

Software Test Factory (A proposal of a process model to create a Test Factory)

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Abstract- Software Quality Assurance (SQA) is becoming a critical issue in software development and maintenance. This paper discusses the existing organizational approaches to implementing testing practices. Today the scenario, software development organizations are beginning to outsource the testing related activities to organizations (testing factories) in order to reduce the resources and increasing the quality and reliability of the software products and services. This model must be composed of a testing process model and an organizational structure establishing the required roles, responsibilities and competences.

Introduction

The software quality assurance is a essential for organizations. The main objective is to reduce the cost of guarantying quality through out the software development process. Testing is a part of verification and validation activities. Verification involves human examination or review of the work product like inspection, walk through, technical review .Validation requires developing tests such as unit test, integration test, system test, acceptance test, usability test. Testing is an integral part of the SQA activities. The correct verification, validation activities result in economic gains: defect rate software delivery to client is reduced, the development costs are decreased and the reduction in delivery time and increase in test efficiency. However, 60% of the developers claimed that verification and validation were the first things that are neglected. In case of time shortage. Good management involves having a well defined organizational model which covers people and processes. Depending on the organizational model implemented in the organization, verification, validations are developed in different way. The developers are tester; other has independent test teams for this activity. Integrated test teams and SQA groups are other possibilities and outsourcing is currently being implemented for testing. Organization are beginning to subcontract testing, the development team that carries out the testing activities, do not have the necessary knowledge and skills. Therefore, outsourcing as a solution to reducing cost. Therefore, if there are organizations which demand testing

services, then organization which provide services must created known by test

factories. Current test factories do not use public and well-defined organizational models meeting the need of both parts (development company-testing subcontractor) for outsourcing testing-related activities. Without this model, it is very difficult to manage the testing process. So, the hypothesis of this research work is” If we have a well-defined organizational model which allows the creation of Test factory, out sourcing testing –related activities could be managed efficiently. A well-defined organizational model involves specifying the organizational structure which establishing the different roles and competences and specifies a process model that properly defines the necessary processes. The later is an important issue because an immature testing process will result in an unproductive, chaotic, frustrating environment, that produces low-quality testing results and unsatisfactory products. Developing an organizational model correctly is a complex task, so it is structured in two phases: first, we have developed the process model, and then we are determining the roles, capacities and responsibilities for each specified process. In this paper, the authors have focused on a process model of a test factory. This paper is structured as follows .Describes the organizational models for performing testing-related activities and the problems of outsourcing testing. The defined model to be implemented in a test factory. Describes the validation and finally contain the conclusions extracted from this work and future lines.

Moreover, we need to know the state of research on outsourcing testing. In addition, Testing Process Reference Models were studied. These models must be analyzed

State of the art

This paper presents two different ways:

i) organizational approaches to perform testing-related activities.

ii) Testing Reference Models.

It is necessary to analyze the different organizational models for testing because we need to know if outsourcing testing is a real possibility and what the main problems are in order to define an excellent process model for testing factories.

Organizational models for performing testing-related activities

It is a fact that testing is an important factor to project success. Occurrence of defects is the greatest contributor to increasing product costs due to correction and rework time and the main cause for lower product quality. In addition, it is well known that the cost associated with fixing a defect after the release of the product is greater than that of fixing a defect during the product development. Researchers differ on how to improve testing. We have found testing process improvement and testing as a part of SQA, with testing outsourcing proposed in both contexts [4]. There are different ways of organizing software testing. How the test organization is internally structured and positioned within the overall organization is very much dependent on policy, quality and corporate culture, skills and knowledge of teams, among others. The most relevant are:

A. Developers as Testers

This case is probably the most common. People who have developed the software product also verify and validate product activities. The problem is that the developer knows how to create software to pass tests but not how to detect failures [9]. Moreover, they do not have the right competences and knowledge [3].

