MODELING THE PROJECT MANAGEMENT PERFORMANCE OF CONSTRUCTION FIRMS

by

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ABSTRACT

MODELING THE PROJECT MANAGEMENT PERFORMANCE OF CONSTRUCTION FIRMS

Construction industry is a complex and fragmented industry. Therefore, well-set project management practices and strategies are needed. For the successful management of construction projects, determination of project management performance is essential. Within this context, this research aims at proposing a project management performance model to measure project management performance of construction firms. In this respect, construction-specific determinants of project management performance are developed based on the fourteen knowledge areas as set by the PMBOK Guide. Moreover, indicators of performance are also determined. The proposed model comprises 63 parameters associated with performance. The model is composed based on constructing the interrelations among the knowledge areas and the impact of those on project management performance. To test the validity of the proposed measures, a questionnaire survey was designed and administered to construction professionals. 121 responses were collected from different construction projects. The data collected was analyzed using structural equation modeling to assess model reliability. Based on the analysis results, it was found that project integration, communications, safety, risk, human resource, financial, and cost management have direct whereas scope and time management have indirect and significant effect on performance. On the other hand, the effects of project claim, environmental, quality, procurement, and stakeholder on performance were not found significant. Furthermore, the relation between project cost and quality management was also found insignificant. This research is expected to help construction project managers devise and implement strategies and develop actions to improve project success.

ÖZET

İNŞAAT FİRMALARININ PROJE YÖNETİM PERFORMANSININ MODELLENMESİ

İnşaat sektörü proje bazlı ve karmaşık bir sektör olması nedeniyle inşaat projelerinin etkin yönetimi çözüm odaklı proje yönetimi uygulamalarını ve stratejilerini barındırmak zorundadır. Bu nedenle, inşaat projelerinin yönetim performanslarının belirlenmesi büyük önem arz etmektedir. Bu çalışmanın temel amacı Türk inşaat firmalarının inşaat projelerindeki proje yönetimi performanslarının belirlenmesi amacıyla bir proje yönetimi performans modeli geliştirmektir. Bu amaçla, proje yönetimi performansının ölçülmesine yönelik proje yönetim enstitüsünün (PMI)"Proje Yönetimi Bilgi Birikimi Kılavuzu"nda (PMBOK Guide) belirtilen 14 temel bilgi alanı baz alınarak bu alanlara dair inşaat sektörüne özgü alt parametreler geliştirilmiş ve bu bilgi alanlarının proje yönetim performansı üzerindeki etkileri araştırılmıştır. Ayrıca proje yönetim performansına dair temel göstergeler belirlenmiştir. Performans ölçümüne yönelik toplamda 63 adet inşaat sektörünü baz alan alt parametre belirlenmiştir. Bu sayede geliştirilen model ile bilgi alanlarının proje yönetimi performansı üzerindeki etkileri ile bu bilgi alanlarının kendi aralarındaki ilişkiler araştırılmıştır. Bu kapsamda bir anket çalışması hazırlanmış ve toplamda 121 farklı projeye ait veri toplanmıştır. Bu veriler yapısal denklem modeli (YDM) ile incelenmiş ve modelin geçerliliği araştırılmıştır. Yapılan analiz sonuçlarına göre proje entegrasyon, iletişim, iş güvenliği, risk, insan kaynakları, finans ve maliyet yönetimi bilgi alanlarının performans üzerinde direk etkileri olduğu belirlenmiştir. Bunun yanında proje kapsam ve zaman yönetiminin de diğer bilgi alanları üzerinden performans üzerinde dolaylı etkileri gözlemlenmiştir. Bu çalışmanın bulgularının inşaat sektöründe faaliyet gösteren küçük, orta ve büyük ölçekli inşaat firmaların proje yöneticilerinin inşaat projelerinde daha yüksek başarı elde etmeleri için yönetim faaliyetlerine katkıda bulunması beklenmektedir.

