EXPLORATORY TESTING: A REVIEW AND QUESTIONNAIRE INVESTIGATION

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Abstract: This paper is an investigation and review on software exploratory testing. The rationale is to summarize the various research questions relevant to this technique through the review of findings of various field studies and experiments done by researchers in past. To know the current status of this approach in industries, software testers from two different companies one from independent software testing company and another from the company which does not have independent testing team are asked to complete a questionnaire. It helped us to know that that the technique is being implemented by both but the degree of acceptance and motive of using this technique in two different companies are different. This paper also gives insight into the domain and situations where the technique actually fits and where it lacks. The paper will also give a brief outline on what more can be done for the future research.

Keywords: exploratory testing, review, software testing life cycle, questionnaire.

Introduction: Software testing plays a crucial role in Software Quality Assurance. While doing research on the current trends of software testing techniques, we found the exploratory testing technique is successfully acceptable by software testers in the industry but still lacks acceptance in the mind of researchers due to its comparison with ad hoc testing which is often synonymous of careless work. Software testing is about revealing or uncovering bugs from the software is an inevitable phase of software development life cycle. Software testers strive a lot to catch as many bugs as possible before releasing the software.

Exploratory Testing: The best definition of exploratory testing is given by James Bach as "Exploratory testing is simultaneous learning, test design, and test execution"[1]. It means the approach eliminates the need of generating planned test cases prior to the test execution. It focuses on exploring the application and giving full freedom to tester to test using their intelligence, creativity without following any predefined and planned documentation [1]. It introduces the concept of formal uninterrupted-sessions to focus the particular functionality or module of the application under test. The technique can be compared with a crime investigation method where there is a team working on a particular case of crime. What if they have to follow a particular script to solve the case? It would be highly restrictive. It would act as a barrier to take the benefits of common sense, intelligence as well experience of a software tester to examine the risk involved in application under test. Of course the technique is opposite to the scripted testing which repeats the same pre-defined test cases every time. So this technique is a new style of testing giving full freedom to every tester to think, learn and test simultaneously. Software testing is considered as cyclic process and generally defined by Software Testing Life Cycle(STLC).STLC defines how the various testing activities are carried out in step by step manner.
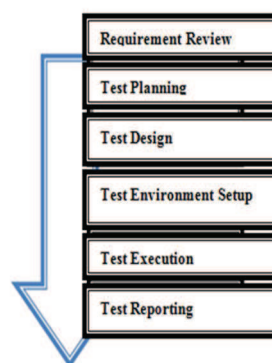

Fig. 1 Software Testing Life Cycle

But exploratory testing does not support the execution of the above phases in this particular order. But the current research shows that industrial software testers prefer to execute multiple phases of STLC in parallel as shown in the figure 2.
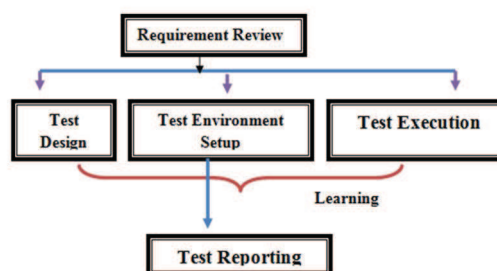

Fig. 2 Exploratory Testing Cycle

This is considered as an influential approach to test the applications in the real world of software industries where there is always a time pressure of completion. Huge pressure of testing the quality of applications from customer point of view in very short duration leads to the arrival of a new approach

called exploratory testing[1].

2. Research Questions:

The questions included here are:

RQ 1.   Does the exploratory testing newly invented technique in the software testing industry?

RQ 2.   Why does it create a misconception with Ad hoc testing and how it is different from ad hoc testing?

RQ 3.   Does the approach follow any algorithms?

RQ 4.   Does the approach contradict other techniques of software testing?

RQ 5.   Does the approach depend on skills, knowledge and experience of tester?

RQ 6.   Is there any difference found in the defect efficiency of traditional pre test design approach and exploratory testing?

RQ 7.   Is it a black box or white box testing technique?

RQ 8.   Is this technique domain-specific?

RQ 9.   Is the approach acceptability varies from small to large scale companies?

