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Impact of Software Testing Techniques on Software Project Success through Regression Analysis

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Abstract

This study is intended to evaluate the effectiveness of software testing techniques for the success of software project. The research studies Functional Testing, Performance Testing and Regression Testing as critical factors and characterizes the importance of them for the acquisition of project milestones. Furthermore, the study aims to address if software testing techniques have significant effect on project success and if software testing techniques have significant relationship with each other. The study contributes to making polices by government, by providing a broad vision about effective testing techniques implementations in software houses and shows how management can boast their business and get the rewards of successful business. This study is focused to lead new techniques in enhancing project quality in IT sector of Pakistan. Moreover, this study will give an opportunity to management to pay more attention on quality assurance department to enhance their project success and finally their business growth.

Keywords: Functional Testing, Regression Testing, Software Project Success

Introduction

Software testing and fault detection techniques are critical for the success of software project, because for the success of project it's necessary to meet the specifications and software must be bugs free. There are several types of software testing techniques that are applied for assurance of quality software. This study is intended to evaluate the effectiveness of software testing techniques for the success of software project. Testing is done as parallel to software development from starting phase to ending phase to expose defects created by developers.

In this study different critical factors are discussed and characterize the importance of these for the acquisition of project milestones. In this research different testing techniques and their effectiveness is discussed in detail. Major critical factors for the success of software project are covered in this research are Functional Testing, Performance Testing and Regression Testing.

This study will be significant in numbers of ways it will contribute to the make polices by government, by providing a broad vision about effective testing techniques implementations in software houses and how management can boast their business and get the rewards of successful business. This study is focused to leads new techniques in enhancing project Quality in IT sector of Pakistan because normally organizations do not consider Software Testing as center of attention for project success. Moreover, this study will give an opportunity to management to pay more attention on Quality Assurance department to enhance their project success and finally their business growth.

The study aims to address the following questions for this research:

Q1: Have Software testing techniques significant effect on project success?

Q2: Does Software testing techniques have significant relationship with each other?

Literature Review

The basic purpose of testing is to assure the quality of software system by thorough analysis that system is performing according to its specification(Chow and Cao, 2008). A good test is one which discovers maximum errors within application whereas a successful.

Generally, the inquiry on testing approaches can be divided into two major types like theoretical and methodological. Software Testing methods are based on set of techniques taken from graph theory, programing language, reliability assessment, reliable-testing theory etc. (Linberg, 1999).

Even software testing has been one of the important parts of software development before the year 1975 yet it has been considered to be an instinctive & extemporary process(Kitchenham et al., 2009). Principle function and structural technique has had more emphasis than the systematic research on these techniques by most of the people. Goodenough and Gerhart have been considered as the pioneers and the founders as they provided the baseline theory of Test Data Selection in 1975(Kitchenham et al., 2004).

Two vital theoretical studies for testing techniques presented in the year 1980 name functional testing and structural testing(Abrahamsson et al., 2017). Functional testing is broadly adopted and found useful in academic and industry practices but theoretical research on functional testing is very little in numbers(Rai et al., 2017). During the 1980, first theoretical approach is built to explain how systematic design methods can be used to construct functional tests.

A domain error can be defined as when a programs functions abnormally due to a subset of a programs input (Dingsøyr et al., 2018). Structural testing data flow study starts in 1985. Rapps and Weyuker introduce test data selection methods based on data flow analysis. They also struggled to fix issue of path selection criteria where some program errors are unnoticed. Series of path selection techniques presented with arguments on affiliation between these methods and techniques (Kitchenham et al., 2017).

In traditional specifications based functionality testing, exploratory selection criteria is used for test cases selection in which test cases are chosen privately on the bases of requirements specifications (Ghaffarian and Shahriari, 2017). On the other side in Structural testing application can be automated. Author added that Implementations based techniques are correlated with formal specifications languages and he introduces a testing methodology by combining both specifications and Implantations based techniques.

