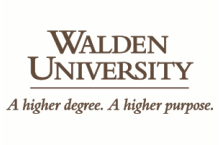

2019

Relationship Between Time Estimation, Cost Estimation, and Project Performance

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

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Walden University
2019

Abstract

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by

Eyas Nakhleh

MS, University of Liverpool, 2011

BS, Applied Science University, 1996

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Business Administration

Walden University

October 2019

Abstract

Although the project management role is increasing, project failure rates remain high. Project time and cost are 2 project factors that can affect the performance of the projects. The purpose of this correlational study was to examine the relationship between time estimation, cost estimation, and project performance. Data collection involved a purposive sample of 67 project sponsors, managers, and coordinators in Qatar. The theoretical framework was the iron triangle, also known as the triple constraints. Participants were randomly invited to answer 18 questions using the project implementation profile instrument. A standard multiple regression analysis was used to examine the correlation between the independent variables and the dependent variable. A significant linear relationship was found of time estimation and cost estimation to the project performance, F (2,63) = 24.57, $p < .05$, $R = .66$, $R^2 = .44$, and adj. $R^2 = .42$. The null hypothesis was rejected that there was no relationship between time estimation, cost estimation, and project performance. The statistically proven findings of the study might provide researchers and practitioners with microlevel information about project factors that influence project performance. The increased rate of project performance might bring about social change by leading to the improvement of local communities, increasing business performance, increasing economies' sustainability, increasing the quality of life, opening new business opportunities, and increasing the rate of employment.

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Dedication

I dedicate this work to my wife, Maisoon, my sons, Amr and Saif, my father, Dr. Nakhleh, and the soul of my mother, Maryam. I could not have done this work without the support of my loving family.

Acknowledgments

I would like to thank my committee chairperson, Dr. Natalie Casale, my second committee member, Dr. Gregory Washington, my URR member, Dr. Deborah Nattress, and the residency mentors, Dr. Reginald Taylor and Dr. Kim Critchlow for their guidance and support in my doctoral process. I also would like to thank Dr. Martin Barnes, Dr. Jeffrey Pinto, and Dr. Dennis Slevin for their research that pave the way for my doctoral study.

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Section 1: Foundation of the Study

With most information technology (IT) projects, organizational leaders experience poor project performance regarding time, cost, or scope that lead to organizational failure (Scheuchner, 2017). Between 70 to 80% of IT projects fail because project management teams could not deliver the projects as per the plan (see Mukerjee & Prasad, 2017). Some researchers indicated the time, cost, and scope, which the scholars refer to as triple constraints, as factors of project success (Scheuchner, 2017). Other scholars indicated additional factors, such as the misalignment between the project and the business strategy, poor stakeholder management, and poor risk management, as factors of project success (Berman & Marshall, 2014; Fayaz, Kamal, Amin, & Khan, 2017; Shrivastava & Rathod, 2015). Catanio, Armstrong, and Tucker, (2013) and Ingason and Shepherd (2014) indicated gaps in the project management literature regarding project success factors that could lead to a potential need for project management research.

Background of the Problem

Although the role of projects in advancing businesses is increasing, project failure across most industries is prominent (Cullen & Parker, 2015). In the last 30 years, the failure rates of information system projects remain high (Ingason & Shepherd, 2014) as only 32% of IT projects are successful (Cullen & Parker, 2015). Elzamly and Hussin (2014) argued that software project teams fail to deliver acceptable systems on time and within budget. Wang, Luo, Lin, and Daneva (2017) suggested that project teams deliver

less than 30% of software projects on time and within budget. Thus, some scholars consider projects are highly important to businesses but incapable of delivering successful systems on time and within budget.

While some project success factors are time, cost, and scope (Joslin & Müller, 2016), Wyngaard, Pretorius, and Pretorius (2012) stated that project management professionals lack the knowledge of the time, budget, and scope as project's critical success factors and Catanio et al. (2013) found that almost 60% of project management professionals lack formal project management training. Vermerris, Mocker, and van Heck (2014) suggested that businesses leaders should conduct strategic alignment at different organizational levels to manage the continued high failure rate of IT projects. However, Parker, Parsons, and Isharyanto (2015) argued that even with the focus on business alignment and project management standards, projects fail. Accordingly, IT professionals should develop new ideas to increase project success rates. IT managers and sponsors may use the findings of this study to enhance their strategic project planning capabilities to avoid poor project performance.

Problem Statement

With most IT projects, organizational leaders experience poor project performance regarding schedule, budget, or scope that lead to organizational failure (Scheuchner, 2017). Between 70 to 80% of IT projects fail to meet the estimation of time and cost (see Mukerjee & Prasad, 2017). The general business problem was that poor project performance has a negative impact on business success. The specific business

problem was that some IT project sponsors and managers do not know the relationship between time estimation, cost estimation, and project performance.

Purpose Statement

The purpose of this quantitative correlational study was to examine the relationship between time estimation, cost estimation, and project performance. The targeted population comprised of IT project managers in Qatar. The independent variables were time estimation and cost estimation. The dependent variable was project performance. The implication for social change encompassed the potential addition to the knowledge of IT that could lead to improve project execution and enhance project success. Scheuchner (2017) found that increasing project success rates could positively increase business performance, increase economic sustainability, increase the quality of life, open new business opportunities, and increase the rate of employment.

Nature of the Study

I used a quantitative approach to examine the relationship between time estimation, cost estimation, and project performance. According to Maxwell (2015), quantitative, qualitative, and mixed methods are the three methods for conducting research. Researchers use a quantitative method to measure behavior, knowledge, opinions, or attitudes to answer questions related to the frequency of phenomena (Cooper & Schindler, 2014). A quantitative approach was appropriate for this study because I used numerical and statistical information to examine the relationships between the variables. Researchers use qualitative methods to extract rich, nonnumerical data to

explore in-depth phenomena (Cooper & Schindler, 2014). A qualitative approach was not appropriate for this research since the purpose of the study was to examine statistically measurable relationships between variables. A mixed-method approach is a combination of a qualitative and quantitative method approaches within the same study (Maxwell, 2015) that requires additional time, effort, and funds. Accordingly, a mixed method was not appropriate for this study because of time and cost constraints.

Researchers use four types of quantitative design to examine relationships between variables: descriptive, quasi-experimental, experimental, or correlational (Saunders, Lewis, & Thornhill, 2015). Researchers use the correlational design to demonstrate the relationship between variables that occur together in a specified manner without implying that one caused the other (Cooper & Schindler, 2014). Therefore, the correlational design was the most appropriate for this study. Researchers use experimental and quasi-experimental designs to examine cause-and-effect relationships by manipulating some of the variables then observe the consequent effect (Cooper & Schindler, 2014). Researchers use the descriptive design in complex systems by creating visual models to demonstrate the sequence of relationships between variables (Cooper & Schindler, 2014). As I investigated the existence of a relationship between the variables, not the cause-and-effect relationship between variables or the sequence between them, quasi-experimental, experimental, and descriptive designs were not appropriate for this study.

Research Question

What is the relationship between time estimation, cost estimation, and project performance?

Hypotheses

Null Hypothesis (H_0): There is no statistically significant relationship between time estimation, cost estimation, and project performance.

Alternative Hypothesis (H_1): There is a statistically significant relationship between time estimation, cost estimation, and project performance.

Theoretical Framework

The theoretical framework for this study was the theory of the iron triangle, also known as the triple constraints model. Developed by Barnes (1956), iron triangle or triple constraints theory refers to time, cost, and scope as three constraints that constitute the quality of the project and form the project governance (Barnes, 2007; Scheuchner, 2017). The change that may happen to any of the three constraints, time, cost, and scope, will lead to a change occurring to the other two constraints (Wyngaard et al., 2012). Scheuchner (2017) recognized the iron triangle as one of the early project success definitions that measure the performance, success, or failure of a project. Cullen and Parker (2015) suggested that traditionally the iron triangle model was the basis of the measurement of project success. Similarly, Scheuchner defined the iron triangle as a model to measure the success of projects based on time, cost, and scope.

Accordingly, the iron triangle theory served two purposes: (a) identification of the project success factors, which were time, cost, and scope and (b) provisioned of a tool to measure project's performance based on the quality of time, cost, and scope. Hence, I used the iron triangle as a lens to view the phenomenon of poor project performance by using two of the iron triangle constraints, time estimation, and cost estimation as constructs of the study.

Operational Definitions

The purpose of the operational definition section was to provide the reader with the scholarly definition of terms I used throughout the study. To understand the notion of this research, readers must familiarize themselves with terms relevant to project management landscape that I commonly used in this study. I ordered the terms in alphabetical order as appeared in the study.

Cost estimation: The output of the process of developing an approximation of the cost of resources needed to complete the project work (Project Management Institute [PMI], 2017). Cost estimates are the quantitative assessment of the approximate expenditure of cost plus the contingency cost of each activity identified in the scope (Iqbal, Idrees, Bin Sana, & Khan, 2017; PMI, 2017).

Project performance criteria: The project performance referred to the process of measuring the difference between the planned and produced work by using metrics of identified goals, such as project time, cost, and scope (Montes-Guerra, Gimena, Pérez-Ezcurdia, & Díez-Silva, 2014).

Time estimation: The output of the process of estimating the amount of time each activity will take to complete the project (PMI, 2017). The time of a project is the duration of the project that leads to the least project cost (Elkhouly, Mohamed, & Ali, 2017). Project time, also known as project timeline estimation, duration estimation, and schedule estimation, is one component of the triple constraints metrics used to measure project success (PMI, 2017).

Tradeoff: The tradeoff between project factors refers to balancing of the interdependent competing factors, time, cost, and quality or scope (Rugenyi, 2015). Delivering the project on or before the target dates may require project managers to decide on processing trading off between time and cost (Habibi, Barzinpour, & Sadjadi, 2018).

Assumptions, Limitations, and Delimitations

Assumptions

Assumptions are attributes and conditions of the research researchers accepted as true without providing a proof of them (Ellis & Levy, 2009) based upon a researcher's belief, which can carry risk related to research's validity, generalization, and findings (Hagger & Chatzisarantis, 2009). I identified three assumptions for the study. First, I assumed the participants were acquainted with the concepts, notions, and terms of the project management frameworks. Second, I assumed that participants were or have been working as project managers, project leaders, or project sponsors within the last 5 years.

Finally, I assumed the questionnaire was a self-explanatory instrument that participants could autonomously manage.

Limitations

Limitations are certain conditions that exist outside the control of the researcher, caused by external factors, and imply weaknesses to the research (Ellis & Levy, 2009; Rule & John, 2015). I identified two limitations of the study. The first limitation related to the possibility of participants bias as they may provide biased answers to support their positions as project managers, leaders, or sponsors. The second limitation was the use of correlational analysis that could limit the relationship between the independent and dependent variables.

Delimitations

Delimitations are certain conditions imposed by the researcher as parameters of the study (Ellis & Levy, 2009). I included three delimitations for this study. The first delimitation associated with the restriction of the geographical location that project managers, leaders, or sponsors must have been working in Qatar. The second delimitation was the consideration of only IT projects. The third and final delimitation was that participants must have a minimum of 5 years of experience as IT project practitioners.

Significance of the Study

The findings of this study may provide value to the global body of knowledge of IT project management. IT managers and sponsors may benefit from the study by obtaining a closer view of the relationship between time and cost estimation of a project

to enhance their strategic planning capabilities to avoid poor project performance. The study may encourage IT managers, and sponsors to appreciate the role of IT project management as one of the strategic business initiative success factors (Sandhu, Al Ameri, & Wikström, 2019). Moreover, the study may motivate IT managers and sponsors to align IT project management practice with the organizational strategy. Vermerris et al. (2014) suggested that businesses should conduct strategic alignment at different organizational levels to manage the continual high failure rate of IT projects. Additionally, the findings of the study could add to the knowledge of IT managers and sponsors on the role of time and cost estimation as two components of IT project success criteria, which may lead to the improvement of IT project execution on time and within budget.

Contribution to Business Practice

The findings of this study may encourage IT managers and project sponsors to develop strategies to improve project performance by using innovation management. Innovation management is the model of creating new organizational structures, administrative systems, management practices, processes, and techniques (Hervas-Oliver, Ripoll-Sempere, & Moll, 2016). Implementing IT project management strategies could provide the required level of control for IT managers and sponsors to govern the inputs, such as time and cost estimation, and the outputs, such as project performance of the IT projects (Mir & Pinnington, 2014; Parker et al., 2015).

Implications for Social Change

Poor project performance could lead to a business failure that leads to loss of employment income, loss of economies' sustainability, and limits the growth of communities (Scheuchner, 2017). On the contrary, an increase in the project success rate could positively increase business performance, increase economies' sustainability, increase the quality of life, open new business opportunities, and increase the rate of employment (Scheuchner, 2017). Hoxha (2017) stated that if project success rates increase that might translate into an improvement of livelihood for local communities and ultimately create a positive change to the society in large. Therefore, this study could lead to a positive social change by providing knowledge to businesses' leaders that would improve project performance and hence improve livelihood for local communities.

A Review of the Professional and Academic Literature

In the literature review section, I provided an in-depth overview of the literature regarding project time, cost, and performance. The focus of the review was to address the research question regarding the relationship between time estimation, cost estimation, and project performance. I organized this literature review into five subsections. First, I presented the literature search strategy. The second subsection was to deliberate the theoretical framework for this study. In the third subsection, I presented and discussed the literature related to the variables: project time estimation, project cost estimation, and project performance. I provided in the fourth subsection an alignment between the theory and the variables. The fifth subsection, I dedicated to the rival theories.

Literature Search Strategy

I accessed the following databases to collect the resources of the study: ACM Digital Library, Dissertations & Theses at Walden University, EBSCOhost, IEEE Explore the digital library, Project Management Journal, ProQuest, ScienceDirect, and SEGA Journals. I included 140 resources in the literature review as the following: 131 peer-reviewed journals (93.6%), three doctoral dissertations (2.4%), and six books (4.3%). More than 85% of the resources were less than 5 years old distributed as the following: 21 resources published before 2014; 29 resources published in 2014; 21 resources published in 2015; 28 resources published in 2016; 33 resources published in 2017; seven resources published in 2018; and one resources published in 2019.

I used the following keywords to search for resources: *project failure, project success, project factors, project performance, key performance indicators, critical success factors, earned value management, project duration, project schedule, time estimation, project budget, project cost overrun, cost estimation, iron triangle, triple constraints, stakeholder management, project risks,* and *project uncertainty*.

Application to the Applied Business Problem

Organizations have used project management methodologies since the 1950s (Cullen & Parker, 2015; Johnson, Creasy, & Fan, 2015). Projects are unique and temporary work performed by individuals or organizations to fulfill defined objectives such as developing new products, creating new services, responding to market needs, driving organizational changes, fulfilling new legislation, improving business processes,

exploring business opportunities, and conducting research (PMI, 2017). The importance of projects resulted from the impact the project team could create as an outcome of projects. One of the most recognized factors of projects is the impact of projects on an organization's strategic elements, such as organizational objectives and goals (Franklin & Cristina, 2015; Parker et al., 2015; Sandhu et al., 2019). Another important factor of projects is the impact on the competitive advantage organizational leaders achieve as a result of successful projects. Organizational leaders use projects to implement process change, obtain productivity improvement, and implement strategies to gain competitive advantage (Awwal, 2014; Cullen & Parker, 2015). Additionally, implementing projects could enable organizational capabilities required to achieve strategic objectives, maintain the competitive advantage, and advance business operations (Adamczewski, 2016; Berman & Marshall, 2014).

Due to the importance of projects, some researchers indicated the need for more research in the area of project management (Habibi et al., 2018; Ingason & Shepherd, 2014; Sridarran, Keraminiyage, & Herszon, 2017). In a narrower view, some researchers studied the phenomena of project failure and poor project performance and identified different causes, such as the misalignment between projects and business strategies (Catanio et al., 2013; Parker et al., 2015). Habibi et al. (2018), Ingason and Shepherd (2014), as well as Sridarran et al. (2017) indicated the need for more research in the field of project management in terms of success criteria, cost management, and time management. I am aiming, as an outcome of this study, to support the IT managers and

sponsors to enhance their project planning capabilities to avoid poor project performance and align IT projects to their organizational strategies. The purpose of this quantitative correlational study is to examine the relationship between time estimation, cost estimation, and project performance. The null hypothesis is that there is no statistically significant relationship between time estimation, cost estimation, and project performance.

