

Applied Quality management in software testing
(Test Inventory Model)

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Abstract

The effectiveness and efficiency of the test process can be clearly improved by using quality management principles. Building high quality products, better ROI, cost optimization, improved processes, satisfied stakeholders and many more are the demand of time now. Quality management concepts and principles are no more restricted to manufacturing industry they are now into software industry where lead time, line efficiency, reordering point is viewed as defect finding time, test-ware efficiency, and coverage point.

Analytical quality management is the central importance to achieving high quality test planning and execution. This paper illustrates the model focusing on broader use of Quality management and inventory management for better and systematic test management. The main objective of this approach is to see how software testing as discipline conveys more confidence to the product/process using applied quality management principles and concepts.

This paper concludes with software test inventory model illustrating quality management concepts usage to contribute towards software testing as well as to the reduction of development costs in many ways like

- Test Item Lists
- Test inventory Systems
- Test Ware maintenance.
- Test production teams.

1. Introduction

With growing global competition, Quality Management is becoming increasingly important to the leadership and management of all organizations. QM concepts evolved from manufacturing industry but the application is not specific to manufacturing products it can be apply in software testing industry as a whole. Success is what matters, and success depends on how effectively we learn and act on these principles. The underline objective of QA and software testing is to ensure successful test effort, which not only means finding bugs but also ensure several other tasks like verify fixes, write bug reports, track status and above all ensure meeting schedule and budget.

The test inventory model is based on the test inventory concepts given by Marnie L. Hutcheson in adherence to quality management principles and inventory management techniques. The prime objective of this approach is to establish sound software testing organization to ensure adequate and successful test effort. It also conveys the future roadmap and integration with other disciplines like development and project management.

2. Test Inventory Model

In most of the projects, in context of software testing there are certain questions that need to be addressed like "What are we going to test?", "What did we test?", and perhaps more importantly, "How big is it?". Once testing begins, in addition to producing results reports, testers need to be able to calculate, at any time, how much time is required to complete the planned testing and bug-fix integration activities so they can communicate the impact of events on the schedule and adjust planned activities to control the situation. They need to get the job done in a systematic and reproducible way. The test inventory model is one such initiative that combines the application of quality management and inventory management techniques.

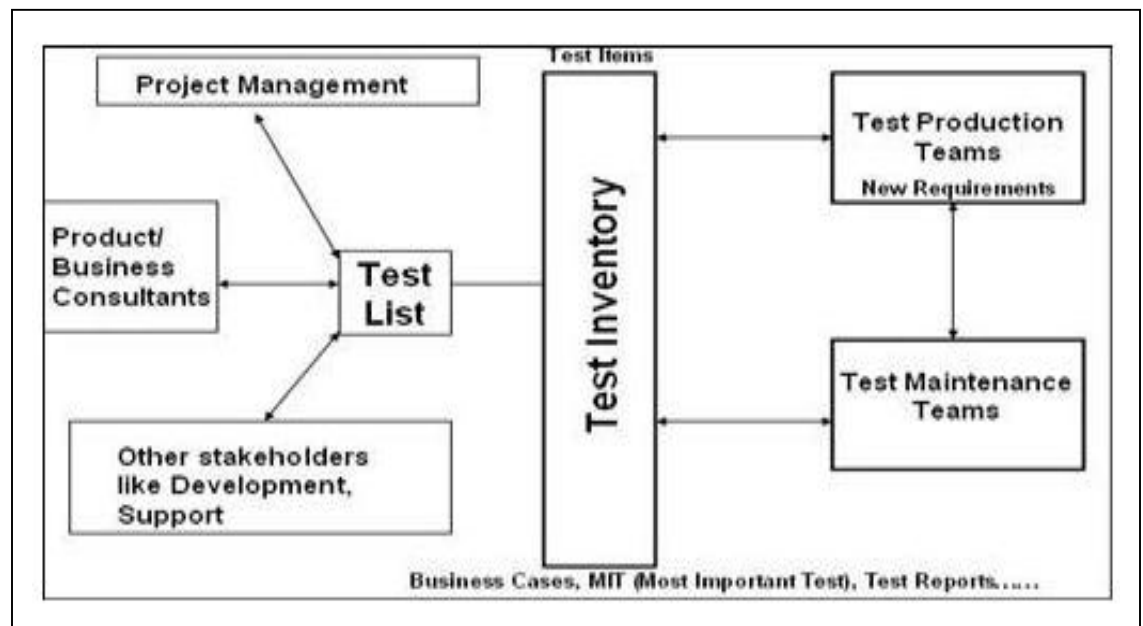


Fig 1: Test Inventory Model

2.1 Test Inventory Objectives

The tester must be able to communicate the size, complexity, priorities, and underlying assumptions of the test effort during planning, because that is when the schedule is established. If the testers cannot communicate these things clearly and adequately, management will not be able to make well-informed decisions. The Test Inventory Model is one such concept that can provide testers and management, clear information so as to facilitate the decision making at both the levels. Underlying objectives are:

Successful Test Effort: The basic objective is to establish test organization that ensures successful test effort in terms of test preparation, test execution, reporting bug fixes, verifies bug fixes, writing test report.