B. Independent test teams

This organizational model defines an independent test team whose primary job is testing. Therefore, they perform the different tasks related to testing. The main advantage is that experienced testing teams with fresh

and objective viewpoints carry out testing while the main problem is between developers and testers. Moreover, it is very difficult to start testing in the early stages [9].

C. Integrated test teams

Integrated test teams are comprised of developers and testers where everyone reports to the same manager. They work as a team and share resources. However, the pressure to finish is great and they often forget about quality [9].

D. QA/QC

In this case, the staff of an existing SQA group does all or part of the testing function. This was done because some of the skills the SQA staff members possess were similar to those the testers needed. The main advantage is that they work in the organization and have some skills. The main disadvantage is that SQA is not only about testing, so they are worried about more than this [9].

E. Outsourcing & Test Factory

Lastly, in outsourcing testing, all or some of the testing activities are assigned to another organization: the Test Factory. The main advantage is that Test Factories often have considerable expertise in testing and many have excellent tools and environments. On the other hand, they rarely have a clear vision of the functional aspects of the business [9].

Testing Process Reference Models

Testing process improvement seems to offer some significant benefits. These include an increase in client satisfaction through the use of software products with lower defect rates or the definition and fulfillment of quality objectives [5]. The first step in testing process improvement is to assess the process against a testing process reference model. Therefore, if we want to create a process model, we need to know the most relevant testing reference model. A reference model for the testing process defines the necessary framework to determine the strengths and weaknesses of the testing process implemented in the organization. In other words, in order to determine the current state of the testing process and to establish the improvement

plan, the available practices have to be collected and compared with a reference model. CMMI [13, 14] is the most widespread reference model in the software industry. However, it does not fully support testing process improvement. We have considered several reference models related to testing: TMM, TMMi, TPI and TestPAI. TMM [15] defines a set of five levels with their corresponding maturity goals and subgoals. Every subgoal specifies the necessary activities, tasks and responsibilities. TMMi [16] is structured like CMMI. It defines five maturity levels. Several process areas which establish the specific and generic goals and practices are identified at each level. At present, only the process areas of level 2 have been developed. TPI [17] proposes a set of 20 key areas. An examination of each area leads to the classification of the test process into certain levels of maturity (ascending from A to D). Moreover, TPI defines a Test Maturity Matrix to establish different relations among areas because each area and each level has its own importance. Finally, it proposes a set of checkpoints and improvements. TPI is based on the TMap methodology. TestPAI [18] is a testing process area integrated into CMMI. It is placed in level 3 with engineering processes and includes and defines all the practices related to testing. It has the same structure as CMMI and is defined for staged and continuous representation. Test PAI proposes five specific goals and their corresponding specific practices. The four models are useful if we want to create a Test Factory. The choice depends on the requirements and necessities of the Test Factory. When we analyzed the existing bibliography, we did not find a model which integrates all the necessary items to create a Test Factory. Organizational structure and a well-defined process model are items which must be included in an integrated proposal. The organizational structure establishes the different roles, competences and responsibilities. A well-defined process model accurately defines the necessary processes and their items, activities, task, roles, work products, work elements, technical instructions, and so on.

Process Model of a Test Factory

This section describes the proposal of a process model of a Test Factory. To build this model we considered the best testing practices published [9-12] and the different reference models [15-18] used to improve the testing process. If we want to define a good process model we need to know the specific goals and practices related to testing. We analyzed carefully testing activities and outsourcing testing needs in order to identify and establish the set of processes. Moreover, we studied all the documents or work products of both project and testing to determine process inputs and outputs. We identified a set of testing processes that we can group in three categories: Management, Technical and Support. First category contains the processes of Testing Requirement Development, Testing Planning, Testing Design. Second Testing Execution and Testing Report and in the third section a set of support processes have been defined, such as: Quality Assurance, Control and Monitoring, Configuration Management, and Measurement and Analysis. Figure 1 shows this model.