The Theoretical Framework: The Iron Triangle Theory

I used the iron triangle theory as a theoretical framework for my doctoral research. Barnes developed the iron triangle theory in 1969 (Barnes, 2007), also known as the golden triangle and triple constraints theory (Scheuchner, 2017). Barnes (2007) explained that he was teaching and drew a triangle to demonstrate to his students the concept of the triple constraints, where each vertex represented one of the three constraints. Barnes (2013) introduced the iron triangle or the triple constraints theory as a project governance model to measure the success of the project based on three constraints, which are project time, cost, and quality. Soon after, Barnes changed the term quality with performance as he realized that quality is too narrow to define the third constraint.

Project time refers to the duration of the project; project cost refers to the expenditure of the project; and project scope or quality refers to the requirements and work of the project (Rugenyi, 2015; Scheuchner, 2017). Time, cost, and scope are competing factors, where a change that may happen to any of the three factors could lead

to a change for the other two factors (Rugenyi, 2015; Wyngaard et al., 2012). For example, adding more requirements to the scope of a project would increase the required time and cost to accomplish the new scope (Rugenyi, 2015). Turner and Xue (2018) explained the relationship of the triple constraints as any change, even if small, could lead to a change to the overall output of the project. Parker et al. (2015) explained the relationship between the triple constraints as a mutually dependent relation where a change of one constraint imposes a change to the other two constraints. Cullen and Parker (2015) clarified that a change of one factor of the triple constraints would result in a change to at least one of the other factors.

Scholars referred to the decision making process of balancing the project scope, time, and cost as a *tradeoff* process between project constraints (Habibi et al., 2018; Rugenyi, 2015). One main role of project leaders is to consider the competing nature of the three constraints and manage the decision making process of the tradeoff relationship between time, cost, and scope, such as the tradeoff between the tight timelines and the large project scope (Abu-Hussein, Hyassat, Sweis, Alawneh, & Al-Debei, 2016; Parker et al. (2015). For instance, the tradeoff between the time and the cost could occur when a project manager decides to add more resources to a project to deliver the project on time, which involves an additional cost of the resources (Habibi et al., 2018). Lermen, Morais, Matos, Röder, and Röder (2016) explained, in the initial stage of projects, the time and cost are both equally important, but the project team may change the priority of the time and the cost throughout the project lifetime. Scholars provided different views of trading

off priorities between the triple constraints. Some scholars considered that project owners are required to complete the project on time and budget equivalently, which creates a challenge for project managers in deciding on the prioritization between time and cost (Kim, Kang, & Hwang, 2012). Other scholars considered time as the first priority, whereas cost comes at the second priority (Laslo & Gurevich, 2014).

To manage the tradeoff between project constraints, such as the tradeoff between time and cost, scholars suggested different methods. Habibi et al. (2018) referred to methods project managers use to reduce project time including adding a second shift, working overtime, and allocating additional resources, which involves adding extra cost to the original cost of the project. Elkhouly et al. (2017) referred to another method of the tradeoff between time and cost that is schedule crashing, which refers to the process of compressing the schedule of project activities to decrease total project time. Elkhouly et al. highlighted the output of schedule crashing generally increases the direct project cost. Lermen et al. (2016) conducted a single case study to explore the effect of applying critical path management and project evaluation and review techniques in optimizing project time and cost. Lermen et al. reported that the tradeoff between time and cost produced 35.8% of time saving but increased the cost of the project by 31.53%. Thus, project tradeoff is an important and practical method projects' teams use to reprioritize the triple constraints.

The recognition and comprehension of the triple constraints theory varied among scholars. Several scholars, such as Franklin and Cristina (2015), Joslin and Müller

(2016), Nicholls, Lewis, and Eschenbach (2015), Parker et al. (2015), and Sridarran et al. (2017), recognized the triple constraints as project success factors. Joslin and Müller denoted that project success evolved from the iron triangle method, and then became a multidimensional construct depending on stakeholders' definitions of success. Accordingly, this group of scholars recognized the triple constraints as project success factors.

Barnes (2007) and Sridarran et al. (2017) referred to the iron triangle as the approach project leaders traditionally used to measure project success. Scheuchner (2017) conducted a qualitative multiple case study to explore strategies that IT leaders use to manage IT projects and explained that the iron triangle provides a concise definition of project success as the three constraints form clear boundaries for project managers to measure the success of the projects. Parker et al. (2015) conducted a qualitative study to explore the benefits of integrating the theory of constraints, resource-based theory, and resource advantage theory, with a structured project-based methodology, and Parker et al. indicated that project teams measure the success of the projects based on the iron triangle. Therefore, this group of scholars considered the triple constraints as a tool to measure projects' success.

Franklin and Cristina (2015) conducted a qualitative study and used a bibliometric approach to analyze 64 papers discussing project management success. Franklin and Cristina realized there is a disagreement between the scholars regarding the criteria of project success but confirmed that scope, time, cost, and profit are certainly some project

success criteria. Joslin and Müller (2016) conducted qualitative research and used a pattern matching technique to analyze the results of interviewing 19 project professionals across 11 industries from four countries. Joslin and Müller emphasized that none of the interviewees provided a standard definition of project success, but the majority of the interviewees recognized the time, cost, and scope, and sometimes customer satisfaction, as project success criteria. Additionally, Joslin and Müller confirmed that implementing project management methodologies has a positive impact on project success. Subsequently, according to this group of scholars, project success factors could include additional factors than time, cost, and quality, such as customer satisfaction and project's profit.

Other scholars, such as Rugenyi (2015) and Wyngaard et al. (2012), considered the triple constraints theory as a project management approach rather than project success factors. Rugenyi conducted a quantitative study to assess the triple constraints approach in project management and referred to the understanding among scholars and practitioners about using the iron triangle or triple constraints as an approach to governing the success of the projects based on the tradeoff between the competing constraints of time, cost, and scope or quality. Wyngaard et al. conducted a qualitative case study to explore the national air and space museum project implementation approach. Wyngaard et al. confirmed that project management teams used the iron triangle as a project management approach to govern the tradeoff between the triple constraints. Therefore, according to this group of scholars, the triple constraints method

in a notion project team can use as a project management approach rather than project success factors or constraints.

The third group of scholars considered another point of view about the appropriate use of the triple constraints. Mir and Pinnington (2014) and Lappi and Aaltonen (2017) considered delivering projects on time and within budget, concerning the triple constraints theory, as project efficiency, not project success. Awwal (2014) explained project management teams could deliver projects on time and within budget, but at the same time, the project's owners do not realize the benefits of projects. Turner and Xue (2018) conducted a qualitative study and examined multiple case studies to assess project success capabilities. Turner and Xue identified four dimensions of project success capabilities including producing outputs, achieving desired outcomes and benefits, delivering positive net present value, and delivering business or public needs. Turner and Xue argued the role of time and cost as project success indicators. In the same context, Turner and Xue differentiated between project success and project management success, and linked project management success to finishing the project on time and within budget, while the project success relates to the realization of the other factors such as the project's output, benefits, net present value, and business or public needs. This group of scholars considered the triple constraints as project efficiency indicators rather than project success indicators because some projects could finish on time and within budget but fail to deliver successful outcomes.

Hoxha (2017) conducted a quantitative correlational study to examine the relationship between the age of project managers, the experience of project managers, and project success. Hoxha noted a distinction between the concept of project management success and project success. Hoxha referred to project management success as the delivery of the scope of projects on time and within budget, while project success involves the realization of the project's objectives after project completion. Zwikael and Smyrk (2015) suggested the realization of project objectives is the role of the project owner while delivering the project on time and within budget is the role of the project manager. Diniz, Bailey, and Sholler (2014) suggested IT project success and failure could be independent of time, cost, and scope, and project team could determine the project success and failure according to the context of the project. Although some scholars identified time, cost, and scope as project success factors, they argued them to be the only project success factors. Laux, Johnson, and Cada (2015) confirmed that project scope, time, and cost are the basic project success factors, but the realization of projects' objectives is another main factor of project success that project teams should provision in the project success. Cullen and Parker (2015) suggested project resources and project risks as additional success factors. Accordingly, this group of scholars suggested that the use of triple constraints, as a tool, could be appropriate to measure the success of delivering projects on time and within budget but not appropriate to measure the realization of projects' benefits on long term.

Additionally, Scheuchner (2017) pointed to stakeholder and customer satisfaction as additional project success factors. Turner and Zolin (2012) found that stakeholder satisfaction is the most important project success factor. Ramos and Mota (2014) indicated that the perception of the success or failure of the project exists within the stakeholders' acceptance of the project. Fayaz et al. (2016) referred to customers' needs and meeting the company's expectations as additional success project factors. Parker et al. (2015) suggested leverage opportunities, social development, and technological improvements are also project success factors.

Furthermore, Mukerjee and Prasad (2017) conducted a quantitative study and surveyed 105 projects to explore dimensions and outcomes of customer relationship management projects in India. Mukerjee and Prasad found customer satisfaction is the headmost project success factor, next was fulfilling the scope, then finishing the project on time, and last was delivering the project within the budget. Awwal (2014) indicated the need to include the achievement of the stakeholders' objectives to the success criteria of the projects in addition to the triple constraints. Relich and Bzdyra (2014) added the net profit of the projects as an additional project success factor. Thus, projects success factors could include multiple constraints, such as time, cost, quality, customer satisfaction, stakeholder's objectives, and projects' net profits.

Finally, some other scholars argued the appropriateness of using the triple constraints as the main project success factors. Allen, Alleyne, Farmer, McRae, Turner (2014) indicated that the project team measures project success by comparing the

outcomes of the project to the original planned objectives of the project in addition to the time and cost of the project. Ramos and Mota (2014) suggested a project could be successful even if the project team managed the project badly and could fail even if the project team managed it properly. Alreemy, Chang, Walters, and Wills (2016) explored IT project failures and suggested IT project success and failure should link to the organization's overall strategy and objectives, not to the triple constraints. Turner and Zolin (2012) suggested the triple constraints, time, cost, and scope, are not the only factors determining the success or failure of a project and argued that project business values extend beyond the project completion stage. Alami (2016) conducted a qualitative study using a case study to explore the IT project success and failure and suggested that IT project teams determine the success of the projects based on the maturity of the environment surrounding the projects, which is beyond the triple constraints. Consequently, scholars varied in their consideration of the triple constraints. Some considered the triple constraints as project success factors while others considered them as project approach. A third group considered the triple constraints as project's efficiency indicators and a fourth group considered them as a tool to measure project success. However, some other scholars argued the appropriateness of using the triple constraints to measure project success. Accordingly, the triple constrains could serve different purposes to different teams.

Project Time Estimation

Time estimation was the first independent variable of the study. Sweis (2015) identified the project time as the main factor that affects the success of the projects. The time of a project is the duration of the project that leads to the least project cost (Elkhouly et al., 2017; Lermen et al., 2016). Project time, also known as project timeline estimation, duration estimation, and schedule estimation, is one component of the triple constraints metrics used to measure projects success (PMI, 2017). Project schedule refers to the list of activities and its durations, resources, planned start dates, and planned finish dates, while scheduling refers to the processes required to create and manage the timely completion of a project (Lermen et al., 2016; PMI, 2017). Project managers use scheduling tools, such as Work Breakdown Structure (WBS), Critical-Path Management (CPM), Gantt charts, and Project Evaluation and Review Technique (PERT) to create the schedule of the project and represent the flow of project activities (Habib et al., 2018; Lermen et al., 2016).

WBS refers to the effort of decomposing and sequencing the scope of the project into smaller manageable activities to create the project schedule and manage the activities of the project (PMI, 2017; Siami-Irdemoosa, Dindarloo, & Sharifzadeh, 2015). A critical path is the sequencing of project activities in a network diagram that resembles the longest duration path of the project and indicates the least possible time to complete that project (PMI, 2017; Samayan & Sengottaiyan, 2017). A Gantt chart refers to the graphical chart project managers generate to present the sequence of project activities and

their start and end dates, resource assignments, activity dependencies, and the critical path (PMI, 2017; Sharon & Dori, 2017). Project managers use PERT to generate the critical path of a project by calculating the average of three estimated durations for each project activity that are optimistic, pessimistic, and most likely activity duration (Lichtenberg, 2016; Mazlum & Güneri, 2015).

Time estimation of a project is an essential factor project managers use to manage projects performance (Hajialinajar, Mosavi, & Shahanaghi, 2015). However, project time estimation is a major challenge project teams encounter that cannot be solved using the existing time estimation methods (Hajiali, Mosavi, Ahmadvand, & Shahanaghi, 2015). Jakhar and Rajnish (2016) stated that accurate project estimation is difficult to attain and observed that time and cost estimation could come over or under the actual project time and cost. Little (2016) conducted a qualitative single case study to evaluate the estimation quality of 106 commercial software projects. Little indicated that the schedule estimation of the software development project was difficult and found the actual duration of the projects were longer than the initial estimation.

Inaccurate time estimation could cause serious damage to the project (Hajiali et al., 2015) and using inappropriate estimation tools could lead to a project overrun (Suliman & Kadoda, 2017). Allen et al. (2014) stated that project teams deliver projects behind schedule and over budget, and Turner and Xue (2018) confirmed that some mega projects failed because the initial time and cost estimation were inaccurate and could be only good for use as input indicators for project progress. Researchers identified different

reasons that could cause inaccurate time estimation. Suliman and Kadoda (2017) suggested that the lack of practice of software project management is a factor of poor estimation. Ciarapica, Bevilacqua, and Mazzuto (2016) referred to the unplanned activities, such as managerial and administrative work, as a reason for time estimation inaccuracy. The uncertainty could be a reason for poor estimation as the uncertainty of the input data during the planning phase, which is usually high, could affect the accuracy of project estimation (Krane & Nils, 2014). Meyer (2014) referred to another cause of project estimation inaccuracy that involves optimism bias, which is the tendency of the project team to believe that they will more likely encounter better project conditions.

Some researchers provided alternative methods to overcome the inaccurate results of conventional project management techniques, such as CPM, PERT, EVM, and WBS. Hajali, Mosavi, and Shahanaghi (2016) used adaptive network based on the fuzzy inference system and parallel structure based on the fuzzy system algorithms to estimate project completion duration and confirmed using the fuzzy model provides a better final estimation result. Hajialinajar et al. (2016) used an autoregressive model and particle filter to estimate the project completion time and confirmed that the estimation error improved from around 2 to 32% by using the filter. Chrysafis and Papadopoulos (2014) conducted a qualitative case study to provide a new approach to manage the drawbacks of the PERT method based on the fuzzy sets method. Chrysafis and Papadopoulos confirmed that estimating optimistic, most likely, and pessimistic project activity durations using the fuzzy model provide better results than the conventional methods.

Project Cost Estimation

Cost estimation was the second independent variable of the study. Cost estimates are the quantitative assessment of the approximate expenditure of cost plus the contingency cost of each activity identified in the WBS (Iqbal et al., 2017; PMI, 2017). Cost estimation involves many direct and indirect cost elements, such as labor, materials, equipment, services, facilities, IT, financing, inflation allowance, exchange rates, and contingency reserve (Al-Qudah, Meridji, & Al-Sarayreh, 2015; PMI, 2017). First, the project team estimates the cost of each activity and aggregates them into one aggregated cost element called the work package. Next, the project team aggregates the work packages into one control account that holds the overall project cost estimate (PMI, 2017).

Osmanbegović, Suljić, and Agić (2017) explained that software cost estimation models consist of algorithmic and non-algorithmic models. The algorithmic models use arithmetic formulas to calculate the cost based on historical data as data inputs (Osmanbegović et al., 2017). Some of the common algorithmic cost estimation models are constructive cost model (COCOMO), software lifecycle management (SLIM), software evaluation and estimation of resources – software estimating model (SEER-SEM), and function point analysis (Al-Qudah et al., 2015; Anooja & Rajawat, 2017; Idri, Amazal, & Abran, 2016; Jain, Sharma, & Hiranwal, 2016; Osmanbegović et al., 2017).