In 1990s one more research on specification based testing was conducted, in which Boolean algebra was introduced as a basic of all logic systems and for logical analysis tools that includes methods to simplify, transform and check specifications(Arcuri, 2018). With the help of Boolean algebra consistency and completeness of a system can be analyzed and also for test designs. Decision tables are also used to define the test designs and functional requirements of a program. Boolean algebra logic in test data selection was an earliest test-based selection approach on existing.

Methodology

The proposed population for this study is Software engineers (SQA Engineers) of senior and lead level positions. Both males and females are respondents of this study. A sample of 100 employees will be selected using Snowball sampling technique based on Probability sampling procedures. Data will be collected through close ended questionnaire and statistical analysis will be performed through Statistical analysis tool SPSS. The concepts will be operationalized using five-point scale like scale ranging strongly agree = 5 to strongly disagree = 1.

Theoretical Framework and Research Hypotheses

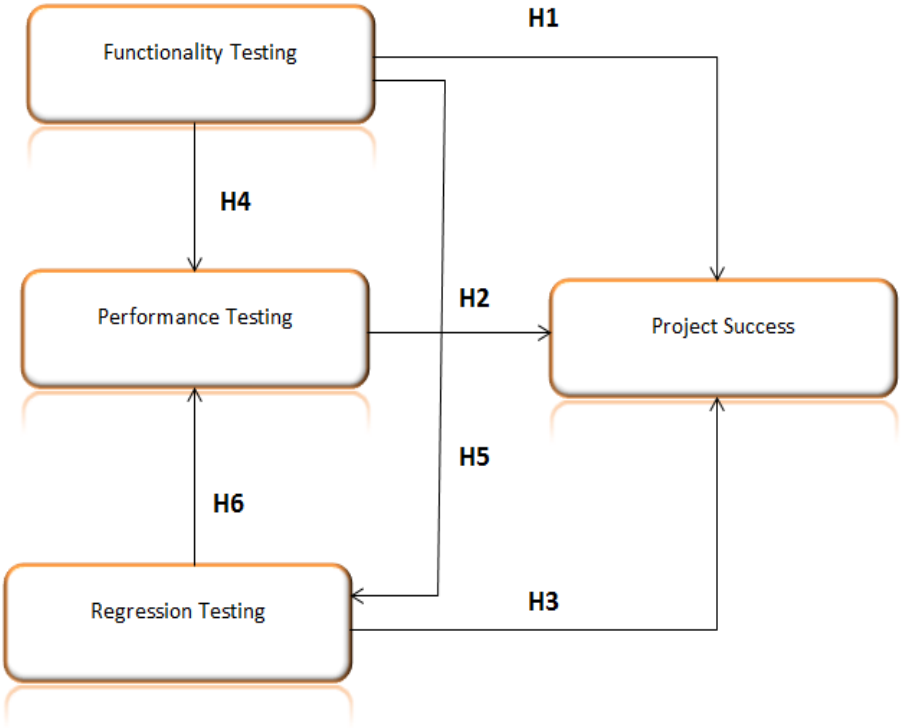

Figure 1. Theoretical Framework

Hypotheses are created to find out solution of research questions, association between dependent and independent variables and to test the theoretical framework of this study. Only Alternative hypothesis are given in this research. In this study six hypothesis are constructed to test the significance of relationship between independent and dependent variables. These hypotheses are given below:

Theoretical framework for all hypotheses is given below. To elaborate in detail, I split this framework in two parts, in first part, I discussed 3 hypotheses to determine the impacts of Software Testing Techniques on Project success in IT sector.

- H_1: To determine the relationship between functional testing and software project success.
- H_2: To determine the relationship between performance testing and software project success.
- H_3: To determine the relationship between regression testing and software project success

In second part of framework, "Do Software testing techniques have significant relationship with each other" has been explained.

- H4: To determine the relationship between functionality testing and performance testing.
- H5: To determine the relationship between functionality testing and regression testing.
- H6: To determine the relationship between regression testing and performance testing.