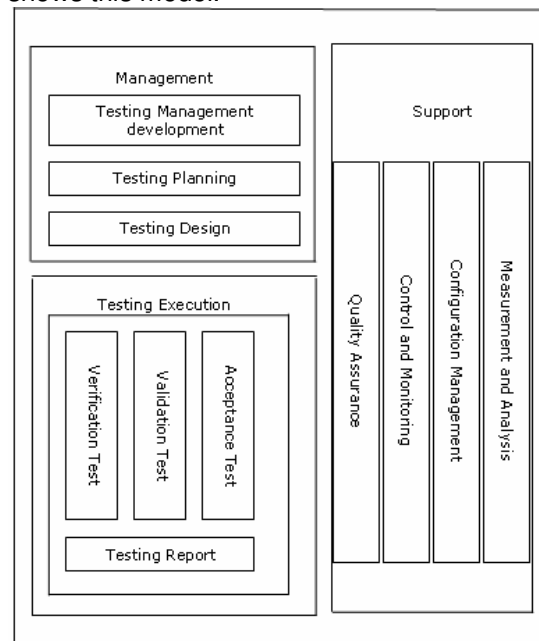


Fig. 1- Process Model of a Test Factory

Each process was identified by defining the following elements.

- Process purpose.
- Process description.
- Activities which define what are we doing.
- For each activity:

- a. Inputs.
 - b. Outputs.
 - c. Task to carry out the activity.
 - d. Roles.
 - e. Work Elements.
 - f. Work Products.
 - g. Technical Instructions.
 - e. Roles.
 - f. Inputs and Outputs.
 - g. Work Elements.
 - h. Work Products.
 - i. Technical Instructions.
- Next, we describe each process briefly, including inputs and outputs.

1. Testing Requirement Development

Inputs: Analysis Document , Requirement Document, Specification of client needs.
Outputs: the contract between organization and the test factory, testing requirements .
Description: Feasibility study and project scope is developed. If project is feasible and the two parties reach an agreement, a contract is signed. From there, testing requirements are captured and managed.

2. Testing Planning

Inputs: Analysis Document, Testing Requirement Document.
Outputs: Test Plan
Description: Test Plan is developed and maintained. It is important to emphasize that the proposed Test Plan is not a conventional one because not only does it include the elements of a Test Plan, but also the sections of the project plan that are necessary to test project management.

3. Testing Design

Inputs: Analysis Document, Design Document, Testing Requirement Document, Test Plan.
Outputs: Test Plan, Test Design Specification, Test Case Specification, Test Procedure Specification.
Description: Establish the necessary information to execute testing effectively and efficiently. The Test Plan includes data on tasks, schedule, risk, resources, costs, and so on, but it does not include the details to organize and execute tests (inputs, outputs, procedures, among others).

Inputs: Test Work Package.
Outputs: Result Reporting.
Description: To prepare and execute tests. Before execution it is necessary to prepare the environment, test cases and scripts and

4. Testing Execution

Inputs: Test Work Package.
Outputs: Result Reporting.
Description: To prepare and execute tests. Before execution it is necessary to prepare the environment, test cases and scripts and

data. After execution, a result report is prepared. This process comprises three different processes: Verification Tests, Validation Test and Acceptance Test. Depending on the testing requirement, testers follow one of these.

5. Verification Tests

Inputs: Artifacts to be tested.
Outputs: Result Reporting.
Description: To perform the testing verification activities and to review the artifacts or work product that we receive through inspections, walkthroughs and technical reviews. Each one has their key elements and phases. In addition, different checklists can be used as a simple and useful verification tool.

6. Validation Tests

Inputs: Project Documentation and Testing Documentation.
Outputs: Result Reporting.
Description: To execute the testing validation activities to check the system. This process supports unit tests, integration tests, system tests, regression tests, stress tests, performance tests and usability tests. Depending on the type of tests, one of the project and testing documents is used.

7. Acceptance Tests

Inputs: Requirement Document and Testing Documentation
Outputs: Result Reporting.
Description: To execute the acceptance tests to check that the system meets the client's needs. It should be carried out by the customer or end user after the system tests have been executed satisfactorily.