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LIST OF ACRONYMS/ABBREVIATIONS

ADF	Asymptotically Distribution Free
AGFI	Adjusted Goodness of Fit Index
AMOS	Analysis of Moment Structures
ANOVA	Analysis of Variance
ARKIV	Architectural Archive of Turkey
ATCEA	Association of Turkish Consulting Engineers and Architects
BIM	Building Information Modeling
BPMM	Business Process Maturity Model
BSC	Balanced Scorecard
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CMM	Capability Maturity Model
CoP	Communities of Practice
ERM	Enterprise Risk Management
ERP	Enterprise Resource Planning
EVA	Earned Value Analysis
GFI	Goodness of Fit Index
GLM	General Linear Model
GLS	Generalized Least Squares
HiAP	Health in All Policies
ICT	Information Communication Technology
IFI	Incremental Fit Index
IPDS	Integrated Project Delivery System
KNM	Knowledge Navigator Model
KPAs	Key Process Areas
KPIs	Key Performance Indicators
MLE	Maximum Likelihood
MMs	Maturity Models
NFI	Normed Fit Index

NNFI	Non-normed Fit Index
OPM3	Organizational Project Management Maturity Model
P2MM	PRINCE2 Maturity Model
PM2	Process Maturity Model
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMMM	Project Management Maturity Model
PPPs	Public-Private-Partnerships
QRA	Quantitative Risk Assessment
RFID	Radio Frequency Identification
RMMS	Risk Management Maturity System
RMSEA	Root Mean Square Error of Approximation
SEM	Structural Equation Modeling
SMEs	Small and Medium Enterprises
SPSS	Statistical Package for the Social Sciences
TCA	Turkish Contractors Association
TCEA	Turkish Construction Employers Association
TEACI	Association of Construction Industries
TLI	Tucker-Lewis Index
TSLS	Two-Stage Least-Squares
ULS	Unweighted Least-Squares
WLS	Weighted Least-Squares

1. INTRODUCTION

Firm performance and the improvement of performance in different industries has been an emerging research topic over the last years. Therefore, performance measurement issue, which helps with determining firm success, has gained an increasing popularity lately. Performance measurement in the construction industry takes a great portion in the performance measurement studies. Construction firms' performance is generally measured through performance models, which are the results of the evaluation of different parameters. The main purpose of this research is to propose a generic model by the consideration of different parameters in order to determine firms' project management performance. The model developed is aimed to reveal how well firms perform in managing project management activities. In this scope, construction specific components are developed to measure project success. Then, a questionnaire survey is addressed to construction professionals. The reliability and the validity of the model are assessed with structural equation modeling (SEM). This research is expected to make a considerable contribution to the performance studies in the construction industry, and expected to guide construction firms to improve themselves in terms of lacking capabilities and develop appropriate strategies. Introduction chapter of the thesis involves the background of the research, problem determination, problem statement, related studies, aims and objectives, research method, scope and limitations, and organization of the thesis.

1.1. Background of the Research

Construction industry is a fragmented and project based industry. Therefore, it takes a great deal to determine project management performance of construction firms and determine how successful they are in managing construction processes. To determine project management success, majority of the researchers have proposed performance models or performance evaluation frameworks, which consist of several internal and external factors (Kagioglou *et al.*, 2001; Takim and Akintoye, 2002; Lin and Shen, 2010; Wang *et al.*, 2010; Jin *et al.*, 2013; Ali *et al.*, 2013). However, the metrics behind the performance models differ according to the project type. Therefore, there is still no agreed consensus on determining project management performance due to the changing nature of the construction industry. Moreover, the literature still lacks a complete project management framework, which best address the industry needs.

1.2. Problem Determination

Performance measurement has always been an important research topic in the project management studies. Performance measurement studies have been conducted for different industries. Among those, a considerable number of studies have focused on performance measurement in construction. Since construction industry takes a great portion in the economic growth, the determination of construction companies' performance in project management is essential. However, the changing and dynamic nature of metrics and measures towards performance measurement requires a detailed analysis and evaluation of the current conditions of the industry.

There are several difficulties in evaluating construction companies' project management performance. One of them is to decide on which performance indicators as subjective or objective measures are assessed. The second one is to decide on whether performance is measured through project or firm level. The third challenge is to assess the complete list of performance determinants and to define the interrelations among performance determinants. Finally, the last challenging step is to assess the determinants of project management performance, and to reveal the relations of the determinants with the project management success.

1.3. Problem Statement

A great portion of the research studies conducted on performance management has focused on the measuring performance through determination of the key performance indicators, use of balanced scorecard approach or development of maturity models.

This research is based on the definition of accurate performance measures and investigation of determinants influencing the project management performance of construction firms. Review of previous studies reflects that performance is a multidimensional construct, which depends on several different measures. Therefore, a complete and valid performance measure should be constructed to investigate direct and indirect impacts of factors on overall performance of construction companies.