Non-algorithmic models are analytical comparison models a project team uses to estimate the cost of the project based on either expert judgment or previous projects' cost

as a reference for estimation (Osmanbegović et al., 2017). The expert judgment method is the most popular method for cost estimation in the software industry where project managers calculate the cost of new projects based on an expert's qualitative assessment (Al-Qudah et al., 2015; Osmanbegović et al., 2017). Guesstimation, Wideband Delphi, Planning Game, Analytic Hierarchy Process, and Stochastic Budget Simulation are common expert judgment methods for cost estimation (Osmanbegović et al., 2017).

Analogy Based Estimation (ABE) is the main non-algorithmic reasoning approach project managers use to estimate the cost of new projects based on previous projects' cost (Al-Qudah et al., 2015; Osmanbegović et al., 2017). Project teams use analogy based estimation method to estimate the cost of a project by using the historical data of a similar project that is equivalent in size and nature (Idri et al., 2016). Fuzzy logic estimates, machine learning, artificial neural network, case-based reasoning, genetic algorithms, regression trees, rule-based induction, and adaptive neuro-fuzzy inference system are other non-algorithmic models project teams use to estimate the cost of the project (Al-Qudah et al., 2015; Idri et al., 2016; Osmanbegović et al., 2017).

In spite of using algorithmic or non-algorithmic models, Several scholars noted current cost estimation methods do not provide accurate project estimation information that could cause project failure. Rahikkala, Leppänen, Ruohonen, and Holvitie (2015) stated, less than 20% of the cost estimators use proper estimation methodologies. Inaccurate cost estimation is a major challenge project teams encounter that cause cost overrun and project delays (Rahikkala et al., 2015). A common reason for inaccurate cost

estimation and budget overruns is the use of primitive and conventional cost estimation methods (Lichtenberg, 2016). Anooja and Rajawat (2017) referred to relying on experts' judgment and historical data to estimate project cost as impractical methods. Osmanbegović et al. (2017) reported IT organizations that use conventional cost estimation methods deliver projects behind schedule and over budget.

In addition to the use of conventional methods, poor planning and biased cost estimates could be two other causes for inaccurate cost estimation. Osmanbegović et al. (2017) referred to poor planning as one main cause of inaccurate cost estimation. Lichtenberg (2016) identified the biased assessment of project cost as one of the main reasons for cost overruns. Meyer (2014) confirmed that optimism bias is one of the main reasons project teams encounter of time and cost estimation.

Project Performance

Project performance was the dependent variable of the study. Scholars described the performance of the project as the main indicator of project success or failure (Florescu, Mihai, & Ene, 2014; Lindhard & Larsen, 2016; Mir & Pinnington, 2014), and indicated triple constraints as the tool to measure that performance (Florescu et al., 2014; Mir & Pinnington, 2014). Some scholars differentiated between project performance and project management performance (Florescu et al., 2014; Mir & Pinnington, 2014). Both project performance and project management performance are interconnected but different as project performance relates to the long term objectives of the project, while project management performance relates to the short term objectives of the project

(Florescu et al., 2014; Mir & Pinnington, 2014). Project long term objectives could be financial, marketing, or technical, while project short term objectives are the outcomes of executing the plan and controlling the work of the project to deliver the project on time, budget, and performance standards (Mir & Pinnington, 2014).

Moreover, scholars differentiated between who is responsible for project performance and who is responsible for project management performance. Zwikael and Smyrk (2015) suggested that the realization of project objectives is the role of project owners while delivering the project on time and within budget is the role of project managers. Florescu et al. (2014), and Mir and Pinnington (2014) explained the project management team could deliver projects on time and within budget but still project owners do not realize the benefits of the projects. Additionally, Florescu et al. differentiated between project management lifetime and project performance lifetime, where the former ends when the project team delivers the project to the customer while the later could span much longer until the owners of the project recognize the project's benefits.

Florescu, Mihai, and Ene (2014) and Mir and Pinnington (2014) examined the relationship between project management performance and project success and noted a positive correlation between project success and project performance. Montes-Guerra et al. (2014) studied the impact of the use of methodologies, techniques, and tools on project performance and concluded that the adoption of new project management tools and techniques would improve project performance. Sirisomboonsuk, Gu, Cao, and

Burns (2018) explored factors a project team could use to influence the enhancement of project performance and recognized IT and project governance have a positive impact on project performance. Demirkesen and Ozorhon (2017) examined the interrelation between Several project performance knowledge areas and concluded that project integration, communications, safety, risk, human resources, financial, and cost management have a direct impact on project performance.

Demirkesen and Ozorhon (2017) and Ghanbari, Taghizadeh, and Iranzadeh (2017) indicated that project scholars and practitioners used performance management to measure the performance of projects. Project performance management refers to the process of measuring the variance between the planned and the actual work a project team produced against the defined indicators, such as project time, cost, and scope (Montes-Guerra et al., 2014). Montes-Guerra et al. (2014) clarified that project management methodologies and standards, such as project management body of knowledge (PMBOK), project in controlled environment (PRINCE2), international competence baseline (ICB), the body of knowledge (BOK), and international standards organization (ISO) 10006, employed the earned value management (EVM) as the main tool for measuring the performance of projects using time and cost variance. The U.S. Department of Defense developed EVM in the 1960s to measure the project performance and estimate the completion cost of projects based on time and cost variance (Aminian, Nejad, Mortaji, & Bagherpour, 2016; Wei, Bao, Yao, & Wang, 2016).

Wei et al. (2016) classified EVM as an integrated project management system that project managers use to measure the performance of projects, using the project's scope, time, and cost. The formula of EVM consists of three main values that are planned value (PV), earned value (EV), and actual cost (AC) (Aminian et al., 2016). The PV is the authorized budget for the scheduled work (PMI, 2017). The EV is the achieved work at a specific period (PMI, 2017). The AC is the realized cost for the work performed at a specific period (PMI, 2017). Project managers use the EVM to calculate project performance indices that include the schedule performance index (SPI) and cost performance index (CPI) (Wei et al., 2016). Project managers use the SPI to measure project time efficiency by calculating the ratio of the earned value to the planned value (SPI = EV/PV) (PMI, 2017).

Similarly, project managers use the CPI to measure the project cost efficiency by calculating the ratio of the earned value to the actual cost (CPI = EV/AC) (PMI, 2017). If the SPI is greater than 1.0, that infers the project is ahead of schedule, while if SPI equals 1.0, that infers the project is on schedule, and if SPI is less than 1.0, that infers the project is behind schedule (PMI, 2017). Likewise, if the CPI is greater than 1.0, that infers the project is over budget, while if CPI equals 1.0, that infers the project is on the budget, and if SPI is less than 1.0, that implies the project is under budget (PMI, 2017).

Alignment Between the Theory and the Variables

The iron triangle theory served two purposes. The first purpose was the identification of project success factors, which were time, cost, and scope. The second

purpose was the provision of a project performance measurement tool based on the quality of time, cost, and scope. Hence, I used the iron triangle as a lens to view the phenomenon of poor project performance by using two of the iron triangle constraints, time estimation and cost estimation as constructs.

Scheuchner (2017) recognized the iron triangle as one of the early project success criteria that measure the performance, success, or failure of a project. Cullen and Parker (2015) suggested that traditionally the iron triangle model was the basis of the measurement of project success. Awwal (2014) referred to the iron triangle as a success criterion of project performance and indicated that projects could be successful if the teams of the projects meet the constraints of time, cost, and quality. Similarly, Scheuchner (2017) categorized the iron triangle as a project success measurement tool using time, cost, and scope as project success parameters.

Several scholars confirmed there is a relationship between the triple constraints of projects and the project performance. Sirisomboonsuk et al. (2018) confirmed the project managers use the triple constraints as one criterion to achieve project performance that implies a positive impact on project performance. Demirkesen and Ozorhon (2017) found the triple constraints of scope, time, and cost are factors affecting the performance of the project, and Abu-Hussein et al. (2016) considered the triple constraints as the main factors affecting the performance of any project. Similarly, Lindhard and Larsen (2016) indicated the iron triangle or triple constraints as common performance indicators project teams use to measure the success of projects. Rungi (2014) found that the iron triangle

model significantly influences the outcomes of organizations. Finally, Walia and Gupta (2017) confirmed that project teams used time and cost to measure project performance.

Some other scholars indicated additional factors to the triple constraints that could affect the project performance, such as risk, stakeholders, and communication management. Abu-Hussein et al. (2016) conducted quantitative correlational research and surveyed 21 projects of enterprise resource planning (ERP) software systems in Jordan to investigate factors affecting project performance. Abu-Hussein et al. wanted to investigate additional project factors that could affect project performance, such as communication management, human resource management, and risk management. Abu-Hussein et al. found a high level of communication management activities in ERP projects and a moderate level of human resource, time, cost, and risk management activities in the ERP projects. Regarding the triple constraints, Abu-Hussein et al. reported the participants of the survey indicated that project scope is the most significantly important factor of the project, while time and cost come next. Moreover, Abu-Hussein et al. concluded that statistically communication, human resource, time, and risk have a significant effect on ERP project's performance. Similarly, Demirkesen and Ozorhon (2017) surveyed 121 projects and developed a project performance indicator model based on the project management body of knowledge (PMBOK). However, Demirkesen and Ozorhon also found project integration, communications, safety, risk, human resources, and financial management are other factors influencing project performance.

Sirisomboonsuk et al. (2018) conducted quantitative research and surveyed 282 IT professionals' responses to develop strategies to enhance project performance. Sirisomboonsuk et al. referred to additional project factors that could affect the performance of projects, such as user involvement, executives' support, clear requirements, risk management, organizational processes maturity, change management, and project and program management. Lindhard and Larsen (2016) conducted quantitative research and used the results of a survey of 87 practitioners to provide guidance on how to fulfill project success criteria of time, cost, and quality. Lindhard and Larsen tested project coordination, communication, trust, shared objectives, forms of cooperation, and sharing of experience as project processes that support fulfilling the triple constraints. Lindhard and Larsen reported project teams could measure the performance of the time and the cost during the project lifetime, while they only could realize the quality of the project after the project closure. Rungi (2014) conducted quantitative research and surveyed 189 responses to examine the performance of the organizational output with regards to the project performance. Lappi and Aaltonen (2017) suggested that the triple constraints model is a good tool to measure only the performance of short-term objectives of projects.

Rival Theories

There is no single project management theory (Cullen & Parker, 2015; Niknazar & Bourgault, 2017). Rival theories are competing theories that scholars use to discuss the same phenomena and do not favor one over the other because some of the rival theories

are compatible with some set of data while others are compatible with a different set of data that both could lead to the same evidence (Siroky, 2012). Project management theories vary among scholars who provided only a few studies in this particular field of knowledge to examine the behavior of the projects in theoretical terms (Niknazar & Bourgault, 2017). Dwivedi et al. (2015) explained that the rate of IT project failure remained substantially high and suggested the need for empirical studies to support the IT project leaders in managing successful projects and avoiding project failures. Catanio et al. (2013), Damoah and Akwei (2017), Pollack, Helm, and Adler (2018), and Wyngaard et al. (2012) identified the iron triangle theory as the most traditional and core theory of the modern project management discipline. Therefore, I choose to use the iron triangle theory as the theoretical framework of this study.

Johnson et al. (2015) conducted a qualitative study and collected data between 1999 and 2014 from seven known journals of project management. Johnson et al. concluded five theories to be the top known project management theories according to their research findings, which include the fuzzy sets theory (FST), the theory of constraints (TOC), actor-network theory (ANT), stakeholder theory, and utility theory. Johnson et al. noted FTS as the most recognized project management theory among the top five project management theories.

Eliyahu Goldrat, in 1988, developed the TOC, as a conceptual theory, suggesting that any system contains at least one constraint (Johnson et al., 2015; Rugenyi & Bwisa, 2016). The theorists defined the role of the constraint as a bottleneck preventing the

system from functioning properly whereas the management work to eliminate that constraint to improve the performance of the system as a whole (Johnson et al., 2015; Rugenyi & Bwisa, 2016). The TOC is a five step process: the identification of the system's constraint, the exploitation of the system's constraint, subordination all factors to support the exploitation of the specified constraint, the elevation of the constraint by increasing its capacity, and repeating the process with the next constraint (Trojanowska & Dostatni, 2017). Some scholars supported the application of TOC in project management to eliminate project constraints, such as schedule, cost, resource, risks, and issues (Johnson, Creasy, & Fan, 2016). However, some other scholars argued the effectiveness of the TOC in project management, as the project team cannot quantify or validate the overall improvement of the project after applying the TOC (Şimşit, Günay, & Vayvay, 2014) while they can use the EVM in the case of the triple constraints.

Michel Callon and Bruno Latour developed the ANT in 1986 considering systems as networks of relations among objects, human and non-human, referred to as *actant*, where the interaction among actants formulates the nature of the relations and the reason of the existence of systems (Burga & Rezania, 2017; Callon, 2017; Floricel, Bonneau, Aubry, & Sergi, 2014). ANT includes four overlapping steps: (a) the *problematization*, describes the indispensable need of the actant, (b) the devices of *interessement*, describes the interest of the actants within the system, (c) *enrolment*, describes the method to define and coordinate the roles of the actants, and (d) *mobilization* of allies, describes the authority of the actants (Callon, 2017). Scholars and practitioners used ANT as a method

to simplify projects' complexities into manageable objects, goals, relations, and deliverables to replace traditional project management methods that focus only on tools and techniques to control the behavior and relationships of projects (Burga & Rezania, 2017; Johnson et al., 2016). Some scholars criticized the inclusiveness of ANT as the founders of the theory based their research on only three types of objects that would not be inclusive enough for generalization (Alcadipani & Hassard, 2010). Additionally, as the use of ANT provides scholars and practitioners with a static view of an environment at a particular period, some scholars argued the effectiveness of using ANT in dynamic environments (Alcadipani & Hassard, 2010), such as projects.

Stakeholder theory is not a single theory or conceptual framework but a collection of concepts that imply multiple interpretations and applications originated from many disciplines, such as business ethics, strategic management, corporate governance, and finance (Jones, Harrison, & Felps, 2018; Miles, 2017; Johnson et al., 2016). Johnson et al. (2016) and Phillips (2003) referred to R. Edward Freman as the founder of stakeholder theory in 1984, while Cleland introduced stakeholder theory to the project management field in 1986 defining project stakeholders as any internal or external individual or group affect or affected by the project. Accordingly, to prevent project failure, the project managers should identify the stakeholders and classify their requirements to manage their objectives and improve projects' outcomes. However, managing stakeholders' requirements, such as project's benefits, risks, communication, and responsibilities, could

be unattainable because the project team might be unable to identify the stakeholders or prioritize their clashing requirements (Phillips, 2003).

The utility theory, initially proposed by Daniel Bernoulli in 1738 and later represented by Von Neumann and Morgenstern in 1944, refers to the level of satisfaction decision makers would gain as an outcome of their decisions, where the better decision is the one that maximizes the expected value of the utility (Dalalah & Al-Rawabdeh, 2017; Johnson et al., 2016). Project managers applied the utility theory in project management as a method to manage the uncertainty surrounding project factors, such as time, cost, and risk to choose from multiple alternatives (Johnson et al., 2016). Some scholars argued the practicality of the utility theory because in practice decision makers violate the hypotheses of the theory and struggle to manage the complexity of the probability of uncertainty (Moscati, 2017; Tan, Liu, Wu, & Chen, 2018).