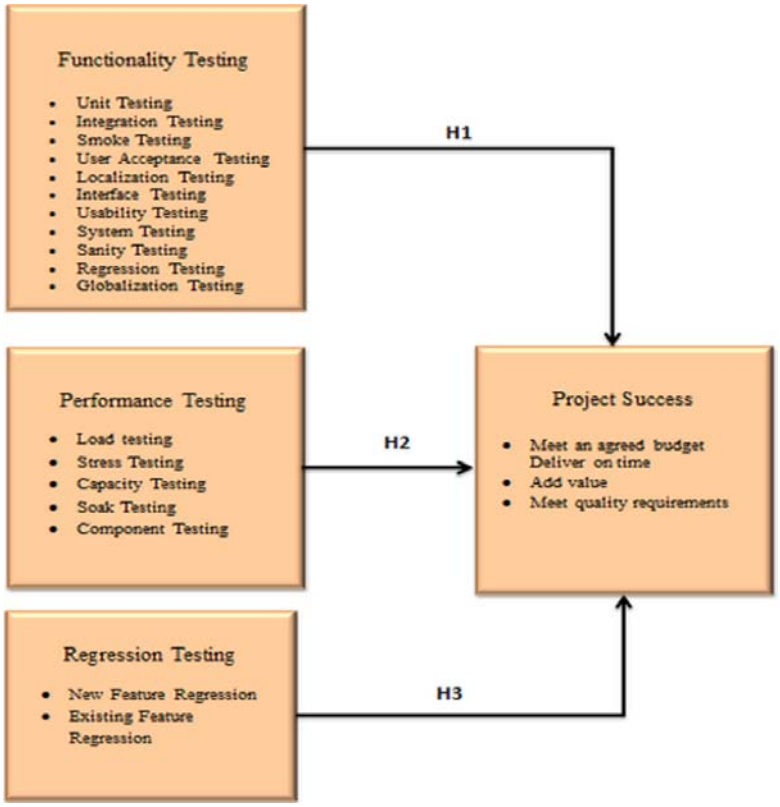

Figure 2. Theoretical Framework Part 1

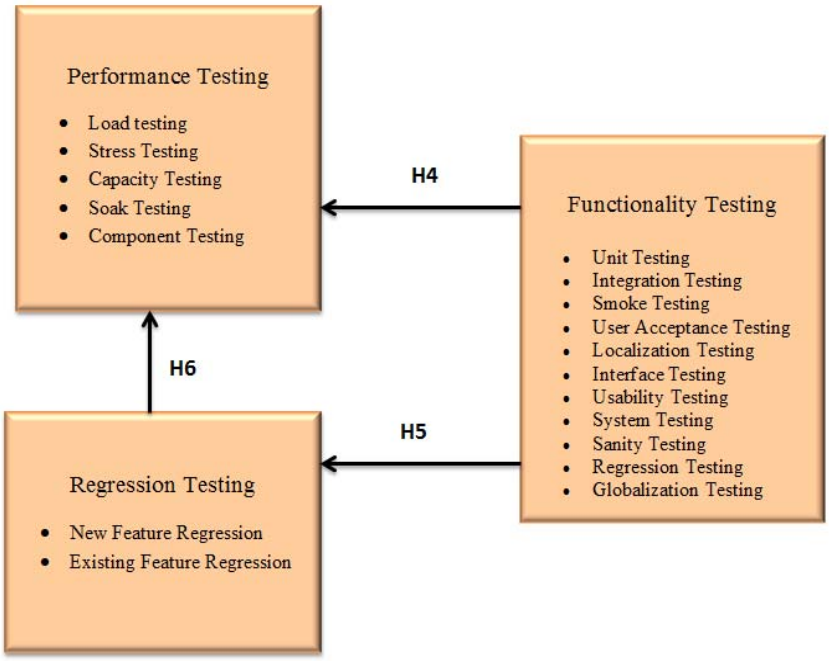

Figure 3. Theoretical Framework Part 2

Results

Reliability Analysis

Reliability statistics table value shows of Cronbach's alpha, which is **0.961**, which indicates a high level of internal consistency for our scale with this specific sample.

Table 1. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.961	.964	41

Data Collection

Overall questionnaires response rate was 31% i.e 92/300, Total three hundred questionnaires was shared with different software houses in multiple cities like Islamabad, Lahore, Gujranwala and Karachi. The study has been focused for 300 respondents across various cities in Pakistan. Be that as it may, only 92 respondents responded to questionnaire and they submitted their response with in specified time frame. Questionnaires were sent to respondents by using Email, Google form and also hard copies of these questionnaires were also shared with some respondents.

