Spring 2017

Role of Requirements Engineering in Software Project's Success

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ROLE OF REQUIREMENTS ENGINEERING IN SOFTWARE PROJECT'S SUCCESS

by

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B.Sc., April 2009, Andhra University, India

A Thesis Submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
Requirements for the Degree of

MASTER OF SCIENCE

ENGINEERING MANAGEMENT

OLD DOMINION UNIVERSITY
May 2017

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ABSTRACT

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Despite considerable time and resources spent on the initiation phase of software projects, discrepancies often exist between formal project documentation, customer requirements, and final project specifications. Such discrepancies in the requirements management process can have a very negative impact on final project outcomes. A Business Requirements Document (BRD) constitutes the formal software requirements documentation, which typically includes stakeholders' needs and expectations and project scope while providing a clear project roadmap and project plan. According to IEEE standards, a BRD should be a structured document that includes specific elements such as functional and technical requirements while incorporating certain traits such as traceability and verifiability. Numerous studies indicate that most software companies do not ritually follow accepted standards, such as IEEE, while developing their BRDs and we know little about the relationship between requirements documentation project outcome. This thesis is a study the impact of requirements documentation quality on software project's outcomes through a random sample of software projects from 12 different hospitals within a large healthcare provider. Requirements documentation quality was evaluated against IEEE standards. Projects' cost and schedule metrics were used to assess project outcomes. Results

outline the key elements of the requirements documentation process that are associated to project success.

AKCNOWLEDGEMENTS

There are many people who have contributed to the successful completion of this dissertation. I would first like to thank my thesis advisor Dr. Pilar Pazos, masters' G.P.D. of the Engineering Management and Systems Engineering Department at Old Dominion University. She consistently guided me on this and steered me on right direction whenever I needed it. I am gratefully indebted for her continuous encouragement.

I would also like to thank the field expert, Dr. Rolando DelAguila, who provided me with the data and his valuable feedback. He was also involved in the validation of evaluation of data. Without his input and contribution, the thesis could not have been successfully completed.

Finally, I would like to extend many, many thanks to my committee members for their patience and their valuable comments on my thesis.

NOMENCLATURE

BRD	Business Requirements Document prepared before initiating a software project
CEO	Chief Executive Officer. The highest designation of a company official.
FRS	Functional Requirement Specification
IEEE	Institute of Electrical and Electronical Engineers. IEEE is a professional organization which engages in and advocates technology improvements worldwide.
PMBOK	Project Management Body of Knowledge; The de facto standard for project management.
PMP	Project Management Professional. A certification provided by PMBOK for project managers.
RD	Requirements Development
RE	Requirements Engineering
RM	Requirements Management
SRS	Software Requirement Specification document, which is another name for BRD

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CHAPTER 1

INTRODUCTION

Within a software project implementation phase, scope creep has been identified as a key factor behind a project failure. Scope creep refers to continuous or uncontrolled growth in project's scope that can occur when the scope is not properly defined, documented, and controlled (Thakurta, 2013). A survey-based study of 376 chief executives, led by the consulting firm CSC Index reported that about 50% of all software projects fail to meet business expectations (Keil, Rai, Mann, & Zhang, 2003). Prior research has determined that causes of failure in software projects are spread over various areas including project management, requirements engineering (RE) and implementation (Lehtinen, Mäntylä, Vanhanen, Itkonen, & Lassenius, 2014). RE is a combination of requirements development (RD) and requirements management (RM).

Business requirement analysis is the process of discovering, analyzing, defining, and documenting the requisites that are associated with a business objective (Kostalova, Tetrevova, & Svedik, 2015). Through this process, the client clearly and precisely defines the scope of the project, so that the project team can establish the timelines and resources expected to finish it.