RQ 10.   Does the approach offer any testing metric to assure the confidence in application?

RQ 11.   Does the exploratory testing really cost effective technique?

The purpose of various research questions is to review the findings of different surveys and field studies.

RQ 1. *Does the exploratory testing newly invented technique in the software industry?*

The technique is not new but introduced by Cam Caner in 1983[1, 2] .But it had not been widely known in research area because it was believed to be just a different term for random or ad hoc testing. Ad hoc testing is always criticized by software engineers as it more a negligent work without any record or documentation. The sloppy nature of ad hoc testing and misconception of complete similarity between ad hoc and exploratory testing is one of the major reasons of why this technique lacks research.

RQ 2: *Why does it create a misconception with Ad hoc testing and how it is different from ad hoc testing?*

Researchers think that there are only two extreme approaches currently used for software testing. They believe that either you can do testing in a complete systematic, planned and formal way or you can just randomly test the software without planning. So the two extreme cases are scripted testing and ad hoc testing. Ad hoc testing sometimes referred as random testing. Although random testing is suggested to applications but ad hoc testing is not considered as good practice as it is not a formal technique. One cannot reproduce results due to the lack of documentation records and designed test cases. Studies prove that random testing is the best solution to test the applications in the real world where we

normally have huge pressure of time delivery. But a better technique is needed which is not completely ad hoc. As ad hoc testing is not a systematic way. There is no path and thought of how to go about testing. As exploratory testing does not follow any planned predesigned test cases hence it is often confused with random testing. But unlike random testing, exploratory approach record sessions and build test cases during testing.

Exploratory testing which neither give privilege to extreme scripted testing which annihilates tester's creativity nor to the extreme random testing which makes the testing process inexplicable after completion. Scripted testing with the help of various tools is efficient but is not always preferred as too much automation deprives testing process of the creativity and intelligence of testers. Hence we mostly prefer automation tools in the regression testing. Exploratory testing is recognized as an industrial approach these days. Those who are not completely aware of this technique understand it as random testing but currently industrial testers has differentiated it from previous ad hoc testing. It is mid way technique between ad hoc and scripted testing.

Fig. 3 Exploratory Testing Status

"Ad hoc Testing" which is chaotic approach in which tester randomly test different modules to check the acceptance of application, exploratory testing is done systematically by introducing testing-sessions to focus specific area of application. These sessions are generally of 30-40 minutes. It can be extended to an hour depending upon the complexity of goal. Unlike ad hoc testing which randomly choose any part of application without knowing the next step, exploratory testing can be performed very systematically.

RQ 3: *Does the approach follow any specific algorithm?*

The approach does not suggest any specific algorithm. But James Bach and few other practitioners suggest some ways which is formalized here into simple steps. It helps researchers to understand how exploratory testing is actually performed. Exploratory testing consists of two important steps.

i. Scope of session.

ii. Tour or journey of exploration.

Step 1: Testers have to choose the scope of testing the

application under test for every session. Scope defines the boundary or area in which tester has to think. Tester has full freedom to apply its creativity but within the defined scope of session.

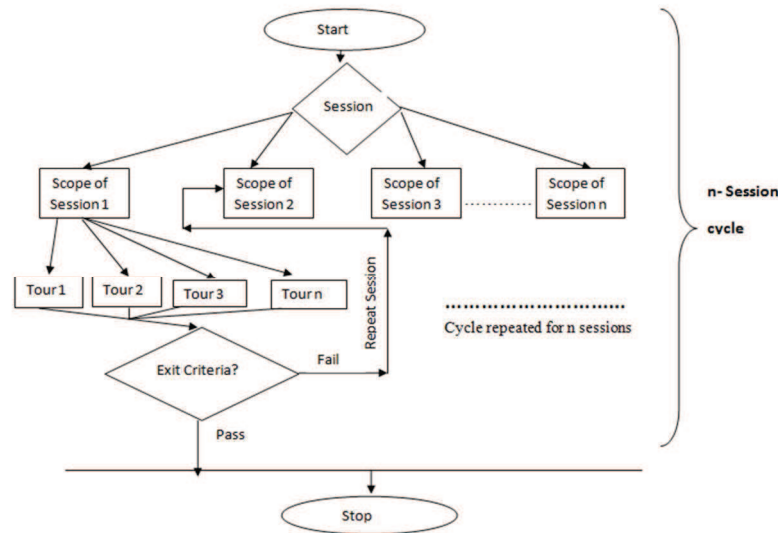Step 2: Tours defines the complete journey of exploration within the pre defined scope.