Lotfi Zadeh developed the fuzzy sets theory (FST) in 1965 (Liu et al., 2018; Johnson et al., 2015). Contrary to the classical set theory, which suggests an element must belong to only one specific set, Zadeh suggested an element could partially belong to more than one set, and gradually transition from being a member of a set to not being a member of that set (Ghapanchi, Tavana, Khakbaz, & Low, 2012). In such a case, each fuzzy set must overlap the neighboring sets (Ghapanchi et al., 2012; Zhao, Hwang, & Low, 2013). As opposed to an ordinary variable that represents an exact value, a fuzzy variable represents an imprecise value, which provides researchers the freedom to work with uncertain answers or answers that could belong to different overlapping sets

(Ghapanchi et al., 2012). For example, according to the classical set theory, the temperature at a specific period would belong to either the cold set, warm set, or the hot set, but nothing in between. In FST, the temperature could partially belong to the hot set and the warm set (Ghapanchi et al., 2012), and risks could belong to the high set and the medium set (Doskočil, 2016) at the same time for a certain degree.

Researchers explored and tested the use of FST in different aspects of project management, such as uncertainty, scheduling, and time-cost tradeoff and supported the appropriateness use of FTS to overcome typical project management problems (Bakry, Moselhi, & Zayed, 2016; Chrysafis & Papadopoulos, 2014; Salari & Khamooshi, 2016). Ghapanchi et al. (2012) and Göçken and Baykasoğlu (2016) used FTS to overcome the uncertainty effect of project parameters and found the use of FTS would provide more accurate results in portfolio management and cost-time tradeoff. Bakry et al. (2016) and Chrysafis and Papadopoulos (2014) used FTS in optimizing projects' schedules and found the use of FTS provides project teams with tools that are capable of generating more accurate schedules than conventional methods.

However, some researchers argued the effectiveness of FTS implementation (Mehlawat & Gupta, 2015). Gerla (2017) and Ghapanchi et al. (2012) considered the subjectivity of quantifying the qualitative factors as a limitation of FTS because, for example, some users could assign three values to a logical set including high, medium, and low value, where others could assign five values to the same logical set that include very high, high, medium, low, and very low. Scholars and practitioners could not address

FTS as a controlled function because FTS membership is not a deterministic as fuzzy logic deals with belief rather than probability (Reddy, 2017). For example, Salari and Khamooshi (2016) used FTS to manage the uncertainty of projects and found that the use of FTS would not replace project management traditional tools, such as EVM, but provides the project manager with an additional tool to improve controlling project uncertainty and performance since EVM provides crisp values where FTS provides fuzzy values. Moradi, Mousavi, and Vahdani (2017) agreed with Salari and Khamooshi's findings that using FTS in a combination of EVM could provide better cost estimates.

Transition

In section 1 of this study, I provided a background of the problem that is some IT project sponsors and managers do not know the relationship between time estimation, cost estimation, and project performance, and I explained the purpose of the study as a quantitative correlational study to examine the relationship between time estimation, cost estimation, and project performance. Additionally, I presented the research question, hypotheses, and operational definitions. Furthermore, I provided a literature review that introduces the triple constraints theory as the theoretical framework of this study, and project time estimation, project cost estimation, and project performance as the constructs of the study. Finally, I presented the significance of the study, assumptions, limitations, and delimitations.

In Section 2, I explained the role of the researcher, participants, research method and design, population and sampling, ethical research, data collection instruments, data

collection techniques, data organization technique, data analysis, and reliability and validity of the study. In Section 3, I presented the findings of the study, recommendations for action, recommendations for future research, and the implications for social change.

Section 2: The Project

In this section, I reiterated the purpose statement of the research, presented the role of the researcher in the quantitative research, and identified the potential participants. Additionally, I explained the methodology and the design of the research, defined the population and sampling size, highlighted the ethical research, and presented the data collection instrument. Finally, I presented the method that I used to ensure the reliability and validity of the research.

Purpose Statement

The purpose of this quantitative correlational study was to examine the relationship between time estimation, cost estimation, and project performance. The targeted population comprised of IT project managers in Qatar. The independent variables were time estimation and cost estimation. The dependent variable was project performance. The implication for social change included the potential addition to the knowledge of IT that could lead to improve project execution and enhance project success. Scheuchner (2017) found that increasing project success rates could positively increase business performance, increase economies' sustainability, increase the quality of life, open new business opportunities, and increase the rate of employment.

Role of the Researcher

The role of the researcher in a quantitative study is to collect and test the data by using theory to answer the study's hypotheses (Khan, 2014). As the researcher of this study, I worked on formulating the research topic, generated research ideas and

hypotheses, wrote the research proposal and conducted the literature review, formulated the research design and strategy, established the ethics and quality of the research design, defined the research sampling, and collected and analyzed the data.

Another role of a researcher is to avoid bias (Yin, 2014). I have 20 years of experience in the field of IT development and project management. My previous experience and background could have affected my methods of collecting and analyzing the data. Therefore, to avoid biases, I conducted a quantitative research using an online questionnaire to eliminate the direct interaction between the researcher and participants to avoid manipulating or directing the participants. I used my LinkedIn account to generate a list of my first, second, and third LinkedIn network connections as potential participants for my research. I sorted the names alphabetically, assign a sequential number to each name, and randomly selected the sample to ensure an equal opportunity of selection and supported the findings. One of the prerequisites to collect the data was to get approval on the research proposal and data collection plan from the institutional review board (see Yin, 2014). Therefore, before I conducted the survey, I requested approval from the Walden University institutional review board.

The researcher must adhere to the *Belmont Report's* ethical principles (1979) of ethical and application principles (see Office for Human Research Protections, 2016). The *Belmont Report* includes guidelines about respect for persons where researchers should treat individuals as autonomous agents, ensure persons with diminished autonomy are entitled to protection, ethically treating individuals by making efforts to secure their

well-being, treating people equally, securing informed consent, protecting the information, and voluntarily participation (see Office for Human Research Protections, 2016). To protect individuals' rights and ensure full consent, I published the instrument online and made it available for voluntary participation, and data was anonymous.

Participants

I used four criteria elements to select the potential participants of the study that were: (a) a participant must have been a project sponsor, project manager, or project coordinator; (b) the participant must have been leading at least one project within the last 5 years; (c) the subject of the projects must have been IT related; and (d) the projects must have been performed in Qatar. I used my LinkedIn account to identify a list of potential participants. I created a list of potential participants in a spreadsheet from my first, second, and third LinkedIn network connections and randomly selected the sample. I used LinkedIn to access the potential participants to introduce and invite them to participate in the study. I used SurveyMonkey to collect the data as SurveyMonkey provides probabilistic and random sampling methods to eliminate participants that do not fit the selection criteria (see Survey Monkey, 2014).

Research Method and Design

Research Method

Quantitative, qualitative, and mix methods are the three methods of conducting research (Maxwell, 2015). Researchers use qualitative methods to extract rich, nonnumerical, and nonstatistical data to explore in-depth phenomena (Cooper &

Schindler, 2014). A qualitative approach was not appropriate for this research since the purpose of the study was to examine statistically measurable relationships between variables. A mixed-method approach is a combination of a qualitative and quantitative method approaches within the same study (Maxwell, 2015). A mixed method was not appropriate for this study because I did not use a qualitative method. Researchers use a quantitative method to measure behavior, knowledge, opinions, or attitudes to answer questions related to the frequency of phenomena (Cooper & Schindler, 2014). I used a quantitative approach to examine the relationship between time estimation, cost estimation, and project performance. A quantitative approach was appropriate for this study because I used numerical and statistical information to examine the relationships between the variables.

Research Design

Researchers use four types of quantitative design to examine relationships between variables: descriptive, quasi-experimental, experimental, or correlational (Saunders et al., 2015). Researchers use experimental and quasi-experimental designs to examine cause-and-effect relationships by manipulating some of the variables then observe the consequent effect (Cooper & Schindler, 2014). Quasi-experimental and experimental designs were not appropriate for the study because I examined the relationship between variables, not the cause-and-effect relationship between the variables.

Researchers use descriptive design method in complex systems by creating visual models to demonstrate the sequence of relationships between variables (Cooper & Schindler, 2014). As investigated the existence of a relationship between the variables, not the sequence of effect between variables, the descriptive design was not appropriate for the study. The correlational design was the most appropriate design for this study because, according to Cooper and Schindler (2014), researchers use the correlational design to demonstrate the relationship between variables that occur together in some specified manner without implying that one caused the other or one must exist to cause the other to exist.

Population and Sampling

Population

The population of the study was IT project sponsors, managers, and coordinators who managed IT projects within the last 5 years in Qatar. A project sponsor is an external person to the project who has a higher authority that would secure funding, commit resources, and authorize the project (PMI, 2017), such as the chief technology officer (CTO), chief information officer (CIO), IT manager, IT project owner, IT program director, IT program manager, IT project director, IT project management office (PMO) director, IT PMO manager, IT PMO officer, or IT delivery manager.

Hoxha (2017) used his LinkedIn account to collect a sample of 360 participants in his research. Similarly, I used my LinkedIn account to identify a list of potential participants for my research. First, I created a list of potential participants in a

spreadsheet from my first, second, and third LinkedIn network connections. Second, I sorted the names alphabetically and assigned a sequential number to each name. Third, I randomly selected the sample to ensure an equal opportunity of selection and supported the generalization of the findings of the study. Omair (2014) suggested that simple random sampling is applicable for a small sample of 30 to 50 participants, and researchers could select participants directly from a given list. For a larger sample, researchers could use a computer system to generate random numbers. Therefore, I used the randbetween() function that Microsoft Excel offers to generate a random sample. Microsoft randbetween() function returns a random index from a given list. Finally, I sent a message to the potential participant on their LinkedIn accounts to invite them to participate in the research.

Sampling

I used the formula provided by Tabachnick and Fidell (2018) to calculate the sample size of this study. Tabachnick and Fidell's standard formula is 50 + 8(m), where m refers to the number of predictor variables, which are two in this study. Accordingly, the minimal sample size for this study, using Tabachnick and Fidell formula is 50 + 8(2) = 66. Larkin, Gallagher, Fraser, and Kennedy (2016) used Tabachnick and Fidell's standard formula to calculate the sample size for two independent variables and one dependent variable and obtained the same result, which is 66 participants.

To confirm the sample size, I also used G*Power 3.1.9.2 software to calculate the sample size as per Faul, Erdfelder, Buchner, and Lang's (2009) description. The input

parameters were linear multiple regression fixed model, R2 deviation from zero, the number of predictors was two, α err prop = 0.05, a statistical power level of .80, and the effect size (f2= .15) (Faul et al., 2009). The minimum sample size was 68 participants. Accordingly, the minimum sample size for this study was between 66 and 68 participants.

Ethical Research

Research ethics is a critical element of any research project (Saunders et al., 2016). Research ethics is more important when research involves human participants, which makes most universities require formal research ethics committee approval (Saunders et al., 2016), such as Walden University's Institutional Review Board (IRB). The IRB is responsible for ensuring that all Walden University research is compliant with Walden University and U.S. federal regulation ethical standards (IRB, 2018). Additionally, the IRB is responsible for Several roles that include judging the risks and benefits of the research, ensuring inform consent of the participants, certifying the research procedures and conditions will protect the confidentiality of the data, confirming the research subject is genuinely beneficial and equitable, and providing permission to researchers to collect researches' data (IRB, 2018). Therefore, students must submit the IRB application to permit data collection and analysis. Otherwise, the IRB will not approve or accredit data gathered without IRB approval (IRB, 2018).

Informed consent is a requirement for conducting ethical research, which forms an agreement between the researcher and the participants (Office for Human Research

Protections, 2016). To ensure participants' rights, to freely enroll in or withdraw from this study, I used SurveyMonkey to provide the informed consent form, brief about the study, the role of the researcher, and the procedure for withdrawing from the study. I stored the data on a flash drive as a storage medium for all information collected in this study, which includes the list of the participants, the SPSS datasets, and the SurveyMonkey data. The data will remain for 5 years as per Walden University's requirements. Finally, I did not start the data collection activity until I received the IRB approval.

Data Collection Instruments

For this study, I used a portion of the project implementation profile (PIP) instrument. Slevin and Pinto developed this instrument in 1986 to measure the human and managerial aspects of project management success by collecting data on 10 project management success factors: project mission, management support, project schedule/plan, client consultation, personnel, technical tasks, client acceptance, monitoring and feedback, communications, and troubleshooting (Pinto, 1986). To design the instrument, Slevin and Pinto used a qualitative approach to gather data from full-time employees, who were also part-time MBA students at the University of Pittsburgh, about success factors of projects they had been involved with in the last 2 years (Pinto, 1986). Slevin and Pinto used experts to analyze and categorize the results into 10 project success factors with 10 items under each success factor (Pinto, 1986). Accordingly, Slevin and Pinto designed the PIP instrument as a 10-point Likert-type questionnaire, where each of

the 10 factors contains 10 items (Pinto, 1986). Slevin and Pinto soon realized the excessive length of the questionnaire and engaged seven experts to improve the PIP by ranking the success factors and eliminating the less important (Pinto, 1986). However, each of the experts ranked the importance of the success factors differently, which led Slevin and Pinto to believe that all the success factors are equally important (Pinto, 1986). Consequently, the researchers decided to use a quantitative approach and administered the PIP to 42 MBA students and 55 project practitioners to test it (Pinto, 1986). Slevin and Pinto used two procedures to analyze the data: item loading proportions and Cronbach's alpha (Pinto, 1986). By using the loading proportions procedure, Slevin and Pinto dropped any success factors they found insignificant, resulting in a reduction of items from 100 to 74, whereas the use of Cronbach's alpha resulted in further reduction to 50 items, including only the highest five items per success factor (Pinto, 1986; see Appendix A). Slevin and Pinto redesigned the survey as a 7-point Likert-type questionnaire to capture the opinion of the respondents about each item (Pinto, 1986). Finally, Slevin and Pinto conducted a pilot study to test the PIP using a sample of 26 project managers and found the instrument reliable to collect data about project performance and success (Pinto, 1986). I used a portion of the PIP to be my primary data collection instrument that I used to collect the data from the participants of the study.

Several researchers have subsequently used the PIP to study various aspects of project success. Pinto (1986) used the PIP to examine the relationship between project

success factors and project success. Hoxha (2017) used the PIP instrument in a quantitative correlational study to examine the relationship between the age of project managers, the experience of project managers, and project success. Rusare and Jay (2015) applied the PIP in a quantitative correlational study to examine the project success assurance factors in nongovernmental organization projects. Therefore, I used a portion of the PIP to collect the data from the participants of the study.

For the purpose of the study, I used the third section of the PIP instrument to collect data about the independent variables (see Appendix A) and the project performance instrument to collect data about the dependent variable (see Appendix B). The third section of the PIP instrument, the project schedule/plan, consists of five items, as follows:

1. We know which activities contain slack time or slack resources that can be utilized in other areas during emergencies.
2. There is a detailed plan (including time schedules, milestones, personnel requirements, etc.).
3. There is a detailed budget for the project.
4. Key personnel needs (who, when) are specified in the project plan.
5. There are contingency plans in case the project is off schedule or off budget (Pinto, 1986; see Appendix A).

I used the second and third items of the third section of the PIP instrument to collect data about the independent variables (see Appendix C). Slevin and Pinto designed

the second item to collect ordinal level data about the planned time of projects, whereas they designed the third item to collect ordinal level data about the cost of projects (Pinto, 1986). I used the second item of the third section of the PIP to collect data about the first variable of this study (the project time estimation) and the third item to collect data about the second variable of this study (the project cost estimation).

Pinto (1986) used the second item of the third section of the PIP instrument to collect ordinal level data and predict whether the participants created a project schedule (see Appendix A). The item was "there is a detailed plan (including time schedule, milestones, personnel, requirements, etc.)" (Pinto, 1986). The lowest score on the 7-point Likert-type scale is 1 being *strongly disagree* and the highest is 7 being *strongly agree* (Pinto, 1986). I used this item to collect data about the first independent variable of this study, time estimation, to predict whether project teams estimated the time of the project to create a project schedule.

Similarly, Pinto (1986) used the third item of the third section of the PIP instrument to collect ordinal level data and predict if the participants created a project budget (see Appendix A). The item was "there is a detailed budget for the project" (Pinto, 1986). The lowest score is 1 being *strongly disagree* and the highest is 7 being *strongly agree* (Pinto, 1986). I used this item to collect data about the second independent variable of this study, cost estimation, to predict whether project teams estimated the cost of the project to create a project budget.