1.4. Related Studies

The main challenge in measuring project management performance of construction companies is associated with the complexity of performance measurement system and the existence of different techniques. Although there are several research studies, which investigated performance management and measurement in different industries, development of a performance model to measure project management performance of construction companies has been rarely investigated. In this context, a small group of studies have investigated development of maturity models for performance measurement in the construction industry (Davies and Arzymanov, 2003; Guangshe *et al.*, 2008; Goh and Rowlinson, 2013) while a higher number of research studies have focused on performance measurement by the determination of several key performance indicators (Chan and Chan, 2004; Roberts and Latore, 2009; Lin and Shen, 2010; Ali *et al.*, 2013).

A minority of the research studies has also focused on performance measurement in the construction industry by adopting balanced scorecard approach (Halman and Voordijk, 2012; Jin *et al.*, 2013). Being also the main focus of this study, a small group of research studies have investigated performance measurement by developing a set of performance indicators (Takim and Akintoye, 2002; Shields *et al.*, 2003; Chan *et al.*, 2004; Nudurupati *et al.*, 2007; Rankin *et al.*, 2008; Marques *et al.*, 2011; Khosravi and Afshari, 2011). However, there is still challenge in developing the most powerful performance measurement model since the construction industry has a dynamic nature.

1.5. Aims and Objectives of the Research

The companies should have certain level of knowledge and capabilities to complete a project successfully in the construction industry. The Project Management Body of Knowledge (PMBOK) Guide of Project Management Institute (PMI) defined a set of project management knowledge areas for the successful completion of projects. Based on PMBOK Guide, there are ten knowledge areas defined applicable to all industries. Moreover, construction extension to PMBOK Guide introduced four additional knowledge areas specific to construction industry. The major objective of this research is to model the project management performance of construction companies. In this respect, knowledge areas of PMBOK Guide are selected as the determinants of performance and effects of those on performance are investigated along with the relations among themselves. Within this context, the study develops the construction specific components of the knowledge areas and investigates the applicability of those in the Turkish construction industry. In this scope, a questionnaire is designed and administered to the construction firms to reveal the level of success they achieve under each knowledge area. Structural equation modeling (SEM) is used for the validity and the reliability of the proposed model. The main aim of this research is to propose a comprehensive project management performance framework specific for the construction industry. Followings are the objectives of the research:

- Developing construction specific metrics for the project management knowledge areas
- Investigating the interrelations among the project management knowledge areas
- Quantifying the impact of the knowledge areas on project management performance

1.6. Research Method

A questionnaire survey is designed and administered to construction firms to reveal their project management performance in their projects. SEM is used as a research tool to test the validity of the proposed measures of construction firms' performance and to test the hypotheses based on the relations among the determinants of the performance and to analyze the influences of these determinants on performance of the construction firms.

1.7. Scope and Limitations

The scope of this research comprises the development of a project management performance model mainly valid for Turkish construction firms. Although this may be seen as a limitation, the construction specific measures developed in this study might be used in different industries as well. The questionnaire developed in the scope of this study reflects the opinions and perceptions of Turkish construction firms regarding project management performance. Despite the international experience of those contractors, a questionnaire including more contractors from different countries could be designed. However, sort of a questionnaire was not included in the scope of this study. In addition, the research also has some limitations in that some of the performance measures are subjective measures, which are subjected to the personal judgment. Therefore, rating levels may differ in different countries in different projects. Another limitation is that the hypotheses among the determinants of performance are constructed by taking the expert opinions, which are also subjected to the personal judgment.

1.8. Organization of Thesis

This research involves seven chapters. First step, which is the introduction of this study, summarizes the importance of performance management and measurement specifically for the construction industry. In the second step, previous studies related to the performance measurement through a set of indicators determined, or measurement models developed are presented. Additionally, the set of indicators determined for the project management knowledge areas are indicated. In the third step, research methodology is presented and the questionnaire, which is designed and administered to the construction professionals, is depicted. In the fourth step, the content of the questionnaire is presented. In the fifth step, data analysis results are presented and the analysis method, SEM, which is proposed as the statistical analysis method using which the hypotheses regarding the interrelations between the attributes of the model and their influence on overall performance of construction companies are tested. Findings of the study are discussed in step six and conclusions depicted and recommendations for future studies are provided for the construction companies in step seven. Figure 1.1 represents the step-by-step organization of the study.