Despite spending tremendous time and resources in requirements management, some projects still have large discrepancies between the characteristics of the final design and specific customer needs. The reason behind these discrepancies can vary, but often include customer changes in requirements halfway through the project, conflicting requirements from multiple clients or additional requirements being included after project design has been approved. A comprehensive business requirements analysis can assist software companies overcome those discrepancies.

1.1. Project Relevance

Despite its significance, requirements engineering (RE) challenges are widespread and very common in all types of industries. Particularly in software projects, it has been reported that there is a clear association among requirements gathering, management, analysis, and software quality. According to an empirical study, it was found that out of 268 cited software development challenges, 48% were requirement related challenges(Hall, Beecham, & Rainer, 2002) . Although it is well accepted that requirements management is critical to process performance, there is a lack of empirical research exploring the specific impact of the Business Requirements Documentation process on overall project success. A comprehensive review of the published literature on the impact of requirements management documentation revealed a surprising scarcity of research. The literature reviews also revealed the lack of guidance and scarcity of non-technical standards to support the business requirements documentation process. This research makes significant practical and theoretical contributions. The main practical contribution is made towards the business requirement management process by identifying the critical components of a business requirement document based on well-accepted standards. From the theoretical perspective, this research contributes to the knowledge by providing empirical evidence of the relationship between specific components and characteristics of a BRD and software project performance.

1.2. Research Objectives

The aim of this study is to determine the critical components of a business requirements document in software projects based on accepted standards, and then determine the relationship between those components and software projects' performance. This study explores the applicability and value of IEEE standards in developing a business requirements document in software projects in the context of health care providers. Given that many software companies do not understand or see the value in following standards, this study explores whether the quality of the BRD documentation based on IEEE standards is associated to project performance. This project relied on a random sample of BRDs from a large health provider with 12 different hospitals to evaluate the impact of requirements documentation on project performance (cost variation and schedule variation).

1.3. Research Problem Statement

A comprehensive review of the literature in business requirements management for the software industry revealed a lack of research on the impact of the requirements documentation process on project success. Although there is anecdotal evidence of the role of requirements management on software project performance, the impact has not been clearly established empirically. This study is aimed at establishing the relationship between key performance indicators of a BRD based on established IEEE standards and software project performance.

CHAPTER 2

LITERATURE REVIEW

2.1. Theoretical Background

The preliminary design of a project including the task scope, objectives, resources, and technology has been presented as a critical element that impacts software project outcomes (McLeod & MacDonell, 2011). This preliminary design phase constitutes an intrinsic part of scope management within the overall management of software projects. Project scope management is defined as the specification of project's boundaries based on expected software deliverables (Woolridge, Hale, Hale, & Sharpe, 2009).

2.1.1. Project Management

Project Management is a strategic approach to planning, implementing, and closing project processes from beginning to project completion. The following are the phases in the project management life cycle: initiation, planning, execution (including monitoring and controlling), and termination. Project scope and requirements are determined during the "initiation" phase (Thakurta, 2013).

Initiation: During this phase of a project, ideas to address stakeholder requests are produced, gathered, recorded, and inspected (idea generation). Generally, these ideas are project planning elements such as project feasibility, purpose, approach to be used, potential problems, preliminary recommendations, and so on. These elements' practicality, likelihood, and strategic impact are analyzed so that a definite conclusion can be made with respect to their execution (idea evaluation). Scope management is part of the initiation phase and it involves identifying stakeholders, creating a project charter and building the business requirements documentation. This phase ends with a formal go/no-go decision made by the management team often using the most applicable and efficient mechanism called Project Portfolio Planning (Maley, 2012).

2.1.2. Project Scope Management

Project Scope Management is the process within the initiation phase concerned with characterizing all foreseen aspects of the work expected to effectively meet the objectives of the project at hand. Every sub-process within scope management happens at least once - and often repeats - all through the project's life (Heldman, 2013). This sequence is exceedingly interactive and it characterizes and controls what is and what is not part of the task.