Pinto (1986) aggregated ordinal level data from 13 items to predict project performance. The lowest score on these items is 1, for *strongly disagree,* and the highest is 7, for *strongly agree* (Pinto, 1986). To predict the dependent variable of the study (project performance), I used the aggregated data of the 13 items, as follows:

1. This project has/will come in on schedule.
2. This project has/will come in on budget.
3. The project that has been developed works (or if still being developed, looks as if it will work).
4. The project will be/is used by its intended clients.
5. This project has/will directly benefit the intended users either through increasing efficiency or employee effectiveness.
6. Given the problem for which it was developed this project seems to do the best job of solving the problem, i.e., it was the best choice among the set of alternatives.
7. Important clients, directly affected by this project, will make use of it.
8. I am/was satisfied with the process by which this project is being/was completed.
9. We are confident non-technical start-up problems will be minimal, because the project will be readily accepted by its intended users.
10. Use of this project has/will directly lead to improved or more effective decision making or performance for the clients.

11. This project will have a positive impact on those who make use of it.
12. The results if this project represents a definite improvement in performance over the way clients used to perform these activities.
13. All things considered, this project was/will be a success. (Pinto, 1986; see Appendix B).

Reliability is one main factor that indicates the quality of research and refers to the ability of researchers to replicate the design of research and extrapolate the same results (Saunders et al., 2015). Pinto (1986) examined the reliability of the PIP instrument by performing item correlation and Cronbach's alpha on each of the instrument's constructs and reported that PIP indicated strong reliability with alpha estimates ranging between .70 and .86 and average reliability of .78. Similarly, Pinto and Mantel (1990) reported that they used Cronbach's alpha to assess the reliability of the PIP, and found Cronbach's alpha results above the acceptable average, ranging from 0.79 to 0.90. Finally, Pinto, Prescott, and English (2009) reported the PIP reliability was within an acceptable range at .87 Cronbach's alpha rate. Accordingly, I find the PIP a proper instrument for use in this research.

I used the original PIP instrument without making any modifications to ensure the reliability of the instrument. I included a copy of the PIP instrument in the appendices (see Appendices A, B, and C). Additionally, I included in the appendices an authorization letter from Dr. Pinto and Dr. Slevin to use the instrument (see Appendix D). I used SurveyMonkey, an online survey tool to collect the data. Potential participants took an

average of 5 minutes to answer the questionnaire. The instrument was an ordinal level measurement, scored 1 to 7 (*strongly disagree* = 1 and *strongly agree* = 7).

Data Collection Technique

The purpose of this quantitative correlational study was to examine the relationship between time estimation, cost estimation, and project performance in Qatar. The research question was what is the relationship between time estimation, cost estimation, and project performance? I used the customized version of the project implementation profile (PIP) questionnaire (see Appendix C) developed by Slevin and Pinto in 1986 as the data collection instrument. The participants must have been project sponsors, project managers, or project coordinators who have been leading at least one information technology project within the last 5 years in Qatar.

I used my first, second, and third LinkedIn network connections as potential participants for my research. I communicated with the potential participants, through their LinkedIn accounts and invited them to participate in the questionnaire. I introduced to them the research and sent them a link to the questionnaire in SurveyMonkey. Catanio et al. (2013) and Hoxha (2018) used SurveyMonkey to publish and manage their questionnaires. SurveyMonkey is an online data collection technique researchers use to publish questionnaires and manage the data. Online collection techniques provide advantages to participants, such as accessibility to participants, effectiveness of data organization, and cost effectiveness (Hoxha, 2018). SurveyMonkey provides the researchers with a tool to export the data into a spreadsheet file. I imported the

spreadsheet file into SPSS to analyze the data. After analyzing the data, I stored the data on an electronic copy on a flash drive, and I will destroy the electronic data after 5 years.

Data Analysis

I conducted data analysis to address the following research question and hypotheses:

Research Question and Hypotheses

What is the relationship between time estimation, cost estimation, and project performance?

Null Hypothesis (H_0): There is no relationship between employee wages, number of employee referrals, and employee turnover intention in the retail industry.

Alternative Hypothesis (H_1): There is a relationship between employee wages, number of employee referrals, and employee turnover intention in the retail industry.

Multiple Linear Regression

Since there are two independent variables and one dependent variable for this study, bivariate linear regression was not appropriate for this study since bivariate linear regression is a statistical analysis model researchers use to examine linear relationships between two variables, where one variable could predict another variable (Green & Salkind, 2017). Researchers use hierarchical multiple regression to control the effect on the independent variable (Ciarapica et al., 2016). Researchers use stepwise regression analysis to control the importance of the independent variables (Fayaz, et al., 2017; Tabachnick & Fidell, 2018). As the purpose of the research was not to study the effect of

controlling or manipulating data inputs or variables, hierarchical multiple regression and stepwise regression analysis were not appropriate models for this study. Finally, by using a multiple regression model, researchers examine the relationship between the dependent variable and multiple independent variables (Green & Salkind, 2017). Therefore, multiple linear regression was the most appropriate analysis model for this study.

Data Cleaning and Screening

Data cleaning is the process of screening, detecting, and managing missing or corrupted data by eliminating or correcting the data to improve the quality of the research (Dedu, 2014; Salem & Abdo, 2016). Data error could result from mistakes caused by data recording and entry (Dedu, 2014). Some researchers used procedures to correct data errors, such as return to the participants to recollect the data, recheck the original data collection documents, or recalculating the response (Dedu, 2014). Other researchers choose to eliminate data error or missing data by eliminating the responses that contain data errors or missing data (Vivek, Beatty, Dalela, & Morgan, 2014; Mukerjee & Prasad, 2017). Since I used an online survey service, I did not anticipate receiving corrupted data as the online service prevent data corruption. Additionally, as I did not request the participants to provide their contacts, I eliminated the responses that contained errors or missing data because I was not be able to contact the participants again to fix the errors or provide the missing data.

Assumptions

Green and Salkind (2017) indicated assumptions related to the linear regression analysis, which included three related to a fixed effect model and two related to a random effect model. For the fixed model, researchers assume (a) normal distribution of the dependent variable in the population for each combination of levels of independent variables; (b) the population variances of the dependent variable are the same for all combinations of levels of the independent variables; and (c) the cases represented a random sample are independent of each other (Green & Salkind, 2017). Regarding the random model, researchers assume variables are (a) multivariately normally distributed in the population, (b) the cases represent a random sample from the population, and (c) the scores are independent of other scores (Green & Salkind, 2017). I applied statistical tests to satisfy each of the assumptions that include linearity, normality, homoscedasticity, and multicollinearity (Schlechter, Thompson, & Bussin, 2015).

Linearity assumption means there should be a linear relationship between independent and dependent variables where the change on the dependent variable relates to the change of one or more independent variables (Saunders et al., 2015). A researcher will use probability plots (P-P) diagram to illustrate the relationships between independent and dependent variables (Schlechter et al., 2015). I used the probability plots (P-P) diagram to inspect linearity. Outliers may violate the linearity assumption. Outliers are odd values or observations that are extreme and distant from other observations (Dedu, 2014; Yin, Wang, & Yang, 2014). Some researchers used boxplot to inspect

outliers (Meyer, 2014; Huijgens, Deursen, & Solingen, 2017). I used boxplot to inspect outliers. Normality refers to the normal distribution and clustering state of the data around the mean (Schlechter et al., 2015). Researchers used the probability plot (P-P) to assess normality (Green & Salkind, 2017). I used the probability plots (P-P) diagram to assess normality. Homoscedasticity is the point where the dependent and independent variables' data values have equal variances (Schlechter et al., 2015). Some researchers used probability plots (P-P) diagram to assess homoscedasticity (Green & Salkind, 2017). I used the probability plots (P-P) diagram to assess homoscedasticity. Multicollinearity is the degree where two independent variables are highly correlated (Saunders et al., 2015). Some researchers used Pearson correlation to determine multicollinearity (Rungi, 2014; Khan, 2017). Other researchers used the variance inflation factor (VIF) (Azhar, Mulyadi, & Putranto, 2017; Mathur, Jugdev, & Fung, 2014; Mir & Pinnington, 2014). I used a Pearson correlation to test the collinearity. Finally, some researchers used bootstrapping of 1000 samples at alfa level of 0.05 with a 95% confidence interval to reproduce the sample to overcome any influence of assumptions' violations (Hoxha, 2017). I applied bootstrapping of 1000 samples at alfa level of 0.05 with a 95% confidence interval to reproduce the sample.

Inferential Results Interpretation

When researchers apply multiple linear regression, they will produce results indicate the significance of the test, such as r, R^2, F value, and *Sig*. (p). The coefficient r represents the degree of normality and linearity. Pearson product-moment correlation

value *r* ranges between -1 to +1, where values closer to -1 or +1 indicate a strong relationship between the variables (Green & Salkind, 2017). The square value of the Pearson product-moment correlation coefficient, R^2, indicates the degree of variance between the independent and the dependent variables (Green & Salkind, 2017; Saunders et al., 2015). R^2 value ranges between 0 to +1, where values closer to +1 indicate higher variance (Green & Salkind, 2017; Saunders et al., 2015). Researchers interpret the value of the *F* coefficient as the overall significance of a regression analysis (Green & Salkind, 2017; Saunders et al., 2015). The *F* value typically greater or equal to 1, and the higher *F* value means a higher significance of the regression analysis (Green & Salkind, 2017; Saunders et al., 2015). The *p* value indicates the significance of the numerical data comparing to the value of alpha (α) (Green & Salkind, 2017; Saunders et al., 2015). The *p* value ranges from 0 to +1, and researchers reject the null hypothesis if p<= α (Green & Salkind, 2017; Saunders et al., 2015).

Finally, I used the IBM SPSS Statistics software, version 24, for data analysis. SPSS is a statistical tool researchers use to conduct a range of statistical analysis (Hoxha, 2009; Sandhu et al., 2019). Hoxha (2009) extracted the data from SurveyMonkey and inserted it to SPSS to perform data analysis on their research data. I used the same approach to use SurveyMonkey to retrieve the data and export it to IBM SPSS for analysis.

Validity

Reliability and validity are two factors that determine the quality of research (Saunders et al., 2015). Reliability refers to the ability of the researcher to replicate the design of the research and extrapolate similar results (Saunders et al., 2015). Validity refers to the appropriateness of the measures used, the accuracy of the analysis of the results, and generalizability of the findings (Saunders et al., 2015).

External validity refers to the level the researcher become confident of collecting data from a particular group of participants, gaining their knowledge and experience about a specific phenomenon, and generalize the findings (Saunders et al., 2015). Saunders et al. (2015) stated that using a valid and reliable instrument is a mitigation strategy to ensure external validity. Hoxha (2017) and Pinto (1986) conducted a quantitative correlational research and used the PIP to collect the data of their research. Slevin and Pinto (1988) tested the PIP on more than 400 different project types and found that researchers can generalize PIP for use in different types of projects (Hoxha, 2017).

Internal validity concerns with determining causal relationships among variables (Aguinis & Edwards, 2014). The purpose of this quantitative correlational study is to examine the relationship between time estimation, cost estimation, and project performance. Researchers use correlation design to investigate the existence of a relationship between the variables and not the cause-and-effect relationship between them (Cooper & Schindler, 2014). Therefore, internal validity analysis does not apply to this study.

Statistical conclusion validity threats are types of conditions related to data collection and analysis that may affect the conclusions of the study (Cooper & Schindler, 2014). These types are either result in rejecting the null hypothesis while is true (Type I error) or accepting the null hypothesis while it is false (Type II error) (Cooper & Schindler, 2014; Tabachnick & Fidell, 2018). Saunders et al. (2015) referred to the appropriateness of the instrument used, accuracy of the analysis of the results, and generalizability of the findings as measures to minimize the errors of the statistical conclusion and ensure validity. To ensure the validity of the instrument, I used an existing and tested instrument that is the PIP. To examine the reliability of the PIP, Pinto (1986) used the PIP on 42 MBA students and 55 industry representatives and performed correlations and Cronbach's alpha test on each of the questionnaire items. Pinto (1986) reported that PIP indicated strong reliability above the average level with alpha scores ranging between .70 and .86 and average reliability of .78. To ensure the accuracy of the analysis and the assumptions were not violated, I tested linearity, normality, homoscedasticity, and multicollinearity (Schlechter et al., 2015).

Finally, to ensure the findings of the study apply to the larger population as part of external validity assertion, I identified purposive sampling that includes participants who are working on IT projects to represent the population. To ensure the adequacy of the sample size, I applied power analysis and used the formula provided by Tabachnick and Fidell (2018) and G*Power 3.1.9.2 software to calculate the sample size of this study, which was between 66 and 68 participants. Since I identified purposive sampling that

includes participants who are working on IT projects to represent the larger population of IT project leaders, generalizations of the findings may be possible.

Transition and Summary

In Section 2, I provided a description of the purpose of this study, the role of the researcher, the research study method and design. I also presented methods to calculate the sample size and data collection. Additionally, I specified methods to test the hypotheses, techniques to analyze the data, and described threats to external and statistical conclusion validity. In Section 3, I presented the purpose of the study, the study findings, applications to professional practice, implications for social change, recommendations for action, recommendations for further research, and ended with the conclusion of the study.

Section 3: Application to Professional Practice and Implications for Change

Introduction

The purpose of this quantitative correlational study was to examine the relationship between time estimation, cost estimation, and project performance. The targeted population comprised of IT project managers in Qatar. The independent variables were project time estimation and project cost estimation, and the dependent variable was project performance. The research question was what is the relationship between time estimation, cost estimation, and project performance? The null hypothesis (H_0) was *there was no statistically significant relationship between time estimation, cost estimation, and project performance*. The alternative hypothesis (H_1) was *there was a statistically significant relationship between time estimation, cost estimation, and project performance.*

To collect the data, I used the PIP instrument and conducted an online survey published on SurveyMonkey. The required sample size was 66 cases. I used my LinkedIn account to send an invitation to 346 potential participants. After 10 days, I received 74 responses. Seven participants skipped some of the questions. Therefore, I had to exclude the seven incomplete responses from further analysis. I conducted descriptive and inferential statistics on data for the remaining 67 responses.

To test the assumptions, I used the boxplot diagram, probability plots (P-P) diagram, and the Pearson correlation test. Additionally, I conducted a multiple regression analysis using IBM SPSS 24 to test the significance of the regression model and

hypotheses. Based on the results of the test, I could confirm there was no serious violation of the assumptions and the regression model as a whole was statistically significant.

Presentation of the Findings

Descriptive Statistics

I sent an invitation to 346 potential participants using my LinkedIn account to participate in an online survey that I published on SurveyMonkey. I used a portion of the PIP to develop the survey (see Appendix C). After 10 days, I received 74 responses. Using the formula provided by Tabachnick and Fidell (2018), I calculated the sample size of the study to be $N = 66$ cases and, by using G*Power 3.1.9.2 software, I calculated the sample size of the study to be $N = 68$. Therefore, the acceptable sample size of the study is between 66 and 68 cases. Although I received 74 responses, I rejected 7 cases because they were incomplete. Accordingly, the number of valid responses was 67 at a power level of .80, $\alpha = .05$. I exported 67 completed responses from SurveyMonkey via a Microsoft Excel file into SPSS software.

To measure project performance, the dependent variable, Hoxha (2017) and Pinto and Mantel (1990) used a 7-point Likert type scale to collect data from 13 questions in the PIP. Pinto and Mantel aggregated the scores of the 13 questions into one new variable, project performance. I used the same method and aggregated variables number 6 to number 18 of the questionnaire of this study into a new variable, project performance.

Table 1 displays the descriptive statistics for the independent and dependent variables. The sample size of the study was 67 cases. The observation for the time estimation independent variable had an average of 4.91 (*SD* = 1.861, Min. = 1.00, Max. 7.00). The observations for the cost estimation independent variable had an average of 4.93 (*SD* = 1.81, Min. = 1.00, Max. 7.00). Finally, the observations for the project performance dependent variable had an average of 64.25 (*SD* = 15.87, Min. = 22.00, Max. 91.00).