Planning the adequate Test Effort: Test coverage alone is not enough to ensure a successful test effort. There are two parts to the successful test effort: adequate test coverage and an adequate test effort. The most effective way to determine if the test coverage is adequate is by measuring, test inventory provides test list to measure test coverage.

Determining the scope of testing: The time required to accomplish the test effort can be estimated based on the total time required to plan, analyze, and execute tests. Test Inventory Integrity with discipline and time required to attempt test ensures successful scoping exercise.

2.2 Test Inventory Development-Building Test Inventory

Tests on the inventory can and should come from a number of sources. The following are some of the most common sources of tests in the inventory:

Tests Based on Requirements: One of the first sources of tests for the test effort should be the requirements. If you can establish the relative priorities of the requirements, then it helps greatly in establishing the rank of the tests that are designed to verify the requirements and the amount of test coverage that will be provided.

Tests Based on Experience: Non-analytical methods are most effective when used after analytical methods have been applied, to test assumptions made in the analytical tests, to do error guessing, and to design purely random tests. A couple of the main types of non-analytical methods are Brainstorming Sessions and Expert Testers.

While building your test inventory, start with the requirements. Even if you don't have formal requirements, you can list what the product is supposed to do. Identify the test, prioritize the test and remaining depends on the kind of the system and product under test. Below the Test Inventory for typical ERP Testing:

ERP Test Inventory Based on Requirement						
Product ----->			Product 1	Product 2		
Business Process Test Unit	Module	Priority	Ver 1.1	Ver 1.2	Ver 2.1	Ver 2.2
Requirement 1	Module 1	3. Medium				
Requirement 2	Module 2	2. High				
Requirement 3	Module 2	2. High				
Requirement 4	Module 3	5. Very Low				
Requirement 5	Module 3	2. High				
Requirement 6	Module 4	1. Very High				
Requirement 7	Module 5	2. High				

Fig 2: ERP Test Inventory Based on the requirements.

1. The overall size of the test inventory is equal to the number of tests that have been identified for the project. (This is how big *it* is.)
2. The size of the test effort will include all test activities undertaken to successfully execute the test inventory.
3. The cost of the test effort can be estimated based on the time and resources required to perform an adequate test effort

2.3 Application of Quality Management principles

QM Principles provide an understanding of and guidance for the applications of Quality Management. Test Inventory could be more effective by learning, applying and using the quality principles.

Inspections, Reviews, and Walk-throughs: Inspection, reviews, and walk-throughs can be used to test the accuracy of Test Inventory List. Test List is the medium currently used to store and communicate Test Inventory.

Assessment: Assessment is an integral part of any quality system. It is an independent examination to determine whether quality activities and related results comply with the systems, and whether these are implemented to achieve objectives. Change in requirements or adding new requirements also requires updating of test inventory list. Assessment methods can be used to maintain test inventory like:

Gap assessment
Audits

Continuous Improvement (corrective and preventive actions): There is no end to improvement if we take initiative like continuous improvements. Regular Quality audits of test inventory ensure proper corrective and preventive actions in place.

Management quality reviews report: Management must participate in planning and in building the test inventory. They must actively participate in discussions about what will be tested and what will be fixed, and they must allocate enough of the right resources to get the job done.

Continuous reporting to management is essential part of system and it can be provided by using this Quality management principle.

ERP Test Inventory Management Review Quality - (Feb-06)				
To: <QA Manager>			Date: 18-02-2006	
From: <Team Lead>				
Updated By: <Team Members>				
 Objective: Monthly Review Report ERP Test Inventory				
Test Inventory Updations:				
<ul style="list-style-type: none">• Test unit added for requirement 1 for product 1.1.• Test unit updated for change in requirement 3 product 1.2•				
Action Points for Next Month				
S.No.	Particulars	Action Plan	By	Dead Line
1				
2				
3				
4				
5				
6				
7				

Fig 3: How MQR Quality reports used for test inventory systems

2.4 Inventory Management Relevance

Test Inventory can be more effective when inventory management principles are applied on it. An inventory is a detailed list. An inventory of all the tasks associated with a project, such as all the tests identified for a test effort. The inventory can be organized in any way that is useful, but it must be as comprehensive as possible. It is normal and healthy that the inventory grows during the test effort. The inventory is dynamic, not static. It evolves with the system. When a test inventory is used, the test coverage metric can be used to measure many types of testing, such as function or specification coverage.