Project Scope Management encompasses both product scope and project scope. Product scope concerns the characteristics of the product or result of the project. Product scope is used to determine the product requisites for effective completion. Project scope involves managing the work associated with the project. It includes the project management plan, project scope statement, the work breakdown structure (WBS) and the WBS dictionary.

According to the Project Management Body of Knowledge (PMBoK), project scope management encompasses five consecutive processes (Snyder, 2014):

Table 1: Steps in Scope Management Process (Heldman, 2013)

Process	Description
Scope Planning	Detailing the requirements of the product of the project
Scope Definition	Verifying those details using measurement techniques
Create WBS	Creating a project scope plan
Scope Verification	Creating a work breakdown structure
Scope Control	Controlling changes to these processes

To ensure successful implementation of the processes outlined above, a standardized documentation of requirements is essential. The document associated to the scope management process is called a BRD (Business Requirement Document).

Requirements gathering comprises mainly of five main activities:

- Eliciting: Meet up with key stakeholders to determine their requirements.
- Analyzing: To determine whether the stated requirements are unclear, inconsistent, ambiguous or contradictory and to modify them accordingly to address any issues identified.
- Documenting: Requirements may be documented as general descriptive content, use cases, user stories, and technical process specifications. These elements would vary depending on the project type and technical knowledge of the stakeholders.
- Validating: Ensuring that the selected strategy meets stakeholders’ needs and it achieves the intended purpose.
- Sign-off: Formal sign-off on documents to start the initiation implementation phase according to agreed time and budget.

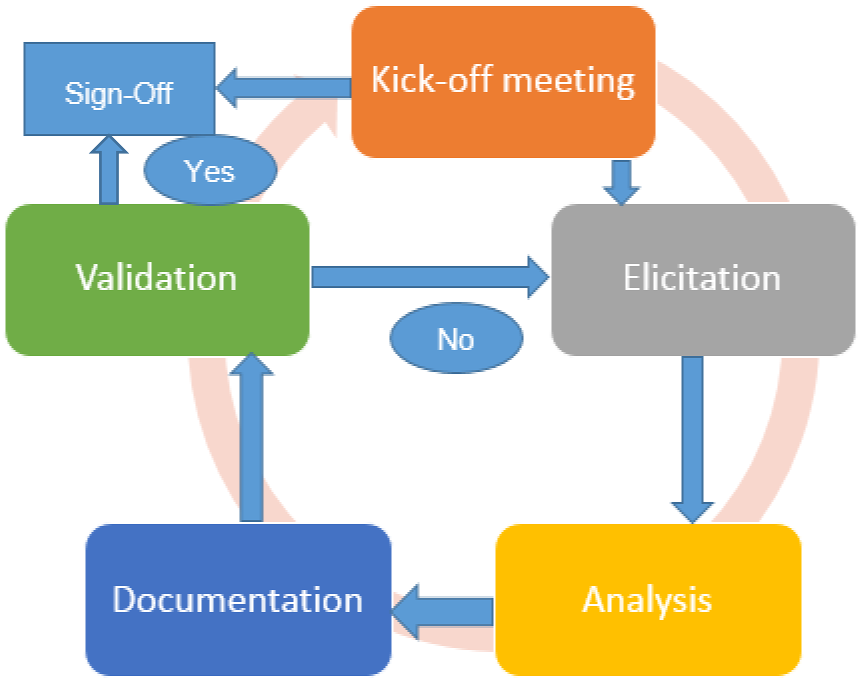

Figure 1: Steps in Requirements Gathering Process

The five processes in the above figure take place consecutively. The kick-off meeting is the first event that takes place only once during the initiation of a project. On the other hand, elicitation, analysis, documentation and validation processes are cyclic and take place repeatedly until all the requirements are set. Lastly, sign-off is a one-time process that takes place before commencing the development process. Even after the sign-off there may be changes in requirements. This change management poses a major challenge to the efficiency of a project's development and implementation.