Table 1

Descriptive Statistics for the Independent and Dependent Variables

Variable	*N*	Min.	Max.	*M*	*SD*
Time Estimation	67	1	7	4.91	1.856
Cost Estimation	67	1	7	4.93	1.812
Project Performance	67	22.00	91.00	64.25	15.87

Note. N = 67

Outliers. Outliers are odd values or observations that are extreme and distant from other observations (Dedu, 2014; Tabachnick & Fidell, 2018; Yin et al., 2014). Meyer (2014) and Huijgens et al. (2017) used the boxplot diagram to inspect the outliers. I generated boxplot diagrams for each variable to inspect outliers.

Pallant (2013) explained that SPSS indicates the outliers with small circles next to each case on the boxplot diagram. The boxplot diagram (Figure 1) does not display outliers for the first independent variable, time estimation. Similarly, the boxplot diagram

(Figure 2) does not display outliers for the second independent variable, cost estimation. Therefore, the violation of the assumption of outliers was not evident for the independent variables. However, the boxplot diagram (Figure 3) displays outliers for the dependent variable; project performance case number 65 denoted with a circle.

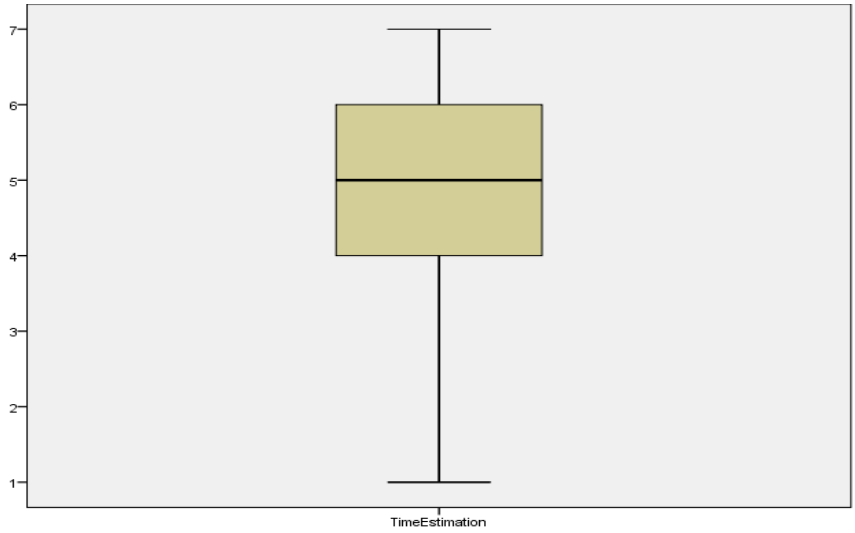

Figure 1: Boxplot diagram for outliers of the independent variable (time estimation).

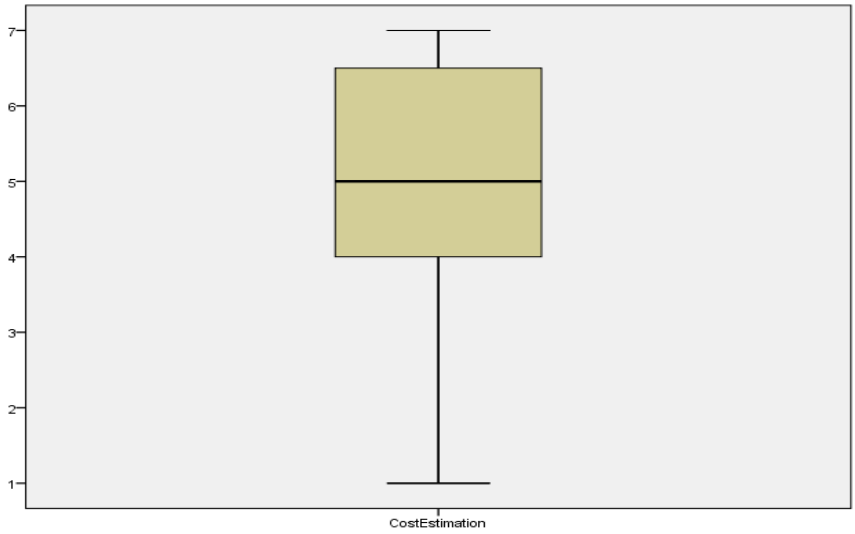

Figure 2: Boxplot diagram for outliers of the independent variable (cost estimation).

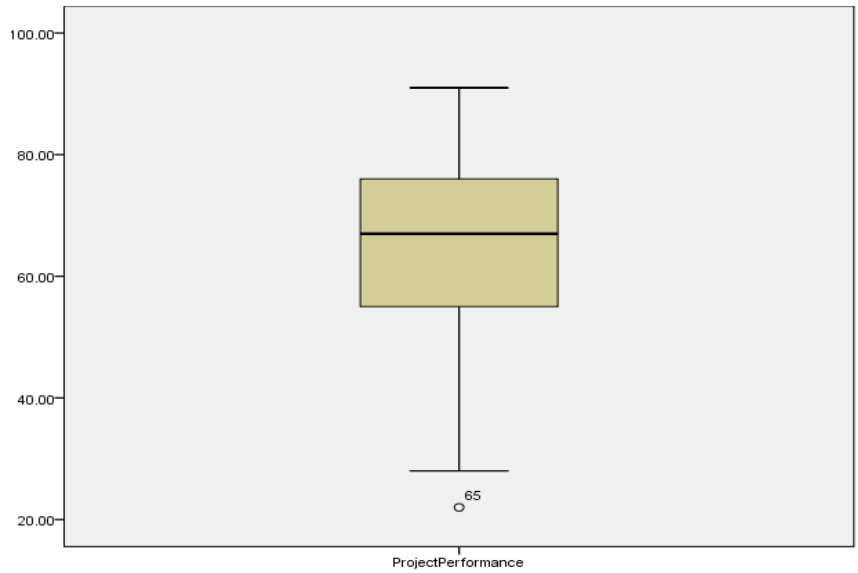

Figure 3: Boxplot diagram for outliers of the independent variable (project performance) with outlier.

Tabachnick and Fidell (2018) suggested four cause of outliers, including incorrect data entry, failure to specify missing value codes in computer syntax, cases not a member of the population, and the cases member of the population but has more extreme values than a normal distribution. Since I used an online multiple-choice survey, the incorrect data entry and computer syntax error are not valid reasoning of the outlier case found. For the other two cases, which are cases not a member of the population and cases member of the population that has more extreme values than a normal distribution, Tabachnick and Fidell suggested that the researcher could either fix the data to reduce their impact or delete the cases. As it is only one violated case, I chose to delete that case. Accordingly, I regenerated the boxplot (Figure 4) for the dependent variable, project performance, after deleting the outlier case 65 and observing the boxplot diagram, outliers were not evident.

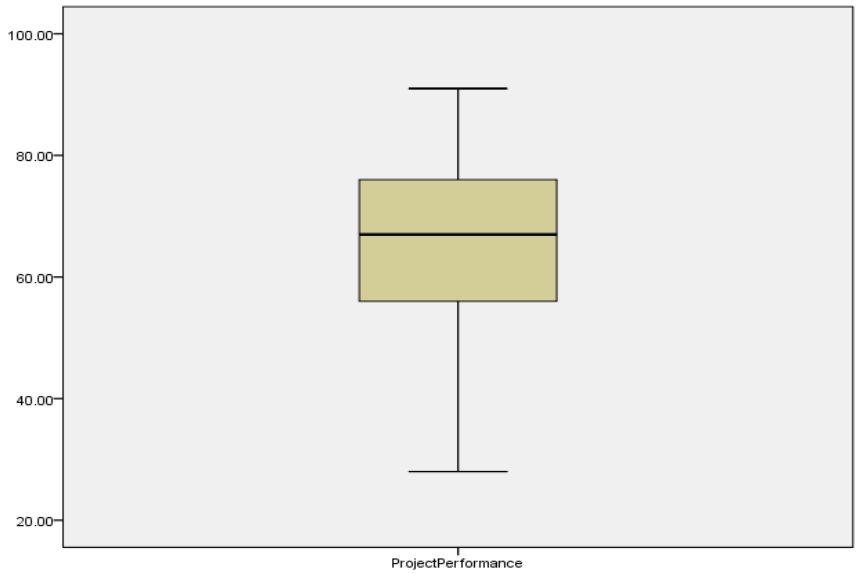

Figure 4: Boxplot diagram for outliers of the dependent variable (project performance) without outlier.

Test of Assumptions

To test the linearity, normality, and homoscedasticity assumptions, Hoxha (2017) and Rungi (2014) used the probability plots (P-P) diagram. For multicollinearity, Rungi (2014) and Khan, 2017 used Pearson correlation. I used probability plots (P-P) diagram to test the linearity, normality, and homoscedasticity assumptions and the Pearson correlation to test the multicollinearity assumption. Based on the results of the test, I confirmed there was no major violation of the assumptions.

Linearity. Linearity means there should be a linear relationship between the independent and dependent variables where the change on the dependent variable relates to the change of one or more independent variables (Saunders et al., 2015). A researcher will use probability plots (P-P) diagram to illustrate the relationships between

independent and dependent variables (Schlechter et al., 2015). I used the probability plots (P-P) diagram to inspect linearity. Hoxha (2017) and Tabachnick and Fidell (2018) explained that a diagonal straight line from the bottom left to the top right provides evidence of a linear relationship between the variables. The tendency of the points of the diagonal straight line, diagonal from the bottom left to the top right (Figure 5), provides supportive evidence that the assumption of linearity has not been violated for the dependent variable project performance.

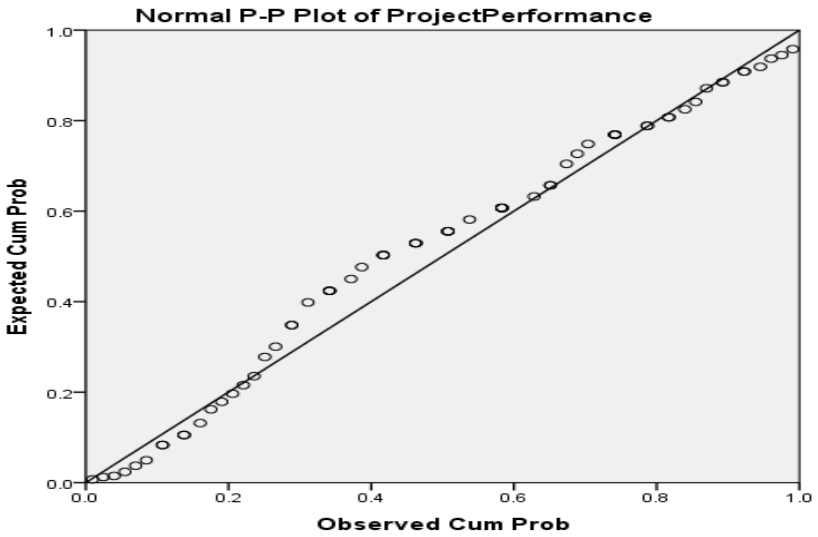

Figure 5: Probability plot diagram for linearity of the dependent variable (project performance).

I generated a probability plot diagram for the independent variables to inspect the level of linearity of each variable. The probability plots (P-P) diagram (Figure 6) illustrates a linear distribution of the cases of the time estimation independent variable.

Finally, the probability plots (P-P) diagram (Figure 7) illustrates a linear distribution of the cases of the cost estimation independent variable.

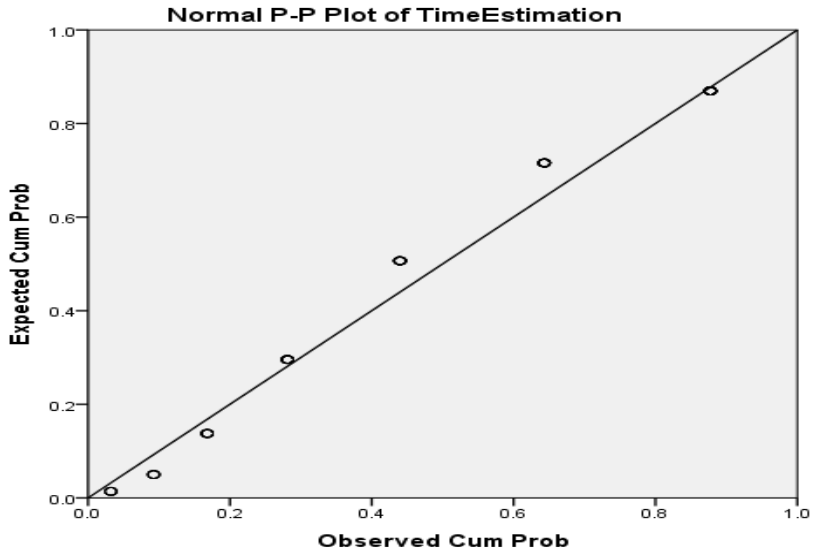

Figure 6: Probability plot diagram for linearity of the independent variable (time estimation).

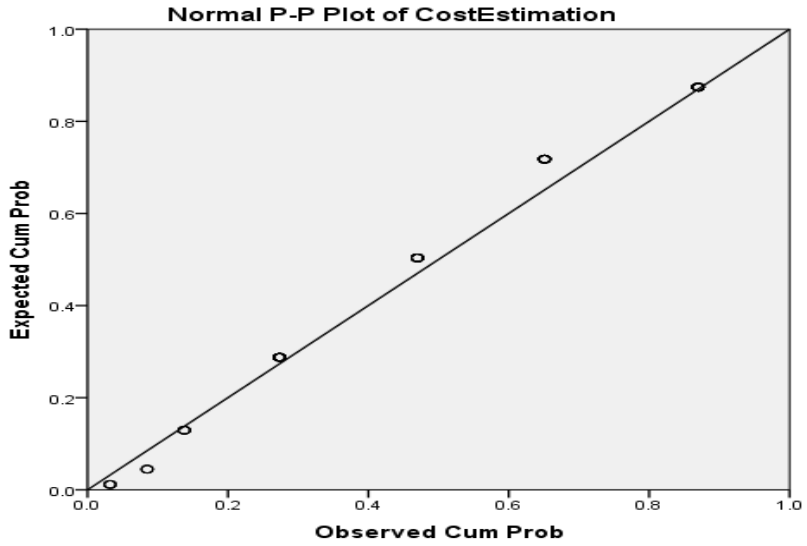

Figure 7: Probability plot diagram for linearity of the independent variable (cost estimation)

Normality. Normality refers to the normal distribution and clustering state of the data around the mean (Schlechter et al., 2015; Tabachnick & Fidell, 2013). A researcher can assess visually the degree of normal distribution in a sample using the normal curve on the histogram (Schlechter et al., 2015; Tabachnick & Fidell, 2018). I generated a histogram for the dependent variable, project performance (Figure 8), that provides a normal bell-shaped curve. Accordingly, I suggest the violation of the assumption of normality was not evident. Additionally, I generated a probability plot diagram for the residuals. The normal P-P plot diagram (Figure 9) displays a normal distribution of the data points on the linear lines indicating normally distributed residuals.

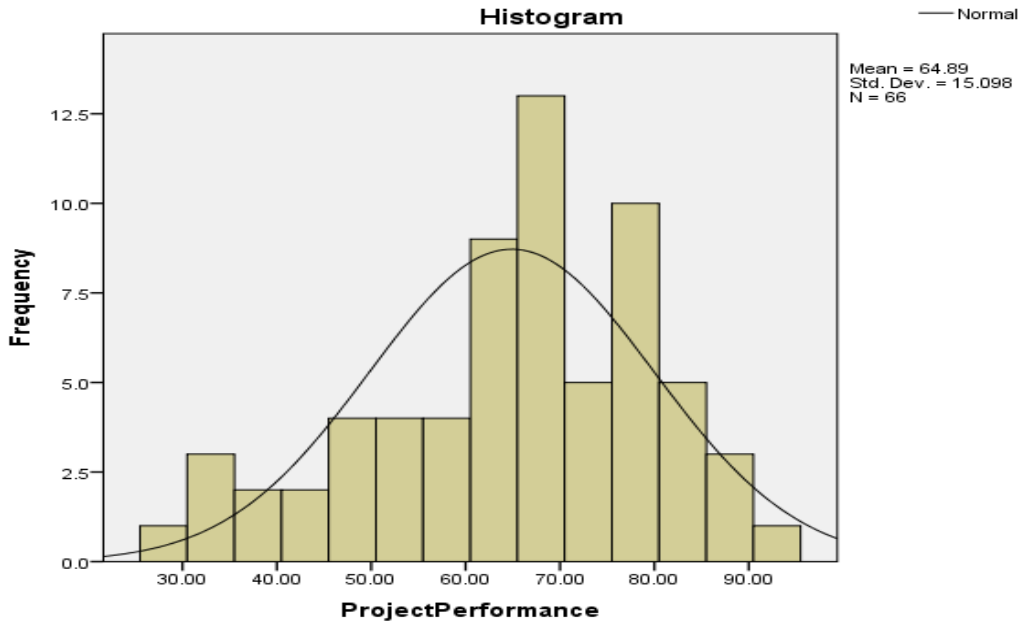

Figure 8: Histogram for normality of the dependent variable (project performance).