Fig. 4 Exploratory Testing Process

Different sessions have different goals, scope and different tours of exploration. Session duration are generally same but may vary a little depending upon the complexity of scope of session.

RQ 4: *Does the approach contradict other techniques of software testing?*

The approach does not contradict any other testing technique. It can either be used independently to learn and test an application simultaneously or it can be employed partially on the application for risk analysis[3,5]. It focuses more on non interrupted sessions where testers can even think of other testing techniques of software testing as well like boundary value analysis, decision table to invent more test cases during the session.

RQ 5: *Does the approach depend on skills, knowledge and experience of tester?*

Yes the role of tester in the exploratory testing is highly significant. It can be understood with an analogy of chess game. In chess game, skills and intelligence of players play a crucial role to make the chess game more interesting and entertaining. Rules of chess game may change but what really matters is the skills of players. Similarly rules of exploratory testing may change from one testing team to another but skills of testers remarkably affect the success of testing. This result has already been proved by a field study conducted with four large organizations with 12 testing sessions in a real time industrial test environment [4]. The study has proved that three

basic type of knowledge is utilized during exploratory testing. It classifies the knowledge into domain knowledge, system knowledge and general software engineering knowledge. This knowledge is materially applied to work on the test oracle during testing sessions which help testers to compare the results of application under test with required expected results. The ultimate goal of exploratory testing is fault recognition which depends how smartly and deliberately the testers are using their skills and knowledge during testing sessions[4].

RQ 6: *Is there any difference found in the defect efficiency of traditional pre test design approach and exploratory testing?*

To answer the above question, a controlled experiment was conducted with 79 advanced software engineering students.[3] The goal was to examine the defect efficiency of two different approaches. No remarkable difference has been found in defect detection efficiency between traditional approach testing approach and exploratory testing. The research proved that the outcome of defects from two different approaches when classified into different category depending upon their technical type, level of difficulty and severity did not show an appreciable difference. The more astonishing result of their research was production of more false defect reports during traditional approach of testing when compared with defect report of exploratory testing. It proves there is no significant profit in predesigned

test cases while measuring the testing in terms of defect efficiency [3].

RQ 7: *Is it a black box or white box testing technique?*
Exploratory testing approach is mainly considered as black box technique because it is used to check the application under test from user point of view. The software testers are asked about the level. [3,5]

RQ 8: *Is the approach acceptability varies from small to large scale companies?*
Any company can use this technique as it does not support any specific size of organization as far as testers have skills to test the application. During the review, we came across a case study where exploratory testing was successfully implemented in Sweden at very large telecom company for three days making the involvement of 80 testers[6]. Another appreciable case study involving three different companies was carried out in Finland[5]. The interview data was collected from seven practitioners from three different companies of different size where size of organization depends on the number of employees. It was concluded that practitioners from different companies even varying in the size were inclined towards exploratory testing approach. Whenever testers come across testing some complex functionality of application, then exploratory testing is preferred to check the quality of application from user point of view[3,5,6].

RQ 9: *Is the exploratory testing technique domain-specific*?
The exploratory testing technique is reviewed as a situational practice [3,5,6,7]. It can be applied to test the applications of particular domain like:
i. Applications having low budget for testing.
ii. Applications having lesser time available for testing.
iii. Application under test has certain complex functionalities whose initial test design is very cumbersome.
iv. Application has to be tested focusing more on the user point of view.
v. Testing an application where it is also expected from testers to learn more and more about the application by exploration along with finding defects.
vi. Applications which require high level of risk analysis during testing.
vii. Testing software applications with no deterministic results. viii. Domain of applications whose defects would not cause harm to human life.
ix. Testing the applications whose software requirement specification (SRS) is not clearly defined or available.