2.1.3 Change Management

Prior studies have shown that the failure rate of software projects has remained high, largely due to the inefficient management of dynamic changes that may occur throughout the project management life cycle (Fogle, 2014). These dynamic changes impact the process workflow, personnel factors, and estimated timelines and budget. Software project managers may have to respond quickly to rework the project plan by using effective risk management methods, project estimation tools, and models. Quantifying the unexpected project events in terms of extra time and cost it may incur and continuous re-evaluation of dynamic project changes may be considered as efficient change management (Fogle, 2014).

2.2. Literature Review

A project is a temporary endeavor aimed at delivering a unique product, service or procedure (Heldman, 2013). In most cases, this uniqueness implies there are no templates or blueprints set up to develop the end-product or service. Requirements gathering is an important phase in the project life cycle by which stakeholders' needs and objectives are collected.

A BRD serves as the ultimate blueprint of the project requirements necessary for a software project success (Handoyo, Isnantoa, & Sonda, 2012). The BRD is also known as SRS (Software Requirement Specification) or FRS (Functional Requirements Specification) document.

The BRD typically consists of eight sections, each dedicated to a specific requirement phase. The sections cover a set of attributes bearing on well-integrated information (Kajko Mattsson, 2009).

According to Handoyo et al. (Handoyo et al., 2012)) the eight sections are explained as follows:

1. General requirement description: This describes basic information needed for identifying, understanding, and classifying requirements. e.g.: requirement ID, requirement title, functional and technical requirements, reference documents, etc.
2. Requirement evaluation data: This describes the data required for analyzing and prioritizing the requirements.
3. Other description data: Gives the detailed description of requirements and their management process.
4. Requirement reporting data: Gives the documented information on the initiation of the project and resource loading.
5. Requirement management data: Provides data about requirements management process.
6. Requirement management progress: Tracks the implementation status essential for monitoring and controlling requirements.
7. Requirement completion data: Covers information about planned and actual activities of the implementation process.

8. Post-Implementation data: Contains information on the analysis on lessons-learned after go-live process.

According to Heldman (Heldman, 2015), every BRD should have the following information to define scope clearly and precisely.

1. Business Requirement: A list of explicit requirements that reflects stakeholders' needs.
2. Functional Requirement: A detailed breakdown that explains how the outcome of a project will be executed to meet the specified client needs. It gives the details such as number of resources required, resource loading, and cost estimates.
3. Non-Functional Requirements: The activities required to support the project outcomes during and after implementation. The activities include hardware requirements, software licensing, page response time, number of concurrent users, security, reliability, maintainability, availability, and extensibility.

Depending on the feasibility and clarity, requirements can be categorized as follows:

1. Expected Requirements: The requirements that the stakeholder is aware of and has been documented.
2. Unconscious Requirements: The trivial requirements which should be carried out but not mentioned in the BRD
3. Unexpected Requirements: The requirements that come in later part of project due to change in scope and needs of client.

2.1.1. Standards for BRD construction

According to IEEE Standard 830-1998, an ideal BRD document should have following main information.

1. Introduction to the requirements in the preparation of the BRD that includes: a complete list of all documents referenced, summary, terminology, acronyms and abbreviations used, data collections systems, objectives, and targeted results that need to be understood by developers and users.
2. Overall description including a list of all factors that impact requirements, a summary of main functions, a description of operation of the software under various constraints, general requirements of users in terms of technical, educational, and expertise levels.
3. All requirements should be included in a common section and should address the following topics: all inputs and outputs used, performance requirements of human interaction, logical requirements, design constraints, attributes needed, and some basic actions on the software in accepting, processing input, and producing output.

Functional Requirements should contain certain functions that are interconnected and interdependent. These functions may vary across projects and typically include: team charter, schedule and budget agreements, liabilities, and legal requirements. Functional requirements can affect quality attributes such as traceability, usability, maintainability, security, reliability, and portability.