8. Testing Report

Inputs: Result Reporting.
Outputs: Result Summary Reporting.
Description: To analyze and evaluate the results obtained and to prepare a brief report which includes the most important results. In addition, this process controls and manages incidents.

9. Quality Assurance

Inputs: Test Work Package.
Outputs: Result Audit Reporting.
Description: To verify that the activities, defined in the current process, have been carried out. Moreover, the appropriate intermediate or final products are obtained as a result of these activities. Audits are carried out to verify this.

10. Control and Monitoring

Inputs: Test Plan, Result Monitoring Reporting.

Outputs: Result Monitoring Reporting.
Description: To control and monitor the state of the project. Elements such as schedule, costs, resources, milestones, commitments, risks are taken into account. This is a continuous and cyclical process because the activities is repeated periodically; for example, fortnightly.

11. Configuration Management

Inputs: Any element involved in the project.
Outputs: Information about the change.
Description: To carry out the configuration and change management and change. Changes in the configuration items on any baseline must follow a formal process of change, which assesses its impact to accept or reject the change.

12. Measurement and analysis

Inputs: Project and Process Specifications
Outputs: Measurement Reporting
Description: To control the processes implemented in the organization. Different indicators are defined to allow the measurement and analysis of the information collected. A measurement report, summarizing the results, is prepared.

Use of the proposed model

The use of the defined process model is being made in collaboration with a Spanish consultant company, and it still is in progress. To do this, we proposed a service provision model to create a Test Factory. The additional items that we have added to the defined process model for this proposal are:

- Justification for choosing a Test Factory as a testing method.
- Process orientated to production environment.
- Defining a set of metrics to assess the performance of the model. The following can be highlighted: testing effort, meet schedules, Test Factory work rate and value management gained.
- Determining a set of methodological guides to be taken into account when testing.

Based on this adapted model, several commercial proposals to create a Test Factory were made to different organizations in the insurance field and to a chain of supermarkets.

Figure 2 shows the validation process, from the process model defined to the commercial proposal

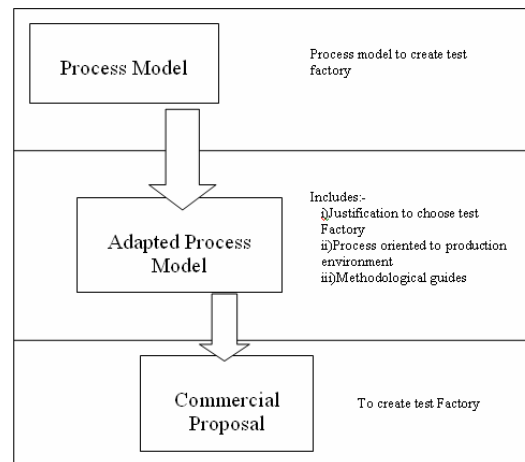


Fig. 2- Use of the Proposed Model

These commercial proposals were evaluated and the result was positive. So, the proposal to create a Test Factory based on the proposed process model is being negotiated. When the organizations reach an agreement, the experimental validation will be developed.

Conclusion

Testing is an important issue in Software Process Improvement and Software Quality Assurance. There are different ways of testing in organizations; one is outsourcing testing or Test Factories. Research is looking at outsourcing testing as a solution to reducing costs and improving software reliability. In order to manage these types of organizations efficiently, a customized management model is needed. This model must comprise a process model and a organizational structure, including detailed specification of roles, responsibilities and competencies. This process model defines the processes required to manage a testing factory, provides the key elements to draw up a contract for outsourcing testing activities, including the definition of deliverables and visibility mechanisms required to manage a testing-centered project.

The evolution of the process model presented in this paper is centered on the following issues:

- Definition of a proposal for the organizational structure, including a

detailed specification of roles, responsibilities and competencies required.

- Definition of a model for quantitative management of a testing factory.

- Definition of an evaluation and improvement model based on the development of competencies and skills of the personnel of the testing factory.

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