Project plan for degree projects

PA2534: Masters thesis in Software Engineering

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Thesis	Tentative title	Effects of development platform heterogeneity in testing of heterogeneous systems
	Classification	Computer systems organizations, other architectures, heterogeneous (hybrid) systems
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1 Introduction and Background

Throughout the years, software has evolved to large and complex system of systems. In the context of system of systems, Lane [12] studied about the impact of development effort, Lewis [14] proposed one process about how to conduct requirement engineering and Ali [1] investigated about test process in these systems. System of systems may exhibit heterogeneity, for example in implementation, hardware, software and processes [9].

1.1 Testing of Heterogeneous systems (HS)

According to the literature, a heterogeneous system is defined as "a system comprised of n number of subsystems where at least one subsystem exhibits heterogeneity with respect to other subsystem" [9]. The area of research in heterogeneous system has also received large attention in recent years, as a result of shift in technology and customer needs.

Testing of heterogeneous systems is considered to be a challenge originating from problem of integration and system level testing [7] [21].The challenges to test heterogeneous systems are mainly related to interoperability [23] [15], conformance [15] and large regression test suites [1] [9] [4]. The common issue discussed frequently in literature related to testing of heterogeneous systems is interoperability [9]. Interoperability is one of the important test activity

in distinct applications and various technology domains. Interoperability is the process to check whether the two related systems can cooperate [9]. According to Xia et.al [23], they proposed a method to automate conformance and interoperability testing for e-business specification language. Narita et.al [15] also proposed another method which is supported by testing framework for interoperability issue in robotic domain related to communication issue. According to [9], they concluded that combination of interoperability and conformance testing may reduce setting cost and execute test process for a standard based system.

1.2 Dimensions in Heterogeneous Systems

In heterogeneous systems, heterogeneity may occur in different dimensions for different systems. According to [9], some of the dimensions for which heterogeneity may occur are different system complexities [16], programming language and platforms [23], type of systems [8], different development process [10], test strategy, software, hardware, test process, system supplies (third party components) etc. Heterogeneity may also occur at different levels within software development process e.g. requirement elicitation techniques, verification and validation strategies etc. [9]. In this study, we intend to investigate the effects of development platform heterogeneity on overall test process to test heterogeneous systems. These studies help the testers to know how platform heterogeneity effects the test process in testing heterogeneous systems.

2 Aim and objectives

The main aim of this thesis is, *"To investigate the effects of development platform heterogeneity in heterogeneous system on the test process."*

Following are the objectives to achieve our aim:

- To determine the influence of platform heterogeneity on software testing (process which includes test design, test execution, test analysis etc.)
- To investigate best practices for testing Heterogeneous Systems with platform heterogeneity

3 Research questions

RQ1: How does platform heterogeneity affects the testing in heterogeneous systems?

RQ2: What are the best practices for testing heterogeneous systems that exhibit platform heterogeneity?

4 Research Method

The method used in this research to solve above research questions is survey. According to [22], surveys are used to collect both qualitative and quantitative data. Figure 1 shows the over view of research methodology process conducted to solve above research questions.

The research questions RQ1 and RQ2 mentioned in section 3, will be answered by using survey as the research method. The reason to select survey is that "survey method allows a collection of large amount of data from sizable population in a highly economical way" [6].