- Defining rules and administrative systems and accreditation by the administrator.

- Gathering remarks or complaints from external clients.
- Maintaining the record of number and degree of importance of stakeholders.

- Authorization for clients who need to utilize the system.
- Access data about the framework.

Nonfunctional requirements outline design constraints, assumptions and dependencies, and system performance.

- Design constraints include possible limitations that administrators and operators can face accessing the designed system.
- Assumptions and dependencies include the expected conditions that a user can anticipate when accessing the system and the understanding of its limitations.
- System performance describes accessibility issues. Examples include system usability, general accessibility, response time, etc. (Handoyo et al., 2012).

According to Handoyo et al. (2012), documenting business requirements prior to developing software has several advantages, which are:

1. Requirements in BRD can uncover exclusions, errors, and inconsistencies ahead of schedule in software development life cycle (SDLC).
2. Give a premise to evaluating expenses and plans that can be utilized to acquire the approval of bids or price estimates.
3. Provide a basis for validation and verification
4. As part of the development contract BRD gives a fundamental record compliance with necessities that can be measured (Handoyo et al., 2012).

IEEE standards also suggests that the parties involved in the development of BRD should include (Handoyo et al., 2012):

- Project core team
- Business Partner(s)
- Process owner(s) or Representatives
- Subject Matter Experts
- Change/product/project management, quality department, and IT department depends on the projects' need.

CHAPTER 3

METHODOLOGY

The design of a project including the task scope, objectives, resources, and technology, has been presented as a critical element that impacts software project outcomes (McLeod & MacDonell, 2011). These aspects of projects are an intrinsic part of scope management within the larger scope of software project management. Project scope management is defined as the process of establishing specifying project's boundaries on the basis of expected software deliverables (Woolridge et al., 2009).To ensure successful implementation of a software project, a standardized documentation of requirements is considered essential. The document associated to the scope management process is called a Business Requirements Document (BRD). The term BRD will be used for the remaining of this thesis to refer to the Business Requirements Document.

3.1. Sample

This study was conducted within a large health care provider with 12 hospitals. The main goal of the analysis is to determine the relationship between the quality of the BRD and project success based on two performance indicators (budget and schedule variance). A random sample of 38 BRDs was used for the analysis. These BRDs belong to different software projects that were carried out at all 12 hospitals over a period of eight years. The quality of the BRD was established by evaluating its content against IEEE software requirement standards.

IEEE Standards for software requirements documentation are very comprehensive and not all the components that are part of the standard are necessary in all projects. However, there are certain key aspects that form the core of the business requirements document that are typically present in any software project. This study included a comprehensive evaluation of the IEEE standards, which led to the identification of three elements of the BRD that are the core of the business requirement documentation. Each BRD was evaluated to determine the quality of the documentation with regards to those three elements.

This research used a quantitative methodology to analyze the relationship between quality of the BRD and software project's performance (time and schedule variance). This methodology involves evaluating BRDs with regards to their alignment with IEEE standards for the business requirement documentation process. The independent variables will reflect the extent to which the BRD reflects the IEEE standards and are denoted by X_1, X_2, X_3. There are two dependent variables that evaluate project success through cost variance and schedule variance. The research variables are defined in the following section.

3.2. Variables

3.2.1. Independent variables

Three independent variables were used to assess key characteristics and elements of a BRD according to IEEE standards. Two subject matter experts in software project management evaluated BRDs to determine the extent to which they met IEEE standards. Three elements of the BRD (X_1, X_2 and X_3) were evaluated using a range from 0 (low quality) to 1 (high quality). The values were assigned by two subject matter experts (SME) based on the following criteria:

1: Denotes an element of the BRD that is complete and clear in terms of project requirements as per IEEE standards.

0.5: Denotes an element of the BRD that with incomplete information per IEEE standards.