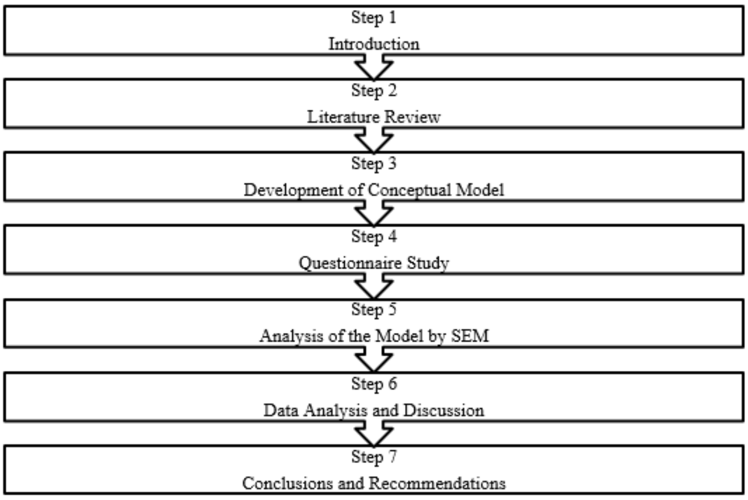

Figure 1.1. Organization of the Study.

2. PROJECT MANAGEMENT PERFORMANCE

Project management relates to the all aspects of the projects including technical, operational and executive tasks to monitor and control the project. Thus, project management covers several tasks such as planning, coordinating and monitoring project activities. Effective management of all these tasks requires several core competencies. These competencies encompass management of work plan, time tracking, performance and status reporting, issue management, risk management, scope change control management and so on.

To effectively manage projects, project management performance should be monitored and sound strategies should be put in place to improve performance. Project management performance might be enhanced with the existence of skillful project managers who are able to monitor and control the work plan within tolerable limits. Project managers are expected to have managerial skills such as concentrating on the risks of the project by keeping the project within budget and time constraints. In addition, project management capabilities of project managers include follow-up of weekly status reports, monitoring progress and upcoming plans. With those capabilities, project managers are expected to be aware of deviations from project baselines and identify problems elsewhere needed.

Project management capabilities not only cover the managerial skills of project managers but also require skills for best managing the project processes. These processes consist of supply of goods, procurement, cost, quality and time issues. The project management performance enhanced in those processes always leads project executives to the completion of the project within tolerable limits. Apart from the processes, right communication among project personnel, teamwork and right use of the resources also contribute to the best management of the project. Correct definition of the project tasks, determination of project scope, and integration are also crucial points in managing the projects. Such capabilities in project management are leading for increase in project performance. Thus, the measurement of project management performance and accurate determination of the performance measures in projects have considerable impact on successful completion of the projects.

Performance measurement in the construction industry has been a popular research area over the decades and various studies have been conducted on performance management so far (Egan, 1998; Latham, 1994; Kagioglou *et al.*, 2001; Nudurupati *et al.*, 2007; Yu *et al.*, 2007; Cheng *et al.*, 2009; Yeung *et al.*, 2009; Wang *et al.*, 2010; Ali *et al.*, 2013; Jin *et al.*, 2013). However, performance is a multidimensional construct that consists of different measures. Therefore, accurate determination of performance measures is critical in the performance measurement studies. For example, project success measurement is investigated in the context of performance studies and it reflects how successful companies perform in managing their projects. Therefore, majority of the research studies have focused on measuring project success specifically in the construction industry (Doloi *et al.*, 2011; Chou *et al.*, 2013; Berssaneti and Carvalho, 2014; Mir and Pinnington, 2014).

Performance might be also evaluated according to the measurement of success based on several success indicators. In this context, PMBOK Guide of PMI (2013) proposed ten knowledge areas (Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Communications Management, Project Risk Management, Project Procurement Management, and Project Stakeholder Management) and Construction Extension to PMBOK Guide of PMI (2005) proposed four additional knowledge areas (Project Safety Management, Project Environmental Management, Project Financial Management, Project Claim Management) for the successful management of projects.