Projects with less duration demands more efficiency and effective output in short duration of time, under such situation using filtering, sorting and applying prioritization on the test inventory can provide the list of Most Important Tests (MIT). Execution of such test ensures system stability

and good coverage in the shortest possible time. Example of such projects can be delivering service packs to the existing users.

3. Test Inventory - Example Test Coverage Metric

In the following section detailed example is explained, how test inventory could be useful to define test coverage metric of project.

Test Coverage Metric Using Test Inventory List

Test Inventory for the ERP module Business Process with their priority and checkpoints.

Test Description			
ERP-Financials Business Process 1			
S.No	Business Process Flow Descriptions	Test Area	Priority
1	Test 1	check points	High
2	Test 2	check points	Medium
3	Test 3	check points	Medium
4	Test 4	check points	Low
ERP-Financials Business Process 2			
S.No	Business Process Flow Descriptions	Test Area	Priority
1	Test 1	check points	High
2	Test 2	check points	Medium
3	Test 3	check points	Low

Fig 4: Representing Basic Test Inventory List for ERP Module

Test Inventory list applied to measure the test coverage by adding status toward each test which has values "completed", "In-process" and "To be done". Test coverage is calculated as sum of all completed test divided by sum of total planned test multiplied by 100.

$$\text{Test Coverage (\%)} = [\text{sum (completed test)}/\text{total planned test}] * 100$$

	Product-Test Coverage Metric Using Test Inventory List						
	Test Description				Reviewed:	Coverage	
	ERP-Financials Business Process 1				Yes	Tester1	
						11.11%	
S.No	Business Process Flow Descriptions			Test Area	Priority	Status	
1	Test 1			check points	High	Completed	
2	Test 2			check points	Medium	In process	
3	Test 3			check points	Medium	In process	
4	Test 4			check points	Low	To be done	
	ERP-Financials Business Process 2					Yes	
S.No	Business Process Flow Descriptions			Test Area	Priority	Status	
1	Test 1			check points	High	In process	
2	Test 2			check points	Medium	In process	
3	Test 3			check points	Low	To be done	

Fig 5: Test Coverage metric using test inventory list for ERP Module

4. Integrations with other disciplines

Providing a Powerful Test Effort Management to Project Management

By itself, the Test inventory is a complete test list, useful for keeping track of Test items. When you add a priority to those items, the inventory becomes a powerful tool for answering all kinds of important questions. If you take one additional step and add a sequencing field like "Test Order," you have created a project management tool that is uniquely applicable to the test effort. The process of filtering and sorting took less than a minute, and the resulting list shows not only the most important test inventory items for this system but also the order in which they will be tested. The inventory became one of the most frequently consulted (and quoted) documents in the integration effort.

Transparency to Development, architects and consultant

Consultants, architects and even development often ask the tester, what have you tested, how much you have tested, is the system is stable enough to ship to the customer. Having proper updated test inventory system can provide comprehensive information to such questions by giving detailed information about planned and executed test items along with the order in which items were tested. So even if the system fails afterwards, we can find out at which point failure happened.

Promoting Reuse

One of the classic test waste scenarios happens when project personnel are changed. The new people don't know the application, or the tests, or what does what. So they tend to ignore the existing test collateral and invent their own. Since they don't know anything, the new collateral usually lacks maturity and depth of the existing material. The company has just paid good money to take a step backward and lose time as well. A well maintained and updated test inventory can help companies to avoid such backward steps.

5. Resource management using test inventory

One of the important function of any organization is the people management, every company try their best to retain the best talent. Best talents remains best as long as they are constantly learning, updated and ready to act according to the requirements of different projects of different kinds. If you take one additional step and add a Name field for each resource like "Resource 1," and indicate values as "Good, Average, NIL" you have created a Knowledge levels of each resource that can be uniquely viewed as knowledge matrix.

ERP Test Inventory Knowledge Management					
Business Process Code	Business Process / Topic	Priority	Resource 1	Resource 2	Resource
BPTFACR010	Test 1	3. Medium	Good	Good	NIL
BPTFACR020	Test 2	2. High	Good	Average	NIL
BPTFACR040	Test 3	2. High	Good	Average	NIL
BPTFCMG040	Test 4	2. High	Average	NIL	Average
BPTFCMG070	Test 5	1. Very High	NIL	NIL	Average
Good:2 ; Average:1 ; NIL:0					
Weight assigned Very High:3 ; High:2 ; Medium 1					
Knowledge Levels(Weighted Average)--->			2.4	1.2	1

Fig 6: Building Knowledge matrix using test inventory list.

