whether the candidate speaks with respect about the testing profession.
9. Note whether the candidate speaks with respect about a previous boss, others

Test Engineer Recruiting

Distinguishing the Best Candidate

10. Don't hire a test engineer who didn't make it as a developer.

Remember, a bad developer does not make a good test engineer.

11. Consider how well the test engineer's personality fits with the rest of the test team. If the project includes too many leaders, disagreements may arise regarding which direction to take, and the test team may lack enough technician strength to persevere through tough challenges.

Test Engineer Recruiting

Roles and responsibilities

Responsibilities	Skills
<p>Test Manager</p> <ul style="list-style-type: none">• Responsible for customer and test tool vendor interaction, recruiting, test tool introduction, staff supervision, and staff training• Test plan development, including development of test goals, objectives, and strategy• Cohesive integration of test and development activities• Acquisition of hardware and software• Test environment and test product configuration management• Test process definition, training, and continual improvement• Test program oversight and progress tracking• Use of metrics to support continuous test process improvement	<ul style="list-style-type: none">• Familiar with test program concerns, including test data management, trouble reporting and resolution, test design, and development• Understands application business area and application requirements• Skilled at developing test goals, objectives, and test strategy• Familiar with different test tools and their use• Good at all planning aspects, including personnel management, facilities, and schedule

Test Engineer Recruiting

Roles and responsibilities

Test Lead

- Technical leadership for the test program, including the test approach
- Customer interaction, recruiting, test tool introduction, test planning, staff supervision, and cost/progress status reporting
- Test requirement definition, test design, test script and test data development, test automation, test environment configuration, test script configuration management, and test execution
- Interaction with test tool vendor to identify best ways to leverage test tool on project
- Staying current on latest test approaches and test tools and transfers this knowledge to test team
- Test procedure walkthroughs
- Implementation of test process improvements resulting from lessons learned and benefits surveys
- Testing of traceability matrix
- Test process implementation
- Review of test product documentation
- Understands application business area and application requirements
- Familiar with test program concerns such as test data management, trouble reporting and resolution, test design, and development
- Expertise in a variety of technical skills, including programming languages, database technologies, and computer operating systems
- Familiar with different test tools and their use

Test Engineer Recruiting

Roles and responsibilities

Usability Test Engineer

- Design and development of usability testing scenarios, administration of testing process
- Definition of criteria for those performing usability testing, analysis of results of testing sessions, presentation of results to development team
- Development of test product documentation and reports
- Definition of usability requirements and interaction with customer to refine usability requirements
- Test procedure walkthroughs
- Proficient in designing test suites
- Skilled in test facilitation
- Excellent interpersonal skills
- Proficient in GUI design standards

Test Engineer Recruiting

Roles and responsibilities

Manual Test Engineer

- Development of test procedures and cases based upon requirements
- Manual execution of the test procedures
- Test procedure walkthroughs
- Conduct of tests and preparation of reports on test progress and regression
- Adherence to test standards
- Good understanding of GUI design—usability errors are often uncovered during QA testing
- Proficient in software testing
- Proficient in designing test suites
- Proficient in the business area of the application-under-test
- Proficient in GUI design standards

Automated Test Engineer

- Development of test procedures and cases based upon requirements
- Design, development, and execution of reusable and maintainable automated scripts
- Adherence to test design standards
- Test procedure walkthroughs
- Execution of tests and preparation of reports on test progress and regression
- Attendance at test tool user group meetings to stay abreast of test tool capabilities
- Good understanding of GUI design—usability errors are often uncovered during QA testing
- Proficient in software testing
- Proficient in designing test suites
- Proficient in the test tool
- Programming skills
- Proficient in GUI design standards

Test Engineer Recruiting

Roles and responsibilities

Network Test Engineer

- Network, database, and middleware testing
- Research on network, database, and middleware performance monitoring tools
- Implementation of performance monitoring tools on an ongoing basis
- Network, database, and system administration skills
- Expertise in a variety of technical skills, including programming languages, database technologies, and computer operating systems
- Product evaluation and integration skills

Test Environment Specialist

- Installation of test tools and establishment of test tool environments
- Creation and control of the test environment via environment setup scripts
- Maintenance of a test database
- Maintenance of a requirements hierarchy within the test tool environment
- Network, database, and system administration skills
- Expertise in a variety of technical skills, including programming languages, database technologies, and computer operating systems
- Test tool experience
- Product evaluation and integration skills

Test Engineer Recruiting

Roles and responsibilities

Test Library and Configuration Specialist

- Test script change management
- Test script version control
- Maintenance of a test script reuse library
- Network, database, and system administration skills
- Expertise in a variety of technical skills, including programming languages, database technologies, and computer operating systems
- Configuration management tool expertise
- Test tool experience

Test Engineer Recruiting

Roles and responsibilities

Business Analyst

- Analysis of business relative to the application's goals
- User interviews and review of current business
- Definition of processes to gather requirements and determination of the need for reengineering
- Creation of requirements specifications
- Coordination with the usability test engineers
- Experience in the business area
- Interviewing skills
- "People" skills
- Proficient in user and task analysis
- Understands the GUI usability process

Chief User Liaison

- Primary user representative
- Communication of business and user requirements to the development team
- Excellent interpersonal skills
- Expertise in the business area

Chapter summary (1)

- ★ The test team needs to possess the specific expertise necessary to comprehend the scope and depth of the required test effort and be able to develop a strategy to execute and implement the test program. Test team composition needs to be designed, the test team assembled, and the roles and responsibilities of the test team defined.
- ★ Several organizational structures are possible for the test team. Potential approaches include stovepipe test team, centralized test team, IV&V test team, and systems methodology and test team organizations.

Chapter summary (2)

- ★ The most important consequence of test team organization pertains to the opportunities for continual improvement in process maturity and software test capability. Test team structures that persist after a project ends can readily retain and improve upon the organization's processes, procedures, and tool knowledge, as well as transfer this knowledge to new projects.
- ★ The different types of test tasks involved in a test program are commonly outlined within a work breakdown structure. This structure is then used in conjunction with timekeeping activities to develop a historical record of the effort expended to perform various test activities.

Chapter summary (3)

- ★ Several methods are commonly employed to determine the size of the test team required to support a test effort. Size estimation approaches include the development ratio, percentage, test procedure, and task planning methods.
- ★ A test engineer needs to possess the ability to discover defects. He needs a developer's mentality to develop work-around solutions to incompatibility problems that may arise when using an automated test tool. Analytical, attentive to detail, and organized and, given the complexities of automated testing, has a creative and planning ahead mindset.

Chapter summary (4)

- ★ Given the complexities of the test effort associated with a client-server or multitier environment, test engineers need a broad range of technical skills. They should possess experience across multiple platforms, operating systems, layers of supporting applications, interfaces to other products and systems, databases, and application/scripting languages.
- ★ To recruit test engineers for a test program, the hiring manager should understand the target composition of the test team. The effective execution of a test program requires that a test team have enough resident expertise to leverage the adopted test process and the applied test tools.

Chapter summary (5)

- ★ In preparation of test engineer interviews, the hiring manager should develop a list of questions intended to confirm that the candidate has the appropriate expertise at the level of proficiency required. All individuals involved in the interview process should document or summarize each candidate's responses to each question.
- ★ The major roles and responsibilities of individuals who perform test activities on a project need to be defined and documented within the project test plan.

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