Some researchers meanwhile investigated performance measurement in terms of specific knowledge areas such as safety management (Goggin *et al.*, 2010) risk management (Mu and Cheng, 2013), and communications management (Albert *et al.*, 2014) while some focused on enhancing project management capabilities in risk and innovation, technology, and integration management (O'Connor and Young, 2004; Toole *et* *al.*, 2010). Apart from the investigation of project success, and project management knowledge areas, performance measurement studies have also concentrated on the determination of key performance indicators (KPIs) (Skibniewski and Ghosh, 2009; Lin *et al.*, 2011; Ali *et al.*, 2013; Ngacho and Das, 2014), adoption of Balanced Scorecard (BSc) (Wang *et al.*, 2010; Halman and Voordijk, 2012), and Maturity Models (MMs) (Meng *et al.*, 2011; Goh and Rowlinson, 2013) for the performance measurement.

2.1. Project Management Knowledge Areas

PMBOK Guide defined ten knowledge areas and construction extension to PMBOK Guide identified four additional knowledge areas, which deserve special care in the investigation of project management processes. Those knowledge areas defined by PMBOK Guide are shown on Figure 2.1 and their detailed definitions are explained at the bottom.

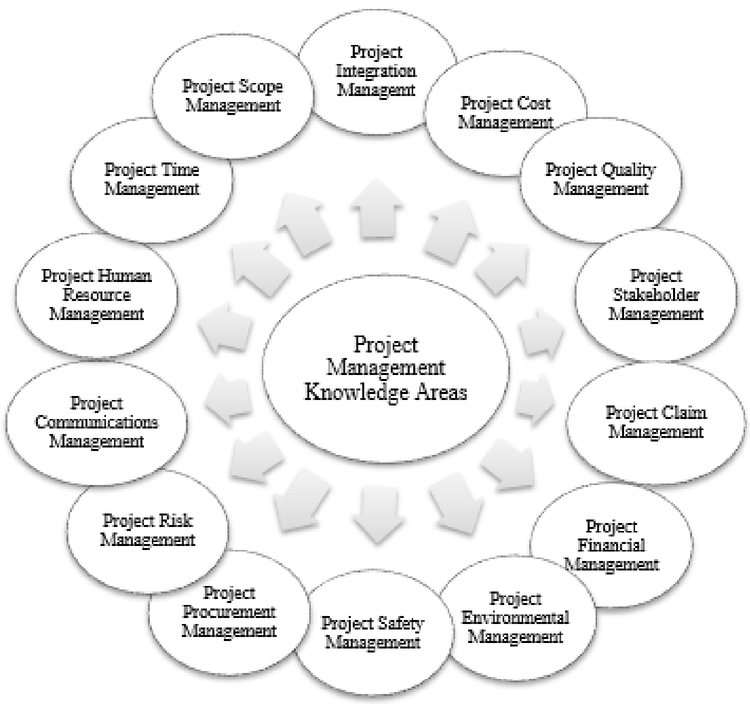

Figure 2.1. Project Management Knowledge Areas (PMI, 2013).

- Project Integration Management: includes the successful identification, definition, combination, unification and coordination of the processes within project management process groups, which are defined as initiation, planning, executing, monitoring and controlling, and closing. Project integration management consists of the development of project charter, project management plans, management of project work, monitoring and controlling the project work and following integrated changes, and closing the project phases.

- Project Scope Management: consists of the processes, which encompass the required work to be done and the boundaries of the project. Project scope management rather concentrates on defining and controlling what is in and out in the project. Project scope management simply requires the creation of scope management plan, collection of requirements, definition of scope, creation of work breakdown structure (WBS), and validation and control of the scope.

- Project Time Management: consists of the management of the processes for the timely completion of the project. Project time management encompasses tasks such as management of the project schedule, definition of project activities and sequencing those, and estimation and activity resources and durations.

- Project Cost Management: consists of the effective management of the processes such as planning, estimating, budgeting, financing, managing and controlling of costs in order to complete the project within the approved budget. Project cost management encompasses several tasks such as preparing cost management plans, estimating costs, determining budget and controlling costs.

- Project Quality Management: consists of the processes through which quality policies, objectives and procedures are determined for the successful completion of the project by satisfying quality needs. Project quality management processes include the planning of the quality management, performing quality assurance, and controlling quality.

- Project Human Resource Management: consists of the processes for the effective management, leading, and directing project teams. Since project teams might have different skills and knowledge related to the context of the project, human resource management requires the involvement of all project members into the project planning and decision making processes. Project human resource management includes tasks such as planning of the human resource management system, acquiring, developing, and managing project teams.