Resource managers can use this to find future improvements in the resources, weak areas and strengths of the team.

6. Future Outlook –Test Inventory maintenance and transition

6.1 Test inventory Maintenance

Testing is a concurrent lifecycle process of engineering, using and maintaining test-ware in order to measure and improve the quality of the software being tested. Maintenance is critical part of any system and test inventory is incomplete without defining the maintenance process for it. However process can be tailored according to the test inventory needs and system, the basic process as follows:

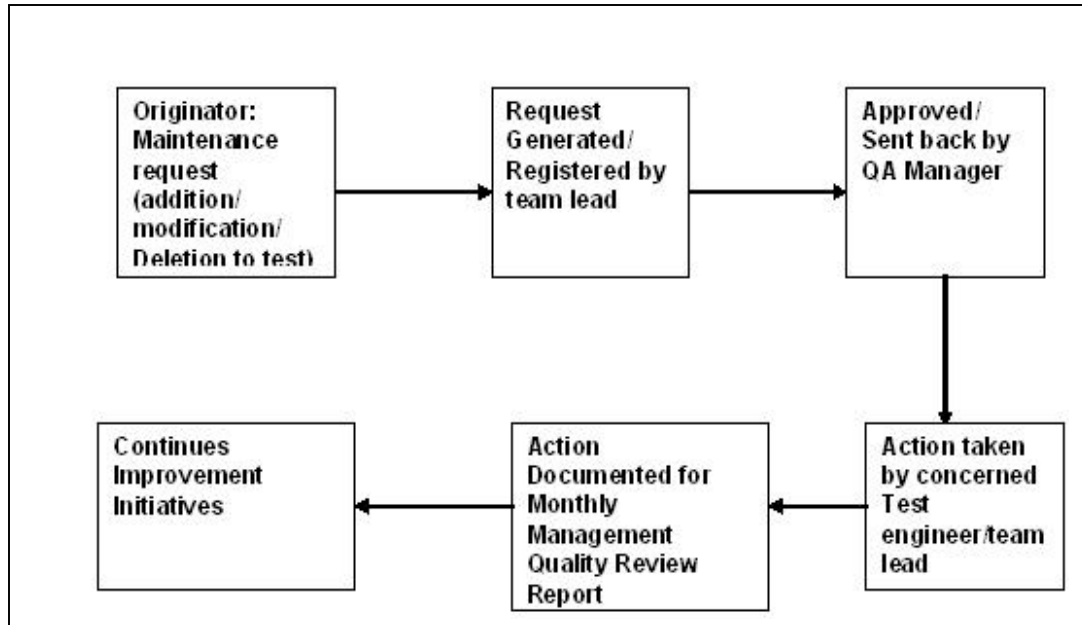


Fig 7: Defining Test Inventory maintenance process.

6.2 Test inventory Transition

To ensure smooth transition from existing test system to test inventory, requires a transition based strategy which involves

- Management Involvement
- Understanding of the Test Inventory Systems
- Knowledge transitions about test inventory systems
- Getting acceptance from team
- Establishing migration path
- Developing maintenance process
- Ensuring integrations with other disciplines

7. Test Inventory Implementation- Case ERP Financials Test List

All of the above sections represent different dimensions and usage of test inventory concept, now lets examine one case how can a test inventory is integrated and used along with other disciplines.

7.1 ERP Financial Test inventory List

Below is the Test Inventory list for ERP Financial Package according to the priority of the test.

Test Inventory List-ERP Financials					
Test Description					
ERP-Financials Business Process Testing					
S.No	Process Code	Business Process Flow Descriptions	Check Points	Priority	Man hrs
1	Test 1	Payment Process Test	Currency, Rounding, Discounts	High	28
2	Test 2	Receipts Methods Test	Currency, Rounding, Discounts	High	36
3	Test 3	Tax analysis Test	Collection office, amounts	High	36
4	Test 4	Financial Statements Test	Statement Layout, totals debits and credits	Medium	18
5	Test 5	Cash Flow Statements Test	Fund Flow Analysis	Low	10

Fig 8: ERP Test Inventory After applying prioritization/sorting on the test

7.2 How ERP Test List is useful to Resource Management

Resource Usefulness is the primary objective of resource management along with projecting project needs and knowledge & training requirements of different resources. Let's say project coming for ERP-financial and resource manager would like to predict current knowledge levels and future training requirements. Add Resource Wise columns to the above ERP Inventory list. Below figure is the answer to that.