0: Denotes an element of the BRD that had no relevant content as per IEEE standards.

The two SMEs assessed the projects independently based on the rubric listed above and reached consensus on their final assessment of all the BRDs.

The variables evaluated are listed and defined in Table 2 in the independent variables column.

Table 2: Independent Variables and their Definitions

	Independent Variables		Definition
X_1: Project Purpose	X_{11}	Purpose	Includes description of the intended external behavior of the application
	X_{12}	Scope	Specifies requirements for software development
	X_{13}	Success Metrics (Verifiability)	Provides a summary of the main functions the software will perform and how to measure them
X_2: Overall Product Description	X_{21}	Product functions	Provides summary of major functions of the software
	X_{22}	Limitations, Dependencies & Assumptions	Includes expected conditions that a user can anticipate when accessing the system and the understanding of its limitations.
	X_{23}	Technical Impacts	Describes how product operates under other constraints such as system, user, hardware, software, communications, memory, operations and site adaptation requirements.
X_3: Specific Requirements	X_{31}	Functions	Includes inputs, exact sequence of operations, processing and generating outputs (Contain test cases)
	X_{32}	Design constraints	Describes possible limitations that administrators and operators can face accessing the designed system

3.2.2. Dependent variables

Two dependent variables were used to measure project outcomes. Y_1 is the cost variance based on the original budget and Y_2 is the schedule variance.

Y_1: Cost variance was calculated as the difference in percentage between the expected cost and the actual cost of a project.

Y_2: Schedule was calculated as the difference in percentage between planed and actual time of a project.

3.3. Hypothesis

The early development phases of a software project including the task scope, establishing objectives, resources, and technology have been suggested as important factors that influence software project outcomes (McLeod & MacDonell, 2011). This study aims to explore the importance of scope management, in particular business requirement documentation, in project performance. This study hypothesizes that the quality of the content of a BRD has a positive association to project performance (budget and schedule). Essentially the hypothesis can be stated as:

> There is a relationship between the characteristics of the BRD and project performance in IT Health Care projects

3.4. Data Analysis Plan

The goal of the analysis was to determine which characteristics and elements of a BRD measured by the independent variables are better predictors of project's success. Linear regression analysis was used to develop a predictive model of project success based on the independent variables previously discussed. PASW/SPSS 20 was used to conduct the regression analysis.

CHAPTER 4

DATA ANALYSIS

The main purpose of this study was to identify the key factors of a BRD that contribute to a software project performance. This chapter provides describes the quantitative analysis and findings of the study.

There are two steps in investigating the relationship between the software project success rate and the quality of BRD.

1) Determine the extent to which the independent variables contribute to budget variance Y_1
2) Determine the extent to which the independent variables contribute to schedule variance Y_2.

Two multiple linear regression analyses were conducted to develop predictive model of each dependent variable considering all independent variables (X_1,X_2,X_3).

4.1. Hypothesis in Null Form

The null hypotheses consist of:

$H_0$1: There is no relationship between the independent variables and Y_1

$H_0$2: There is no relationship between the independent variables and Y_2

Analyses were conducted to determine to what extent these independent variables are significant predictors of software project success.

4.2. Regression Analysis Result

The first stage of the analysis consisted on calculating the descriptive statistics for all independent and dependent variables. Table 3 illustrates those values for the predictive model of Y_1. Table 4 indicates bivariate correlations.

Table 3: Descriptive Statistics for Y1

	Mean	**Std. Deviation**	**N**
Y1	-.0029	.1972	38
X1	.6579	.3932	38
X2	.6184	.2256	38
X3	.5066	.3209	38

Table 4: Pearson Correlations for Y1

		Y1	**X1**	**X2**	**X3**
Pearson Correlation	Y1	1.000	.457**	.052	.208
	X1		1.000	.114	.340*
	X2			1.000	.627***
	X3				1.000

* p<0.05, **p<0.01, ***p<0.001

Table 5 is the model summary table which provides information about the regression line's ability to account for the total variation in the dependent variable.