- Project Communications Management: consists of the processes for the timely handling of the planning, collection, creation, distribution, storage, retrieval, management, control, and monitoring and ultimate delivery of the project information. Project communications management requires the disposition of several tasks such as planning, managing and controlling communication among project teams.

- Project Risk Management: consists of the processes for the development of an appropriate risk management scheme. These processes might be summarized as the creation of a sound risk management system, identification and analysis (qualitative and quantitative) of possible risks, development of risk response planning schemes, and controlling risks.

- Project Procurement Management: consists of the processes necessary for purchasing and acquiring the goods in the scope of the projects. The major processes of procurement management are planning, conducting, controlling, and closing of the procurement.

- Project Stakeholder Management: consists of processes for determining people that are directly or indirectly affected by the project. The major processes of stakeholder management are identification of stakeholders, planning stakeholder management, managing and controlling stakeholder engagement (PMI, 2013).

- Project Safety Management: consists of the processes that ensure the completion of the project with special care in the prevention of potential hazards and accidents. The major processes of safety management are planning, safety plan execution, and administration and reporting of the safety records.

- Project Environmental Management: consists of the processes that allow the completion of the project within the legal permits and without causing adverse environmental impacts. The major processes of environmental management are environmental planning, assurance, and control.

- Project Financial Management: consists of the processes that intend the acquirement and management of the financial resources. Project financial management rather concentrates on determining revenue source and analyzing/updating net cash flows. The major processes of financial management are financial planning, control, and administration of financial records.

- Project Claims Management: consists of the processes, which intend the prevention of claims from arising and ensuring timely handling of claims. The major processes of claims management are claim identification, quantification, prevention, and resolution (PMI, 2005).

Various studies were conducted on performance measurement by the adoption of knowledge areas of PMI so far. However, previous studies rather investigated performance measurement or project success by adopting some specific knowledge areas rather than investigation all knowledge areas in one study. Within this context, Chou *et al.*, (2013) investigated project management knowledge of construction professionals. In this scope, they focused on the cross-country effects on project success. In their study, they implied that integration, scope, time, cost, quality, human resources, risk, communication and procurement management have considerable effects on project performance. In the light of this statement, they have constructed several hypotheses among these knowledge areas along with the hypotheses between knowledge areas and project success.

A group of researchers conducted studies in performance measurement by the investigation of one knowledge area or a combination of those such as integration, scope, time, cost, quality, safety, human resources, and communication management as the determinants of performance (Rankin *et al.*, 2008; Shokri-Ghasabeh *et al.*, 2009; Haponava and Al-Jibouri, 2010; Marques *et al.*, 2011; Almahmoud *et al.*, 2012; Chovichien and Nguyen, 2013; Langston, 2013).

As indicated above, studies in the literature have mainly investigated performance issue from several aspects so far and some of them rather focused on the construction industry in terms of investigating capabilities of construction companies for determining in terms of knowledge areas as set by PMBOK Guide. However, there has been no other study conducted on measurement of performance by adopting fourteen knowledge areas including construction specific ones. Moreover, there is no other study, which determined the construction specific components for all those knowledge areas to measure and to investigate the relations between knowledge areas and project management performance along with its indicators. Hence, this study is expected to be unique guide in terms of determination of underlying construction specific components of each knowledge area and proposing a generic model based on this set of components.

2.2. Key Performance Indicators, Balanced Scorecard Approach, and Maturity Models

Majority of the performance measurement studies relied on the development of key performance indicators for measuring success, adoption of balanced scorecard approach or development of maturity models. Therefore, these methodologies of performance measurement studies are worth mentioning. Key performance indicators, balanced scorecard approach, and maturity models are herein explained and summarized, and related studies are presented.

2.2.1. Key Performance Indicators (KPIs)

Key performance indicators (KPIs) are measurement tools used to assess performance of several processes. KPIs are typically used to analyze company performance by a set of performance indicators. KPIs mainly represent key aspects of company activities and the main purpose of using KPIs is to apply benchmarking concept in business processes and products in different industries. The basic idea behind using

KPIs lie on measuring actual performance of several business aspects and comparing those with the best of the specific sector examined. KPIs are also used for project control since they are applied with the idea of comparing actual performance with the desired outcome.