Correlation Analysis

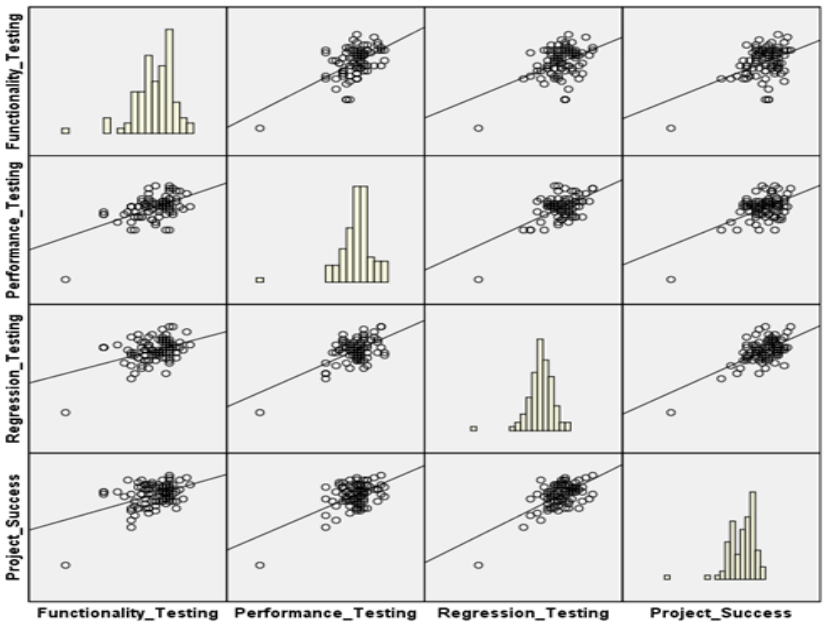

Figure 4. Scatter Plot between Functionality Testing, Performance Testing, Regression Testing and Project Success

In particular, in order to investigate whether the functionality testing, performance testing and regression testing are correlated with and have an impact on the project success. For this, the Spearman rank correlation test is used. Spearman correlation coefficient between all variables were calculated. The results are shown in Table 2.

Correlation coefficient was computed to assess the relationship between functionality testing and project success, r = .445, n = 92, p = 0.000. Overall, there was a weak, positive correlation between functionality testing and project success, meaning these variables tends to increase together. Hence, H_1 is accepted.

Correlation coefficient was computed to assess the relationship between performance testing and project success, r = .553, n = 92, p = 0.000. Overall, there was a significant, positive correlation between performance testing and project success, meaning these variables tends to increase together. Hence, H_2 is accepted.

Correlation coefficient was computed to assess the relationship between regression testing and project success, r = .628, n = 92, p = 0.000. Overall, there was a significant, positive correlation between regression testing and project success, meaning these variables tends to increase together. Hence, H_3 is accepted.

Correlation coefficient was computed to assess the relationship between functionality testing and performance testing, r = .552, n = 92, p = 0.000. Overall, there was a significant, positive correlation between functionality testing and performance testing, meaning these variables tends to increase together. Hence, H_4 is accepted.

Correlation coefficient was computed to assess the relationship between functionality testing and regression testing, r = .434, n = 92, p = 0.000. Overall, there was a significant, positive correlation between functionality testing and regression testing, meaning these variables tends to increase together. Hence, H_5 is accepted.

Correlation coefficient was computed to assess the relationship between regression testing and performance testing, r = .596, n = 92, p = 0.000. Overall, there was a significant, positive correlation between regression testing and performance testing, meaning these variables tend to increase together. Hence, H_6 is accepted.

Table 2. Correlation Results

	Functionality_Testing	Performance_Testing	Regression_Testing	Project_Success
Functionality_Testing	1			
Performance_Testing	.552**	1		
Regression_Testing	.434**	.596**	1	
Project_Success	.445**	.553**	.628**	1
**. Correlation is significant at the 0.01 level (2-tailed).				