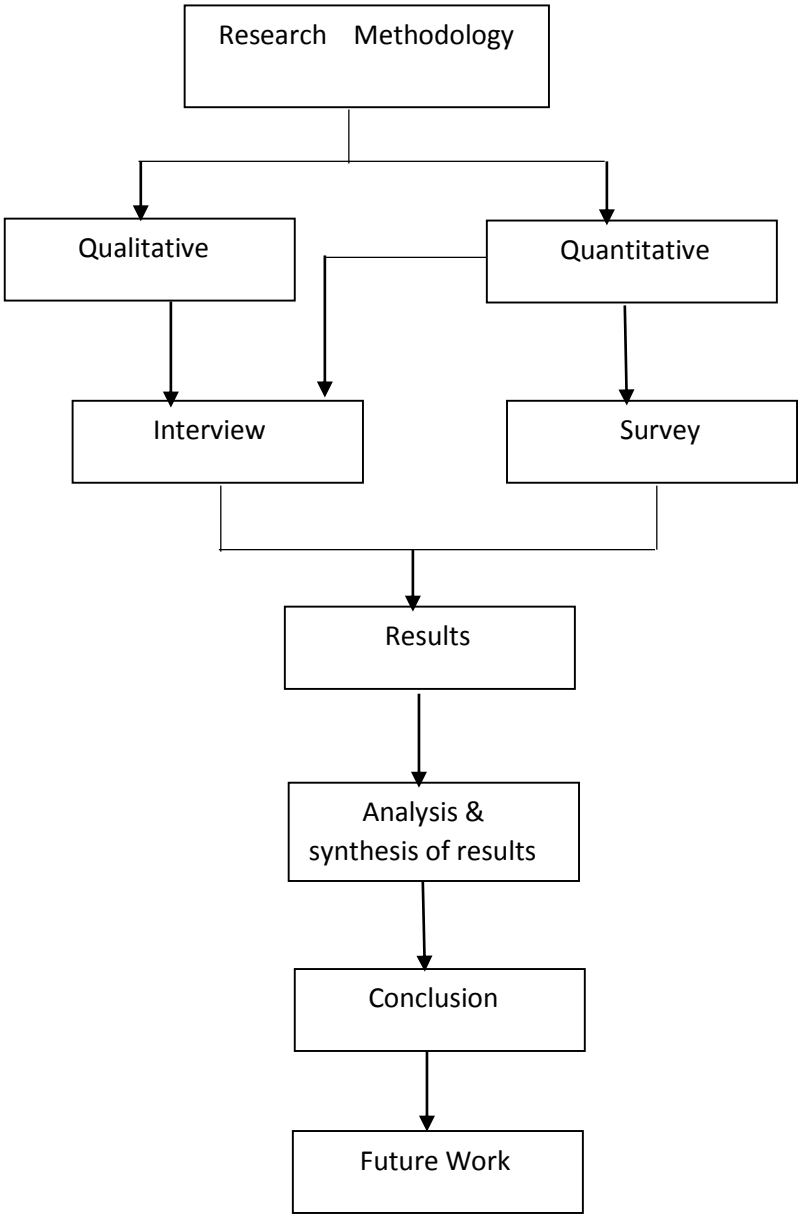

Figure 1: Overview of the research methodology

It also plays an important role as a research strategy as it allow the researchers to learn about the state of the practice, identify improvement potentials and investigate the acceptance of a technology [17].

4.1 Data Collection

The most common approaches for data collection in surveys are through questionnaires and interviews [2]. In this research study, both survey questionnaires and interviews will be used as the data collection method for triangulation purposes. The questionnaire for survey will be prepared based on our research questions and further improved on the basis of interview data collected from the practitioners. Furthermore, for data collection, electronic surveys will also be used as part of research method. This survey is designed online and will be distributed by posting the link in social networking sites like LinkedIn, different focus groups and through email to selected practitioners involved in development of heterogeneous systems. The reason for choosing an electronic survey as data collection method is to receive more responses from practitioners at globally distributed locations. The online questionnaire consists of both open and closed ended questions. The motivation behind choosing this method as data collection is that "these are the most common approaches and take less time and data can be collected from a large number of respondents" [13].

For data triangulation, in this survey, interviews are conducted with industry practitioners as mentioned earlier. The maximum data is collected by conducting semi-structured interviews with industry practitioners as it was also one of the most frequently used approach and an important source of data in case studies in software engineering [19] [18]. The interviews are conducted with the selected practitioners that are experts in testing and development of heterogeneous systems.

4.2 Sampling Method

Sampling is the process of selecting a set of respondents from the total population under study [17]. We used convenience sampling method, which is one of the probability sampling technique to select the respondents. According to [22], convenience sampling is an approach used to select nearest and most convenient practitioners as subjects. In this process, we proceed with this method by contacting experts in the area of heterogeneous systems with the help of our personal contacts and also with the help of experts in industry. We also use electronic forums to collect data to answer the research questions. The data analysis also may influence the choice of sample size [22], so it is important to consider how the data can be analyzed before the start of survey process. In section 4.3, we discuss the data analysis techniques to be used in this thesis.

4.3 Data Analysis

The basic objective of the data analysis is to synthesize the collected data to draw conclusions [18].

To analyze the quantitative data collected during this study will be analyzed using descriptive statistics. Descriptive statistics is one of the analysis method suggested by [18]. These descriptive statistics will include mean values, histograms and scatter plots to represent the trends.

For qualitative data, thematic analysis will be used for the purpose of data analysis. This method is one of the most frequently used synthesis method in software engineering [5]. It is a method used for analyzing, identifying and reporting themes from the collected data [5]. According to [5], there are four different approaches for thematic analysis in the process of synthesizing evidence, but according to our research we have selected to use the approach proposed by Boyatzis [3] as it is the most relevant to our research study. During this process, different themes will be generated from the raw data and will go through constant comparison

by scoring, scaling and clustering. According to [5], the thematic analysis approach proposed by Boyatzis [3] is also reliable to use for qualitative data. The themes identified from the collected data will help us identify the best practices to test systems that exhibit platform heterogeneity.