Table 2.2.1 shows the key performance indicator groups developed by the Department of Environment, Transport, and the Regions (DETR) (2000) of UK. The table indicates the main KPIs for the construction industry and their levels as headline, operational, and diagnostic. Headline level indicates the rude state of health of a project where operational level indicators rely on specific aspects. Diagnostic level indicators reflect why changes have occurred in the headline and operational levels (DETR, 2000).

Table 2.1. Key Performance Indicator Groups (DETR, 2000).

Group	Indicators	Level
Time	Time for Construction	Headline
	Time Predictability-Design	Headline
	Time Predictability-Construction	Headline
	Time Predictability- Design & Construction	Operational
	Time Predictability-Construction (Client Change Orders)	Diagnostic
	Time Predictability-Construction (Project Leader Change Orders)	Diagnostic
	Time to Rectify Defects	Operational
Cost	Cost for Construction	Headline
	Cost Predictability-Design	Headline
	Cost Predictability-Construction	Headline
	Cost Predictability-Design and Construction	Operational
	Cost Predictability-Construction (Client Change Orders)	Diagnostic
	Cost Predictability-Construction (Project Leader Change Orders)	Diagnostic
	Cost of Rectifying Defects	Operational
	Cost in Use	Operational
Quality	Defects	Headline
	Quality issues at available for use	Headline
	Quality issues at end of defect rectification period	Operational
Client Satisfaction	Client Satisfaction Product-Standard Criteria	Headline
	Client Satisfaction Service-Standard Criteria	Headline
	Client Satisfaction- Client Specified Criteria	Operational
Change Orders	Change Orders-Client	Diagnostic
	Change Orders-Project Manager	Diagnostic

Several studies have previously utilized KPIs to assess performance in the con-

Table 2.1. Key Performance Indicator Groups (DETR, 2000).

Group	Indicators	Level
Business Performance	Profitability (company)	Headline
	Productivity (company)	Headline
	Return on Capital Employed (company)	Operational
	Return on Value Added (company)	Operational
	Interest Cover (company)	Operational
	Return on Investment (client)	Operational
	Profit Predictability (project)	Operational
	Ratio of Value Added (company)	Diagnostic
	Repeat Business (company)	Diagnostic
	Outstanding Money (project)	Diagnostic
	Time taken to reach final amount (project)	Diagnostic
Health and Safety	Reportable Accidents (inc. fatalities)	Headline
	Reportable Accidents (non-fatal)	Operational
	Lost Time Accidents	Operational
	Fatalities	Operational

struction industry. For example, Cox *et al.*, (2003) investigated management perception of KPIs in the construction industry. Horta *et al.*, (2010) combined key performance indicators and data envelopment analysis to assess construction companies' performance. Toor and Ogunlana (2010) conducted research on stakeholder perception of KPIs for large-scale public development projects.

2.2.2. Balanced Scorecard (BSC)

Balanced Scorecard (BSC) concept was first introduced as Kaplan and Norton's Balanced Scorecard by Brown & Root/Halliburton engineering and construction company (Kaplan and Norton, 1992). Balanced Scorecard is another concept in performance measurement framework, which consists of four different perspectives: financial, customer, internal processes, and innovation. The scorecard was then used as in strategic management system. Oliver and Palmer (1998) also developed a different performance measurement framework, which includes additional design and implementation features.

The Balanced Scorecard was a useful step in performance measurement systems when there has been a heavy reliance on financial measures (Kaplan and Norton, 1992;

Kaplan and Norton, 1993). Although this scorecard has lacking points, it was a huge step in the development of performance measurement frameworks for its time and it encouraged the development of other frameworks gradually. Kagioglou *et al.*, (2001) categorized Balanced Scorecard into three parts to measure performance of construction projects. These categories are financial perspective which consists of elements such as cash flows, cost and benefit analysis; internal business processes that encompass several networks like critical path analysis; and customer perspective.

A group of studies rather used balanced scorecard approach in the performance measurement studies. For instance, Kagioglou *et al.*, (2001) developed a conceptual framework for performance measurement by adopting balanced scorecard approach. In another study, Wang *et al.*, (2010) used balanced scorecard approach in developing a risk management framework for R&D projects. Halman and Voordijk (2012) investigated performance measurement in supply chains. In this scope, they developed a balanced framework by using balanced scorecard approach. Jin *et al.*, (2013) conducted research on performance measurement of international construction firms by adopting balanced scorecard approach in deciding on performance measures.