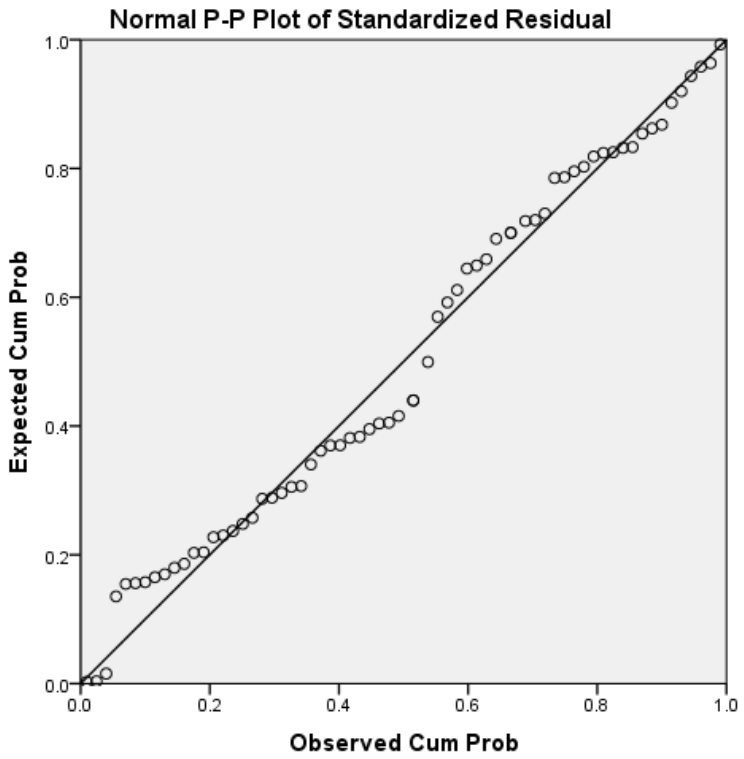

Figure 9: probability plot diagram for normality of the dependent variable (project performance).

Homoscedasticity. Homoscedasticity is the point where the dependent and independent variables' data values have equal variances (et al., 2015). Some researchers used scatterplots diagram to assess homoscedasticity (Saunders et al., 2015; Tabachnick & Fidell, 2013). Pallant (2013) and Tabachnick and Fidell (2018) explained that the distribution of the cases in a rectangular fashion provides evidence that the assumption of homoscedasticity is not evident. I used the scatterplots diagram to assess homoscedasticity (Figure 10) that shows the cases were distributed in a rectangular

fashion with no specific pattern. Therefore, I could suggest that the assumption of homoscedasticity was not violated.

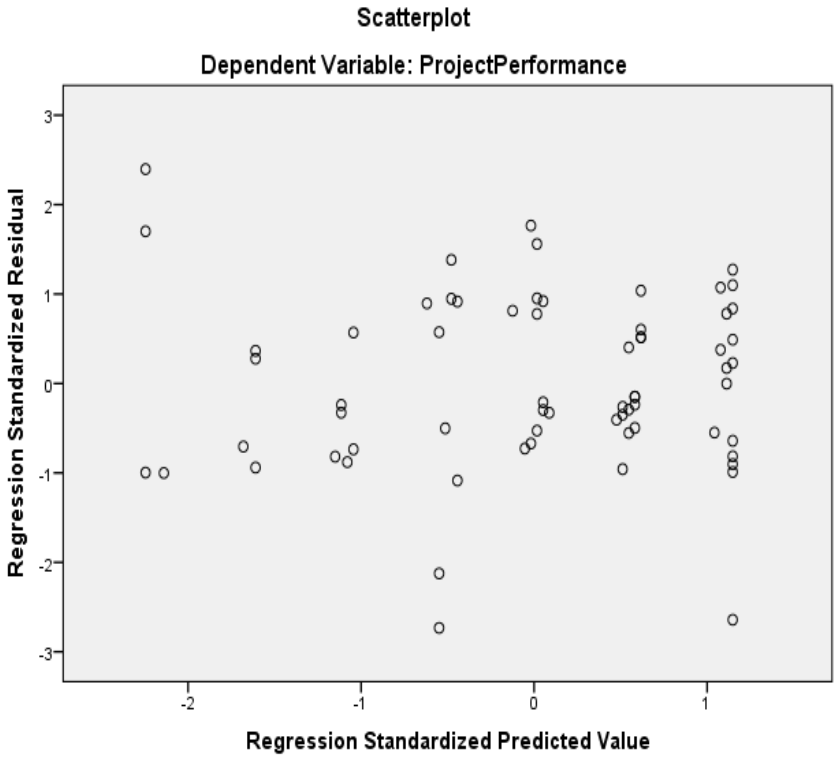

Figure 10: Scatter plot diagram for homoscedasticity of standardize residual.

Multicollinearity. Multicollinearity is the degree where two independent variables are highly correlated (Saunders et al., 2015). Some researchers used the Pearson correlation to determine multicollinearity (Rungi, 2014; Khan, 2017). When the correlation < .80, that implies there is no multicollinearity (Rungi, 2014; Khan, 2017). I used a Pearson correlation to test the multicollinearity (Table 2). The *p* value > .01 implies there is no strong correlation between the variables (Pallant, 2013; Tabachnick &

Fidell, 2018). Table 2 provides the $p > .01$ and correlation < .80; I could suggest that the assumption of multicollinearity was not violated.

Table 2

Pearson Correlations for Independent Variables (Time Estimation, Cost Estimation)

		Time Estimation	Cost Estimation
Time Estimation	Pearson Correlation	1	.664**
	Sig. (2-tailed)		.000
	N	66	66
Cost Estimation	Pearson Correlation	.664**	1
	Sig. (2-tailed)	.000	
	N	66	66

Note. ** Denotes correlation is significant at the 0.01 level (2-tailed). N = 66

As a conclusion, the examinations of the assumptions indicate there were no serious violations, except for one case of an outlier. Hoxha (2017) used bootstrapping of 1,000 samples at α level of 0.05 with a 95% confidence interval to overcome any potential violation of the assumptions. Therefore, to overcome any influence of assumptions' violations, I added 1,000 bootstrapping samples at α level of 0.05 with a 95% confidence interval to reproduce the sample.

Inferential Statistics

I conducted a standard multiple regression analysis using IBM SPSS 24, $\alpha = .05$ (one-tailed) and bootstrapping of 1,000 samples at 95% bootstrap confidence intervals to

examine the correlation between the independent variables and the dependent variable. The independent variables were project time estimation and project cost estimation. The dependent variable was the project performance. The null hypothesis (H_0) was there was no statistically significant relationship between time estimation, cost estimation, and project performance and the alternative hypothesis (H_1) was there was a statistically significant relationship between time estimation, cost estimation, and project performance. The research question was what is the relationship between time estimation, cost estimation, and project performance?

Based on the results of the standard multiple regression analysis, I found a linear combination relation of time estimation and cost estimation that was significantly related to the project performance (Table 3), F (2,63) = 24.57, $p < .05$. The sample multiple correlation coefficient (Table 4) $R = .66$, the $R^2 = .44$, and the adj. $R^2 = .42$, which indicated that approximately 42% of the variance of the dependent variable, project performance, in the sample can be predicted by the linear combination of the independent variables, time estimation and cost estimation. Therefore, I rejected the null hypotheses that there is no relationship between time estimation, cost estimation, and project performance, and I failed to reject the alternative hypotheses that there is a relationship between time estimation, cost estimation, and project performance.

Table 3

Analysis of Variance Table (ANOVA)

Model	Sum of Squares	*df*	Mean Square	*F*	*p*
Regression	6492.624	2	3246.312	24.571	.000
Residual	8323.634	63	132.121		
Total	14816.258	65			

Note. Dependent variable (project performance). Independent variables (time estimation and cost estimation)

Table 4

Model Summary

Model	*R*	*R2*	*Adj.R2*	Std. Error of the Estimate	*F*	*df1*	*df2*	*p*
1	.662	.438	.420	11.49440	24.571	2	63	.000

Note. Dependent variable (project performance). Independent variables (time estimation and cost estimation)

Table 5

Regression Analysis Summary for Predictors Time Estimation and Cost Estimation (N = 66) with Bootstrapping

	Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
Variable	*B*	Std. Error	*β*	*t*	*p*	Lower Bound	Upper Bound
(Constant)	36.793	4.593		8.011	.000	27.615	45.970
Time Estimation	5.301	1.055	.634	5.023	.000	3.192	7.411
Cost Estimation	.352	1.084	.041	.325	.746	-1.814	2.518

Note. Dependent variable (project performance)

As indicated in the coefficients table (Table5), the correlation between the first independent variable, time estimation, and the dependent variable, project performance is statistically significant as the time estimation $p < .05$. The unstandardized coefficient $B = 5.30$. Pallant (2013) and Tabachnick and Fidell (2018) explained the *B* value indicates the amount of change in a dependent variable due to a change of 1 unit of the independent variable. The unstandardized coefficient $B = 5.30$ means that a one-unit increase of the time estimation is associated with 5.3 unites of project performance. However, the correlation between the second independent variable, cost estimation and the dependent variable, project performance, is statistically insignificant as the cost estimation $p > .05$. The unstandardized coefficient $B = .35$ means that a one-unit increase of the cost estimation is associated with only .35 unites of project performance. The unstandardized coefficient results show that most of the impact on project performance is accounted for by the project time estimation factor while the project cost estimation factor is almost neutral to the project performance.

Analysis Summary

The purpose of this study was to examine the relationship between time estimation, cost estimation, and project performance. I used standard multiple linear regression to examine the correlation between the independent variables and the dependent variable. I assessed the assumptions of an outlier, linearity, normality, homoscedasticity, and collinearity and found no serious violations exist of the assumptions except only one case of an outlier that I deleted from the sample data.

The results of the linear regression model were significant, F (2,63) = 24.57, p < .05, R^2 = .42. I rejected the null hypotheses and suggested there is a relationship between project time estimation, project cost estimation, and project performance. I found the correlation between the time estimation independent variable and the project performance dependent variable is statistically significant, p < .05 and B = 5.30. I rejected the null hypotheses and suggested there is a relationship between the time estimation and project performance. I found the correlation between the cost estimation independent variable and the project performance dependent variable is statistically insignificant, p > .05 and B = .35. I failed to reject the null hypotheses and suggest there is no statistically significant relationship between cost estimation and project performance. It is tempting to conclude that the only useful predictor is the project time estimation for project performance in this model.

Theoretical Conversation on Findings

The theoretical framework for this study was the theory of the iron triangle, developed by Barnes (1956). The iron triangle theory refers to time, cost, and scope as three project's constraints that together constitute the quality of the project and form the project governance (Scheuchner, 2017). Scheuchner (2017) recognized the iron triangle as one of the early project success definitions that measure the performance, success, or failure of a project. Cullen and Parker (2015) suggested that traditionally the iron triangle model was the basis of the measurement of project success. Hence, I used the iron triangle as a lens to view the phenomenon of poor project performance by using two of

the iron triangle constraints, time estimation, and cost estimation as constructs of the study.

Scheuchner (2017) suggested with most information technology (IT) projects, organizational leaders experience poor project performance regarding schedule, budget, or scope that lead to organizational failure. The specific business problem of this study is that some IT project sponsors and managers do not know the relationship between time estimation, cost estimation, and project performance. The findings of this study confirm the existence of a relationship between project time estimation and project performance but failed to confirm the existence of a relationship between project cost estimation and project performance.

Although, some scholars have indicated time, cost, and scope or quality of projects as main success factors (Franklin & Cristina, 2015; Joslin &Müller, 2016; Nicholls et al., 2015; Parker et al., 2015; Scheuchner, 2017; Sridarran et al., 2017), others argued the effectiveness of these factors to lead to successful projects (Alami, 20016; Turner & Zolin 2012). Turner and Xue (2018) argued the role of time and cost as project success indicators. Ramos and Mota (2014) suggested a project could be successful even if the project team could not deliver the project on time and within budget and fail even if the project team managed to deliver the project on time and within budget. Turner and Zolin (2012) suggested that the triple constraints are not the only factors determining the success or failure of a project. Alami (2016) suggested that IT project teams determine the success of the projects based on the maturity of the environment surrounding the

projects, which is beyond the triple constraints. Alreemy et al. (2016) suggested the successful implementation of the organization's overall strategy and objectives is a key success factor of projects rather than delivering projects on time and within budget.

In summary, I found a partial agreement between the findings of the study and the findings of previous studies suggesting that some of the triple constraints could determine project performance. However, there could be some other factors participate in the determination of project performance.

Additionally, I found the results of the study aligned with the concept of the project tradeoff that some scholars referred to in their studies. Isharyanto (2015) stated the relationship between the triple constraints as a mutually dependent relation where a change of one constraint imposes a change to the other two constraints. One main role of project leaders is to consider the competing nature of the three constraints and manage the decision making process of the tradeoff relationship between time, cost, and scope (Abu-Hussein et al., 2016; Parker et al., 2015). Habibi et al. (2018) provided an example of the tradeoff between the time and cost of projects when project managers decide to add more resources to a project to deliver the project on time, which involves an additional cost of the resources. The study provides evidence that the project sponsors and managers favor the project time factor over the project cost factor.

Applications to Professional Practice

Projects are important to organizational success and performed to fulfill organizational objectives (PMI, 2017). The importance of projects resulted from the

impact the project team could create as an outcome of projects. One of the most recognized factors of projects is the impact of projects on an organization's strategic elements, such as organizational objectives and goals (Franklin & Cristina, 2015; Sandhu et al., 2019). Vermerris et al. (2014) suggested that businesses should conduct strategic alignment at different organizational levels to manage the continual high failure rate of IT projects. Implementing projects enables organizational capabilities required to achieve strategic objectives, maintain the competitive advantage, and advance business operations (Adamczewski, 2016; Berman & Marshall, 2014).

Due to the importance of projects, some researchers indicated the need for more research in the area of project management (Habibi et al., 2018; Ingason & Shepherd, 2014; Sridarran et al., 2017). In a narrower view, some researchers studied the phenomena of project failure and poor project performance and identified different causes, such as the misalignment between projects and business strategies (Parker et al., 2015; Sandhu et al., 2019). Habibi et al. (2018); Ingason and Shepherd (2014); as well as Sridarran et al. (2017) indicated the need for more research in the field of project management in terms of success criteria, cost management, and time management.

The findings of the study would add to the knowledge of IT managers and sponsors on the role of time and cost estimation as two components of IT project success criteria, which may lead to the improvement of IT project execution on time and within budget and develop strategies to improve project performance. Implementing IT project management strategies provides the required level of control for IT managers and

sponsors to govern the projects' factors including time, cost, and performance (Mir & Pinnington, 2014; Parker et al., 2015). Additionally, the findings of the study would provide value to the global body of knowledge of IT project management as the study provided a closer view of the relationship between time and cost estimation of a project. Moreover, the study may motivate IT managers and sponsors to align IT project management practice with the organizational strategy.