RQ 10: *Does the approach offers any metric to assure the confidence in application?*
As per our knowledge, no standard test metric has been defined for measuring exploratory testing[5].Although exploratory testing claims good defect efficiency[3,5] but management of test coverage during exploratory testing is the biggest short coming of this technique.

RQ 11: *Does the exploratory testing really cost effective technique?*
Exploratory testing does look very time and cost effective when we have very less time available for testing. Example a website can be tested in very few days saving time and predesigned test cases efforts. But some evidences have also proved that the technique could cause the organization to suffer from technical debt. Technical debt is the bad consequences suffered by organization at later stages due the various shortcuts carried by the employees during software life cycle. It may cause the management of organization to suffer from loss of repairing and patching the product during maintenance stage [7]. Loss may occur in term of cost or loss in reputation. So, the managers and practitioners of organization should be aware of the drawbacks on excessive usage of this technique along with its benefits.

Questionnaire Results: To review the status of exploratory testing in the current scenario, software testers from two different companies were chosen as shown in figure 5.

The first company chosen was Tata Consultancy Services. Practitioners having more than three years of experience in testing were asked to fill the questionnaire. They said that exploratory testing is being used by their team to explore and test software in parallel as they usually get lesser time for testing. This company does not hire any independent testing team for testing their products. Developers themselves test the code but exploratory testing technique is used by them after successful completion of software product to test the product from user point of view so that software quality can be raised. They also prefer it because time to delivery is the always the prime requirement of customers. The same questions when asked by other software testers in the Crestech Software Systems which is testing-centric software company had different opinions. The practitioners also have more than three years of experience but their work is to test the third party software products. So they use exploratory testing initially to learn and explore the product but they never give prime focus to it when testing is the urgent requirement of customer. Like safety critical system cannot be tested using exploratory testing

COMPANY NAME	GOAL	TESTING TEAM	CMM LEVEL
TATA CONSULTANCY SERVICES	INDIAN MULTINATIONAL COMPANY PROVIDES I.T. SOLUTIONS AND CONSULTANCY SERVICES.	NO SPECIAL TEST ENGINEERS. HARDLY ANY TESTER IS CERTIFIED.	5
CRESTECH SOFTWARE SYSTEMS	CRESTECH IS AN INDEPENDENT SOFTWARE TESTING COMPANY. IT PROVIDES TEST SOLUTIONS TO ITS CUSTOMERS.	SPECIAL EXPERT TEST ENGINEERS. FEW TESTERS ARE CERTIFIED TESTERS AS WELL.	3

Fig. 5 Companies summary

Other testing techniques like boundary value analysis etc are used to design the test cases before test execution. Their goal is not just to pass the software from user point of view but also to break the system so that as many defects can be revealed. The results are summarized in figure 6. Some noticeable and useful points of questionnaire results are summarized below -

i. Testers of both companies accept exploratory technique as a good testing practice.

ii. Testers of both companies call exploratory testing as common trend of market due to quick delivery pressure of software product by customers in almost every organization. The reason suggested by both is the competition in almost every domain.

iii. Testers of both companies recommend the technique to other testers as it is much reliable than simply random testing and much creative than scripted testing.

iv. All the experienced testers of companies suggested that the team should keep a good balance between scripted and exploratory testing to reveal as many bugs as possible.

Parameters	TCS	Crestech
Experience in software testing	More than 3 years	More than 3 years
Objective	Information technology services, business solutions and consulting company	Testing solution based company
Focus on testing	To pass the product.	Prime focus
Exploratory Testing	Preferred	Not much preferred.
Motive of using exploratory testing	To explore and test the product from user point of view. To test the product under time pressure. It is preferred to improve the quality.	Only used to learn the software initially. Pre designed test cases are mostly used.

Fig. 6 Questionnaire Results

Conclusion and Future Work: Our answers to research questions from various surveys and field studies suggest that exploratory testing is an attractive approach of software testing and currently practiced in industries. Our questionnaire results proved   exploratory testing as current market trend.

Well experienced testers from two different companies even having different goals happily recommend this technique to the testers of other organizations to fulfill the demand of quality product of customers on time.

For future work, survey can be conducted at higher

level to know why the technique still lacks the standard testing metrics and what possible solutions can be suggested.

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