5 Expected outcomes

Figure 2 depicts how objectives are mapped to research questions and expected outcomes of this thesis. The expected outcomes are also listed as follows:

- Various challenges proposed by some of the researchers are documented.
- Effects of platform heterogeneity in heterogeneous systems are documented.
- Guidelines for testing heterogeneous systems that exhibit platform heterogeneity

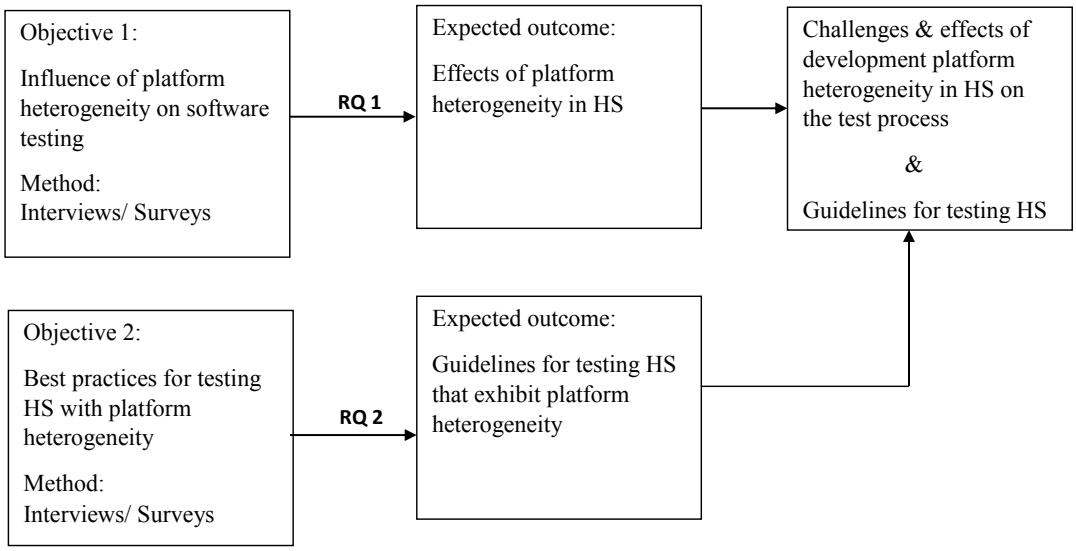

Figure 2: Mapping of objectives, research questions and expected outcomes

6 Time and activity plan

The following are the scheduled milestones to complete my thesis work.

Scheduled Milestones:

- 20150115: Start writing Proposal
- 20150125: First draft of proposal to supervisor
- 20150206: Final draft of proposal to supervisor
- 20150207 Start of Literature review
- 20150210:Instrument design for Interviews

- 20150228: End of Literature review
- 20150410: Start of Interviews
  - Search for Industrial contacts
  - Preparation of Questionnaires
  - Interviewing selected candidates
- 20150430: Analysis and Extraction of Data
- 20150420: Start Drafting Thesis report
- 20150505: Draft sent to Supervisor
- 20150519: Final Submission of report to supervisor
- 20150520: Supervisor tells OK to examiner for presentation
- 20150525: Document sent to opposition
- 20150601: Thesis Presentation
- 20150614: Updated report sent to examiner

7 Risk management

The process of identifying, analyzing and further taking necessary precautionary steps to avoid issues in developing any project or research work is called risk management [20]. In this section of document we provide some of the risks which can be identified in the initial stages of research work. The following are some of the expected risks identified in this thesis work are:

Strengths	**Opportunities**
- Good command on writing skills - Responsible and hardworking - Interested in software testing research	- Opportunity to contribute to heterogeneous systems research through this thesis - To explore different challenges and effects of heterogeneity on testing of heterogeneous systems - Opportunity to communicate with industrial practitioners to increase practical knowledge
Weakness	**Contingency Plan**
- No industrial experience - Limited contacts from industry related to heterogeneous systems	- Search for more contacts in industry with the help of existing contacts that are involved in development of heterogeneous systems
Threats	**Contingency Plan**
- Limited Literature - Not following deadlines - Unavailability of employees to conduct interviews	- Search for industrial contacts as soon as possible - Allocate extra time for difficult tasks - Contact more practitioners in different companies

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