Regression Analysis

Since Spearman rank correlation analysis shows the existence of relationships between variables but not the impacts of independent variables on dependent variable. The regression analysis produced equations that represent the best prediction of the dependent variable from several of the independent variables. Therefore, the objective of the multiple regression analysis was to determine which independent variables were important in predicting Project success.

Step1: Models accuracy (Adjusted R^2)

The value of multiple correlation coefficient (R) indicating moderate of all independent variable with project success and the value of Adjusted R^2 is 0.437. This means that approximately 44 percent of variation in Project Success is explainable by all the three constructs developed in this study.

Table 3: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.675[a]	.456	.437	.36376
a. Predictors: (Constant), Regression_Testing, Functionality_Testing, Performance_Testing				

Step 2: Models Significance:

Anova table indicates (p = 0.000) that model is statistically significant. It means at least one regression coefficient is playing a role in the model.

Table 4. ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.758	3	3.253	24.581	.000[b]
	Residual	11.644	88	.132		
	Total	21.402	91			
a. Dependent Variable: Project_Success						
b. Predictors: (Constant), Regression_Testing, Functionality_Testing, Performance_Testing						

Step 3: Predictors Significance:

The results of the regression table indicated the three predictors explained 44% of the variance (R^2=.437, F (3, 88) = 24.581, p<.01). It was found that the significant variables are Functionality Testing (β = .113, p = 0.000), Performance Testing (β = .223, p = 0.047) and Regression Testing (β = .464, p = 0.000).

Table 5: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.066	.372		2.868	.005
	Functionality_Testing	.113	.080	.135	1.412	.000
	Performance_Testing	.223	.110	.216	2.019	.047
	Regression_Testing	.464	.104	.440	4.442	.000
a. Dependent Variable: Project_Success						

All regression coefficients (β) have significant positive relationship between all independent variables and project success, it means that these variables tend to increase together.

Conclusions

As concluded with the correlation and regression analyses, significant relationship between the functionality testing, performance testing, regression testing and project success could be found with the data given. This leads to the validation of the hypotheses as formulated previously.

A Pearson product-moment correlation coefficient was computed to assess the relationship between functionality testing, performance testing, regression testing and project Success.

Overall, there was a moderate, positive correlation between functionality testing and project Success and the direction of relationship is positive meaning these variables tends to increase to-

gether. Hence, H_1 is accepted. There was a significant, positive correlation between performance testing and project success. and the direction of relationship is positive meaning these variables tends to increase together. Hence, H_2 is accepted. There was a significant, positive correlation between regression testing and project success. and the direction of relationship is positive meaning these variables tends to increase together. Hence, H_3 is accepted. There was a significant, positive correlation between functionality testing and performance testing and the direction of relationship is positive meaning these variables tend to increase together. Hence, H_4 is accepted. There was a significant, positive correlation between functionality testing and regression testing and the direction of relationship is positive meaning these variables tend to increase together. Hence, H_5 is accepted. There was a significant, positive correlation between regression testing and performance testing and the direction of relationship is positive meaning these variables tend to increase together. Hence, H_6 is accepted.

The impacts of the functionality testing, performance testing and regression testing have been tested by multiple linear Regression Analysis and they are found to be very significant factors. The Regression Model has been developed and examined and the value of Adjusted R^2 is .437. This means that approximately 44 percent of variation in project success is explainable by the three constructs developed in this study.

From the analysis its valid that functionality testing is a fundamental part for a successful project which ensures that software is working according to its specifications as it starts from Software test life cycle first phase. Functionality testing, regression testing and performance testing has a significantly impact on each other because the strong functionality testing can identify all possible issues ("bugs") and after fixing these bugs, critical Regression testing cycle is required to make sure that there is no ripple after the bug fixes. If there are no ripples and project is in the complete working state according to the requirements, project Performance will also be on high level of acceptance.

Hence, it has been concluded that functionality testing, regression testing and performance testing techniques are very significant factors for software project success from initiation phase to its deployment phase. This implies that organization should follow TQM techniques to properly implement processes and perform these testing techniques before deployment to make sure that bug's free project is delivered on client side.

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