Table 5: Model Summary for Y1

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					F Change	df1	df2
1	.463[a]	.214	.145	.1824	3.094	3	34

The above table shows the multiple linear regression model summary and overall statistics. From the regression analysis results, $R^2 = .214$. This implies that the proposed model explains 21.4% of the variance in the dependent variable Y_1. The value of R (0.463) is only very slightly higher than the correlation between Y_1 and the independent variable X_1.

The ANOVA table tells that the model can predict Y (dependent variable) using X (independent variable).

Table 6: ANOVA for Y1

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.309	3	.103	3.094	.040[b]
	Residual	1.131	34	.033		
	Total	1.439	37			

a. Dependent Variable: Y1
b. Predictors: (Constant), X3, X1, X2

The next table is the F-test. The linear regression's F-test has the null hypothesis that there is no linear relationship between the variables. The F-test is statistically significant.

Table 7: Coefficients for Y1

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	-.144	.099		-1.460	.153
	X1	.216	.082	.430	2.639	.012
	X2	-.051	.172	-.058	-.297	.769
	X3	.061	.128	.099	.475	.638

In multiple linear regression, the β coefficients represent the relative importance of each independent variable in standardized form. Based on the results from Table 6, we find that only X_1 is a statistically significant predictor of Y_1 and it also has the largest regression coefficient ($p=0.012$, $\beta = .430$). However, X_2 and X_3 were found to be unrelated to the Y_1. Hence, we can reject our first null hypothesis that “no independent variable is associated to Y_1”.

The elements of the BRD that contribute to the value of X_1 are include project’s purpose, scope and success metrics. There were no significant p values for any of the other independent variables.

The regression equation is as shown below:

$$Y_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \text{ ----} \tag{1}$$

Substituting the values from table 6, the regression equation can be written as follows.

$$Y_1 = -.144 + .430X_1 + (-.058)\ X_2 + .099X_3 \text{ ----} \tag{2}$$

A second regression analysis was conducted on Y_2 for the same independent variables X_1, X_2, X_3. The results are discussed next. Table 8 outlines the descriptive statistics of the sample.

Table 8: Descriptive Statistics for Y2

	Mean	**Std. Deviation**	**N**
Y2	-.658	1.995	38
X1	.658	.393	38
X2	.618	.225	38
X3	.507	.321	38

The Pearson correlation produces a sample correlation coefficient, r, which measures the strength and direction of linear relationships between pairs of continuous variables.

Table 9: Pearson Correlations for Y2

		Y2	X1	X2	X3
Pearson Correlation	Y2	1.000	-.183	.354*	.041
	X1	-	1.000	.114	.340
	X2			1.000	.627***
	X3				1.000

* p<0.05, **p<0.01, ***p<0.001

From the correlation, the independent variable X_2 shows the significant positive relationship with the schedule variance Y_2.

From the regression analysis results in table 10, $R^2 = .203$. This implies that the proposed model explains 20.3% of the variance in the dependent variable Y_2. The unadjusted R^2 is 0.133.

Table 10: Model Summary for Y2

					Change Statistics			
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**
1	.450[a]	.203	.133	1.8583	.203	2.885	3	34

Table 11: ANOVA for Y2

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	29.891	3	9.964	2.885	.050[b]
	Residual	117.414	34	3.453		
	Total	147.305	37			

Table 11 shows the ANOVA results of the independent variables. The value of F shows that there are more chances of Null Hypothesis being rejected. This supports the (1) alternate hypothesis that there exists a relationship between independent variables and Y2. ON the other hand, the significance tells us the confidence level of accepting the alternate hypothesis. Here, the significance is 0.050, which means that there is 95% confidence that the alternate hypothesis is accepted.