Implications for Social Change

According to Damoah and Akwei (2017), project failure causes financial losses to project owners. Poor project performance could lead to a business failure that leads to loss of employment income, loss of economies' sustainability, and limits the growth of communities (Scheuchner, 2017). On the contrary, an increase in the project success rate could positively increase business performance, increase economies' sustainability, increase the quality of life, open new business opportunities, and increase the rate of employment (Scheuchner, 2017). Hoxha (2017) stated that if project success rates increase that might translate into an improvement of livelihood for local communities and ultimately create a positive change to the society in large. In my organization, I will request from my management to discuss the findings of the study, in the monthly steering committee, to explore new methods of improving project performance.

I demonstrated the relationship between time, cost, and project performance that could help organizational leaders to make decisions on improving project performance. The findings of the study provided some evidence of the strength of the relationship

between time estimation, cost estimation, and project performance. The statistically proven findings of the study will provide researchers and practitioners with a micro level information about project factors that influence project performance. The increased rate of project performance might lead to the improvement of local communities, increase business performance, increase economies' sustainability, increase the quality of life, open new business opportunities, and increase the rate of employment.

Recommendations for Action

The role of projects in advancing businesses is increasing, but project failure across most industries is prominent (Cullen & Parker, 2015). Catanio et al. (2013) found 60% of project management professionals lack project management formal training and knowledge of project's critical success factors. Implementing IT project management strategies could provide the required level of control for IT managers and sponsors to govern the inputs, such as time and cost estimation, and the outputs, such as project performance of the IT projects (Mir & Pinnington, 2014; Parker et al., 2015).

In this study, I discussed, with great emphasis, time and cost as two project success factors influencing projects' performance. According to the findings of the study, I found that project sponsors and project managers favor the time factor over the cost factor of the projects. Project sponsors and managers could use the results of the study to improve their project management strategies.

I have more than 2000 followers on LinkedIn. Most of them are project manager and sponsors. To bring broader attention to the results of the study and disseminate the

findings to a wider audience, I will publish the study on my LinkedIn account. Additionally, I will publish the study on peer-reviewed journals and Several IT project management groups in LinkedIn that include more than 100,000 members.

Recommendations for Future Research

I conducted this study in Qatar. Qatar is a small developing and emerging market and rich country. The population of Qatar is 2.639 million and the GDP per capita is 63,505.81 USD (World Bank, 2019). The rapid development within the last few years and the wealth of the country might influence the preference of projects' factors to favor time over the budget of projects. Therefore, my first recommendation is to study a larger population in other countries to validate the results of this study versus other counties' studies.

My second recommendation for future research is to use actual projects' data records to examine the relationship between the variables. In my study, I used a questionnaire to collect the data from project sponsors, managers, and coordinators about projects they managed within the last 5 years. Some of the participants might have provided some biased answers. Therefore, it would be more accurate if future researchers could test the actual data records of the projects.

Reflections

As a professional and certified project manager, I was aiming from this study to find the causes of the poor project performance. Originally, I was planning to conduct a qualitative study to explore the causes of the poor project performance. Throughout the

doctoral study journey and after some piloting of the cases, I found that it would be impractical to collect the data using such approach as project teams may become reluctant and hesitant to provide sensitive information about their projects especially in case of project failures. Therefore, I reconsidered the approach of the study and chose the quantitative approach where participants could anonymously provide their data.

Moreover, I had a strong belief and understanding that the time, cost, and quality were three equally important factors affecting project performance. The results of this study have changed my professional bias. I reached the conclusion that there are more factors that could influence project performance other than the triple constraints.

Finally, when I started the research, I had limited knowledge of project management theories. During my research, I had the chance to explore more theories and methods that would help me in my academic and professional future. This study broadened my knowledge and intensified my cognition of IT project management.

Conclusion

In this study, I intended to examine the relationship between the time estimation, cost estimation, and project performance. The results of the study provided evidence of a significant relationship between time estimation, cost estimation, and project performance. The results of the study supported the argument that there is a strong relationship between time estimation and project performance and does not support the argument of the existence of a relationship between cost estimation and project performance. Accordingly, the study supported the concept of project tradeoff where

project managers tend to favor delivering the project on time with extra cost rather than delivering the project within budget but late.

Project sponsors and managers could benefit from this study by enhancing their project management strategies, policies, and governance to develop practical and realistic project performance matrices. Project sponsors and managers should develop matrices that prioritize and weight the importance of projects' factors, such as time, cost, and quality. Accordingly, project sponsors and managers could allow different tolerance levels of acceptance according to the importance of project factors.

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Appendix A: Project Implementation Profile (PIP) Instrument

(Pinto, 1986)

This questionnaire attempts to measure the relative contribution of the following factors to the project's final outcome and subsequent performance. Please circle the number that indicates the extent to which you agree or disagree with the following statements as they relate to activities occurring in the project about which you are reporting (Pinto, 1986).

		Strongly Disagree			Neutral			Strongly Agree
1	Project Mission							
	The goals of the project are in line with the general goals of the organization.	1	2	3	4	5	6	7
	The basic goals of the project were made clear to the project team.	1	2	3	4	5	6	7
	The results of the project will benefit the parent organization.	1	2	3	4	5	6	7
	I am enthusiastic about the chances for success of this project.	1	2	3	4	5	6	7
	I am aware of and can identify the beneficial consequences to the organization of the success of this project.	1	2	3	4	5	6	7
2	Top Management Support							
	Upper management will be responsive to our request for additional resources, if the need arises.	1	2	3	4	5	6	7
	Upper management shares responsibility with the project team for ensuring the project's success.	1	2	3	4	5	6	7

	I agree with upper management on the degree of my authority and responsibility for the project.	1	2	3	4	5	6	7
	Upper management will support me in crises on this project.	1	2	3	4	5	6	7
	Upper management has granted us the necessary authority and will support our decisions concerning the project.	1	2	3	4	5	6	7
3	Project Schedule/Plan							
	We know which activities contain slack time or slack resources that can be utilized in other areas during emergencies.	1	2	3	4	5	6	7
	There is a detailed plan (including time schedules, milestones, personnel requirements, etc.)	1	2	3	4	5	6	7
	There is a detailed budget for the project.	1	2	3	4	5	6	7
	Key personnel needs (who, when) are specified in the project plan.	1	2	3	4	5	6	7
	There are contingency plans in case the project is off schedule or off budget?	1	2	3	4	5	6	7
4	Client Consultation							
	The clients were given the opportunity to provide input early in the project development stage.	1	2	3	4	5	6	7
	The clients are kept informed of the project's progress.	1	2	3	4	5	6	7
	The value of the project has been discussed with the eventual clients.	1	2	3	4	5	6	7
	The limitations of the project have been discussed with the clients.	1	2	3	4	5	6	7
	The clients were told whether or not their input was assimilated into the project plans.	1	2	3	4	5	6	7
5	Personnel							

	Project team personnel understand their role on the project team.	1	2	3	4	5	6	7
	There are sufficient personnel to complete the project.	1	2	3	4	5	6	7
	The personnel on the project team understand how their performance is evaluated?	1	2	3	4	5	6	7
	Job descriptions for team members have been written and distributed and are understood.	1	2	3	4	5	6	7
	Adequate technical or managerial training (and time for) is available for project team members.	1	2	3	4	5	6	7
6	Technical Tasks							
	Specific project tasks are well managed.	1	2	3	4	5	6	7
	The project engineers and other technical people are competent.	1	2	3	4	5	6	7
	The technology that is being used to support the project works well.	1	2	3	4	5	6	7
	The appropriate technology (equipment, training programs, etc.) has been selected for project success.	1	2	3	4	5	6	7
	The people implementing the project understand it.	1	2	3	4	5	6	7
7	Client Acceptance							
	There is adequate documentation of the project to permit easy use by the clients (instructions, etc.).	1	2	3	4	5	6	7
	Potential clients have been contacted about the usefulness of the project.	1	2	3	4	5	6	7
	An adequate presentation of the project has been developed for clients.	1	2	3	4	5	6	7
	1 know whom to contact when problems or questions arise.	1	2	3	4	5	6	7
	Adequate advance preparation has been done to determine how best to sell the project to clients.	1	2	3	4	5	6	7

8	Monitoring and Feedback							
	All important aspects of the project are monitored, including measures that will provide a complete picture of the project's progress.	1	2	3	4	5	6	7
	Regular meetings to monitor project progress and improve the feedback to the project team are conducted.	1	2	3	4	5	6	7
	Actual progress is regularly compared with the project schedule.	1	2	3	4	5	6	7
	The results of project reviews are regularly shared with all project personnel who have impact upon budget and schedule.	1	2	3	4	5	6	7
9	Communications							
	The results of planning meetings are published and distributed to applicable personnel.	1	2	3	4	5	6	7
	Individuals/groups supplying input have received feedback on the acceptance or rejection of their input	1	2	3	4	5	6	7
	When the budget or schedule is revised, the changes and the reasons for the changes are communicated to all members of the project team.	1	2	3	4	5	6	7
	The reasons for the changes to existing policies/procedures are explained to members of the project team, other groups affected by the changes, and upper management.	1	2	3	4	5	6	7
	All groups affected by the project know how to make problems known to the project team.	1	2	3	4	5	6	7
10	Troubleshooting							
	The project leader is not hesitant to enlist the aid of personnel not involved in the project in the event of problems.	1	2	3	4	5	6	7

	Brainstorming sessions are held to determine where problems are most likely to occur.	1	2	3	4	5	6	7
	In case of project difficulties, project team members know exactly where to go for assistance.	1	2	3	4	5	6	7
	I am confident that problems that arise can be solved completely.	1	2	3	4	5	6	7
	Immediate action is taken when problems come to the project team's attention.	1	2	3	4	5	6	7

Appendix B: Project Performance Questionnaire

(Pinto, 1986)

This questionnaire relates to your evaluation of the ultimate performance of the project in which you were involved. Please indicate by circling the appropriate number the extent to which you agree or disagree with the following statements as they related to outcome of the project (Pinto, 1986).

		Strongly Disagree			Neutral			Strongly Agree
1	This project has/will come in on schedule.	1	2	3	4	5	6	7
2	This project has/will come in on budget.	1	2	3	4	5	6	7
3	The project that has been developed works, (or if still being developed, looks as if it will work).	1	2	3	4	5	6	7
4	The project will be/is used by its intended clients.	1	2	3	4	5	6	7
5	This project has/will directly benefit the intended users: either though increasing efficiency or employee effectiveness.	1	2	3	4	5	6	7
6	Given the problem for which it was developed this project seems to do the best job of solving the problem, i.e., it was the best choice among the set of alternatives.	1	2	3	4	5	6	7
7	Important clients, directly affected by this project, will make use of it.	1	2	3	4	5	6	7
8	I am/was satisfied with the process by which this project is being/was completed.	1	2	3	4	5	6	7
9	We are confident non-technical start-up problems will be minimal,	1	2	3	4	5	6	7

	because the project will be readily accepted by its intended users.							
10	Use of this project has/will directly lead to improved or more effective decision making or performance for the clients.	1	2	3	4	5	6	7
11	This project will have a positive impact on those who make use of it.	1	2	3	4	5	6	7
12	The results if this project represents a definite improvement in performance over the way clients used to perform these activities.	1	2	3	4	5	6	7
13	All things considered, this project was/will be a success.	1	2	3	4	5	6	7

Appendix C: Data Collection Survey

Please consider the below conditions and guidelines prior to starting the survey:

1) A participant must be or have been a project sponsor, manager, or coordinator.

2) A participant must be 18 years old or above when taking the survey.

3) The project must have been performed within the last 5 years.

4) The project must be IT related.

5) The projects must have been performed in Qatar.

For section 1, please circle the number that indicates the extent to which you agree or disagree with the following statements as they relate to activities occurring in the project about which you are reporting. For section 2, please indicate by circling the number that indicates the extent to which you agree or disagree with the following statements as they related to the outcome of the project.

		Strongly Disagree			Neutral			Strongly Agree
1	Project Schedule/Plan							
1.1	We know which activities contain the slack time or slack resources that can be utilized in other areas during emergencies.	1	2	3	4	5	6	7
1.2	There is a detailed plan (including time schedules, milestones, personnel requirements, etc.)	1	2	3	4	5	6	7
1.3	There is a detailed budget for the project.	1	2	3	4	5	6	7
1.4	Key personnel needs (who, when) are specified in the project plan.	1	2	3	4	5	6	7

1.5	There are contingency plans in case the project is off schedule or off budget?	1	2	3	4	5	6	7
2	Project Performance							
2.1	This project has/will come in on schedule.	1	2	3	4	5	6	7
2.2	This project has/will come in on budget.	1	2	3	4	5	6	7
2.3	The project that has been developed works, (or if still being developed, looks as if it will work).	1	2	3	4	5	6	7
2.4	The project will be/is used by its intended clients.	1	2	3	4	5	6	7
2.5	This project has/will directly benefit the intended users: either through increasing efficiency or employee effectiveness.	1	2	3	4	5	6	7
2.6	Given the problem for which it was developed this project seems to do the best job of solving the problem, i.e., it was the best choice among the set of alternatives.	1	2	3	4	5	6	7
2.7	Important clients, directly affected by this project, will make use of it.	1	2	3	4	5	6	7
2.8	I am/was satisfied with the process by which this project is being/was completed.	1	2	3	4	5	6	7
2.9	We are confident non-technical start-up problems will be minimal because the project will be readily accepted by its intended users.	1	2	3	4	5	6	7
2.10	Use of this project has/will directly lead to improved or more effective decision making or performance for the clients.	1	2	3	4	5	6	7
2.11	This project will have a positive impact on those who make use of it.	1	2	3	4	5	6	7

2.12	The results if this project represents a definite improvement in performance over the way clients used to perform these activities.	1	2	3	4	5	6	7
2.13	All things considered, this project was/will be a success.	1	2	3	4	5	6	7

Appendix D: Permission to use the PIP

Re: using PIP

Pinto, Jeffrey <[redacted]>
Mon 11/5/2018 4:21 PM
To: Eyas Orabi <[redacted]>
Cc: Eyas Nakhleh <[redacted]>; Slevin, Dennis <[redacted]>

Dear Eyas Nakhleh,

This note constitutes formal approval for you to use the PIP in your research. Please note that this approval does not extend to using it for training or consulting purposes. Best of luck with your work.

Sincerely,

Jeff Pinto

From: Eyas Orabi <[redacted]>
Sent: Sunday, November 4, 2018 11:02:59 AM
To: Pinto, Jeffrey
Cc: [redacted]
Subject: Re: using PIP

Dear Dr. Pinto,

I hope my email finds you well.

I would like to ask your permission to use the Project Implementation Profile (PIP), specifically section 3; the Project Schedule/Plan, to be the instrument of my quantitative correlational research. My research question is What is the relationship between time estimation, cost estimation, and project performance?. I mean by project performance is whether the project was successful or failure or somewhere in between. Moy (2016) applied the same concept to measure the profromance of projects based on projecct sucess or failure. I will use the triple constraints theory as the theoretical framework and IBM SPSS to analyze the data.

I hope my request gets your attention and approval.

Best regards,
Eyas Nakhleh

Appendix E: Invitation to Participate

Dear Participants,

My name is Eyas Nakhleh. I am a candidate student for a Doctor in Business Administration (DBA) degree at Walden University. I am inviting you to participate in my research questionnaire. The title of the research study is "Relationship Between Time Estimation, Cost Estimation, and Project Performance." The purpose of this study is to examine the relationship between time estimation, cost estimation, and project performance. The questionnaire is an online questionnaire published on SurveyMonkey, contains 18 questions, and takes between 10 to 15 minutes to complete.

Please note your participation in this study is voluntary and anonymous, and you can withdraw or decline the invitation at any time before you click submit of the survey. To protect your identity and confidentiality, you are not required to provide personal information, such as your name or your company's name. I will not store your personal information and will not be able to contact you once you decide to take a part of this study. Completing and submitting the questionnaire indicates your consent to participate in this study and include your data to be analyzed. Furthermore, please note that I will keep the data safe and secured for a minimum of five years before I destroy the data. The result of the study will be presented in summary only. Finally, I will post the results of the study on my LinkedIn account.

To participate in the survey, please click on this link:

https://www.surveymonkey.com/r/588XL3W