ERP Test Inventory for Resource Management					
Business Process Code	Business Process / Topic	Priority	Resource 1	Resource 2	Resource 3
Test 1	Payment Process Test	High	Good	Good	NIL
Test 2	Receipts Menthods Test	High	Good	Average	NIL
Test 3	Tax analysis Test	High	Good	Average	NIL
Test 4	Financial Statements Test	Medium	Average	NIL	Average
Test 5	Cash Flow Statements Test	Low	NIL	NIL	Average
	Good:2 ; Average:1 ; NIL:0				
Weight assigned	Very High:3 ; High:2 ; Medium 1				
	Knowledge Levels(Weighted Average)--->		2.4	1.2	1

Fig 9: Resource Management Calculating Knowledge levels, Training needs

Resource manager can predict that Resource 3 needs training on High priority tests, he can predict knowledge gaps and current knowledge levels.

7.3 How ERP Test List is useful to Project Management

Test Effort estimation, test coverage at different stages of the project, test effort tracking and controlling are the prime requirements of project manager in terms testing and QA.

Test Inventory List for Project Management					Test Coverage	
Test Description					Reviewed:	Coverage
ERP-Financials Business Process Testing					Yes	Tester1
Effort						40.00%
S.No	Process	Business Process Flow Descriptions	Check Points	Priority	Man hrs	Status
1	Test 1	Payment Process Test	Currency, Rounding,	High	28	Completed
2	Test 2	Receipts Methods Test	Currency, Rounding,	High	36	Completed
3	Test 3	Tax analysis Test	Collection office, amounts	High	36	In process
4	Test 4	Financial Statements Test	Statement Layout, totals debits and credits	Medium	18	To be done
5	Test 5	Cash Flow Statements Test	Analysis	Low	10	To be done

Fig 10: Project Management Calculating Test Coverage, Estimating test effort

7.4 ERP Financial Test Inventory Maintenance and Reporting

Test Inventory reporting using management Quality review reports of quality management concept.

**ERP Financials Test Inventory
Management Review Quality - (Feb-06)**

To: <QA Manager>
From: <Team Lead>
Updated By: <Team Members>

Date: 18-02-2006

Objective: Monthly Review Report ERP Test Inventory

Test Inventory Up dations:

- Business process Test6 added to the list.
- New check Points added to the Test5 and Test4.
- Resources Trainings planned for Test6
- Resource 3 upgraded with High priority Tests

Action Points for Next Month

S.No.	Particulars	Action Plan	By	Dead Line
1	Test Inventory Review planned by consultants	Planned	QA Manager	28-02-2006
2	New Test Additions planned by Test production team for next project	In-process	Team lead	-
3	Resource Knowledge Review for new test	Planned	Resource Manager	01-03-2006

Fig 11: Management Quality Review Report ERP-Test Inventory.

8. Conclusion –The challenge

Most of the biggest quality improvements in software over the past 10 years have been due to standardization and improved development methods. Software testing is now perceived as services to s/w development. Software testing is now an industry with in the software development. Innovation and creativity lies in learning the best from experienced industries and implement to act on that learning. It is important that the maturity level of the test effort meet or exceed the maturity level of the software development.

Test inventory model is an innovative attempt to use the experienced concepts of inventory management and powerful principles of quality management to position software testing as complete system itself from just a function of the system. Model not only provides the test-ware development but also shows the integrations with other disciplines along with defined maintenance process.

References

1. Quality Assurance & Models, <http://www.softwaredioxide.com/channels/qa.htm>

2. Software Testing Fundamentals by Marnie L. Hutcheson
3. Software Engineering: A Practitioner's Approach
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5. www.softwareqatest.com

Authors Biography

Vishal Grover is currently working as Associate Software Quality Analyst in SSA Global Technologies (India) Pvt. Ltd. He has 2 years experience in software testing of ERP Financials domain.

Current position/core responsibilities:

Associate Software Quality Analyst

- Authors and executes test designs for manual tests.

- Isolates, reproduces and tracks bugs and verifies fixes.
- Interfaced with development teams to resolve technical as well as functional issues.
- Assists in the assessment and planning of test efforts required for new functions/features under development.
- Responsible for Business Process Testing/Functional Testing/System Testing/Integration Testing and preparation of test reports in SSA ERP Financials.

College attended, degree

MBA Degree in Systems and Finance from ICFAI Business School, Hyderabad

Bachelors degree in Management and information technology