Table 12: Coefficients for Y2

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-2.210	1.006		-2.196	.035
	X1	-.834	.834	-.164	-1.001	.324
	X2	4.547	1.753	.514	2.593	.014
	X3	-1.403	1.302	-.226	-1.078	.289

From the above table, only X_2 is a statistically significant predictor to Y_2 ($\beta = 0.514$. $p=0.14$). However, X_1 and X_3 had no statistically significant association to Y_2. Hence, we can reject our second null hypothesis that "no independent variable is associated to Y_2". The elements of the BRD that contribute to the value of X_2 are product functions, constraints, assumptions and dependencies, and technical impacts of the project

From Table 10, the regression equation can be written as follows.

$$Y_2 = -2.210 + (-.164)\ X_1 + .514X_2 + (-.226)\ X_3 \text{ ----} \qquad (3)$$

Based on the prior results, it can be concluded that the quality of a BRD is associated to the successful outcome of a software project’s performance in terms of cost and schedule variances. The above statistical analysis provides empirical proof for this statement. With clear specification of scope and success metrics, project budget is more likely to stay in assigned limits. Likewise, with well-documented practices of product functions, projects are more likely to remained within the originally planned schedule.

CHAPTER 5

CONCLUSION

This study provides empirical evidence that the business requirements documentation process plays a key role in software project success. With regards to budget-related performance, it was found that projects with more clear determination of verifiability through key success metrics are more likely to stay within budget. Often, a discrepancy among multiple stakeholders regarding the prioritization of a set of requirements leads to a lack of clarity in defining the assumptions and dependencies. In those scenarios, the likelihood of budget creeps increase.

With regards to project schedule performance, it was found that well documented practices with regards to project functions were associated with better performance. There are limitations to this research. The project sample was collected from a large health care provider with 12 different hospitals. Although there is a documented difference in requirements documentation across different hospitals in the sample, this variability may not reflect the absolute variety across all possible health providers in the US. The budget and schedule for projects varied in range, scope and application type.

5.1 Limitations

One limitation of the data is that there was no information on whether the organization has used traditional project management or agile techniques in the project sample. This study was not able to provide the measurement of quality of a project, based on its quality metrics.

This study used a rating system for evaluating BRDs as per IEEE standards. Although there is some potential for measurement bias, an attempt was made to minimize it by using two expert raters following a well-accepted standard. A third researcher evaluated the assessment of BRDs. The research findings indicate that adequately documenting the business requirements is critical for achieving good project performance.

5.2 Implications

This research suggests that the projects that followed standards more closely were associated to higher levels of performance. In fact, lack of requirements management can be a large contributor to software project failure. This implies documenting the requirements essentially plays an important role in software project success. This also indicates documenting requirements might be most important and difficult part in a project's life cycle (Hofmann & Lehner, 2001).

Business requirement analysis is the process of discovering, analyzing, defining, and documenting the requisites that are associated with a business objective (Kostalova et al., 2015). Through this process the client clearly and precisely defines the scope of the project, so that the project team can establish the timelines and resources expected to finish it.

There are several important implications for engineering management practice that emerge from this research. First, evidence is provided, that it is paramount important to follow certain standards while documenting BRD to ensure proper documentation and traceability of project requirements. The BRD should allow all the stakeholders in the software production to consider all requirements rigorously to reduce redesign, recoding and retesting in later stage. Careful review can help reveal omissions, ambiguities and inconsistencies early in the development cycle when these issues are easier to correct. Second, there is evidence of a need to define various aspects of specific requirements to ensure clarity and consistency: These aspects include realistically estimated costs and schedules, a basis for verification and validation, a basis for later enhancement and facilitate transfer to new clients.

Future research can be extended to analyze possible independent variables that are not listed in this study, that could explain the rest of variance on the dependent variable. Another avenue would be to learn the feasibility of having clear and complete requirements in complex projects and to assess the chances of having more likely successful projects when IEEE standards are followed during the requirements documentation process.

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