2.2.3. Maturity Models

Organizations adopt different strategies and techniques to improve their performance management. As an indicator of the better performance, the maturity of the organizations in applying project management practices encourages organizations to better manage processes and contributes to the improvement of those processes. A maturity model is defined as an entity or an evolution path of the objects in the form of discrete shaped stages (Becker *et al.*, 2009; Klimko, 2001). Thus, maturity models take an important part to serve as a benchmarking tool in terms of the comparison of maturity levels among companies and efficiency of the management processes. To date, researchers have developed various maturity models for different industries. For example, Ibbs and Kwak (2000) conducted a research to reveal the financial and organizational impacts of project management. Within this context, they developed a five level project management maturity model to define the positioning of an organization's project management level.

Kwak and Ibbs (2002) developed a project management process maturity model (PM2) to determine an organization's relative project management level. This model was designed to improve project management effectiveness in organizations by combining project management practices, processes and maturity models.

Andersen and Jessen (2003) investigated the project maturity in organizations. The aim of their study was to reveal the exact definition of project maturity and to assess the level of project maturity.

Davies and Arzymanov (2003) assessed the maturity of six different industries and created several different project management models. The study aimed to reveal different project management practices in different industries in terms of the extent of the variations among those practices.

Jiang *et al.*, (2004) investigated the relationship between the software development process maturity and the project performance. They stated that there are several software development maturity models to reduce the risk of failure in software projects.

Beset (2007) investigated the project management maturity level of an architectural design office so called ARCH-PMM. The purpose of this study was to create productive and efficient design conditions.

April and Abran (2009) introduced a software maintenance model since the software industry lacks software quality caused by the maintenance problems.

Hsieh *et al.*, (2009) created a knowledge navigator model (KNM) in order to evaluate the knowledge management maturity. The model consists two frameworks as evaluation and calculation framework.

Demir and Kocabas (2010) investigated whether project management maturity model (PMMM) can be applied to educational organizations. Lee *et al.*, (2010) conducted research on a maturity model based on communities of practice (CoP) evaluation framework. In their study, it is emphasized that CoPs are important tools in the improvement of knowledge management practices. In their study, it is underlined that the operation of CoPs both internally and externally has several benefits such as enhanced core competency and working efficiency, increased innovation learning and responsiveness.

Smith (2010) examined the role of knowledge management in an organization's maturity. In this scope, he also investigated the interaction of formal and informal channels in the knowledge management approach of the organizations.

Oliveira and Kaminski (2012) proposed a reference model to identify the degree of maturity in the small and medium enterprises' (SMEs) product development processes.

Wendler (2012) conducted research about the maturity of the maturity model research area. Cuenca *et al.*, (2013) developed a maturity model for the assessment of structural elements of coordination mechanics in the collaborative planning processes.

Storm *et al.*, (2013) conducted research on the applicability of a maturity model for health in all policies (HiAP). The research aimed to categorize the stages of HiAP and describe its indicators and conditions.

Van Looy *et al.*, (2013) brought a new perspective to the selection of the right business process maturity model (BPMM). In this scope, they designed a new decision tool that facilitates the selection of one business process over another.

Jia *et al.*, (2013) introduced a prototype of a risk management maturity system (RMMS) to measure the risk management maturity in large-scale construction projects.

Zhao *et al.*, (2013) developed a fuzzy enterprise risk management (ERM) maturity model for construction firms.

Rae *et al.*, (2014) developed a maturity model for quantitative risk assessment (QRA). This modeled is aimed to improve QRA and reveal all the potential flaws in a QRA.

Kang *et al.*, (2015) conducted a study about creating an information integration maturity model for the capital projects. Within this context, they aimed to reveal the opportunities in work processes or defining the areas to be improved in those processes.

However, maturity is expressed in a different manner by each maturity model. Therefore, maturity model diversity allows measuring different items. Among the maturity models, which have been developed up-to-date, Capability Maturity Model (CMM), and Organizational Project Management Maturity Model (OPM3) are the well-known maturity models, which are mainly generated for the software industry. Although there have been several studies that aim to investigate the maturity levels of different industries such as software, pharmaceutical, defense technologies, oil and so on, the maturity level of construction companies thereby the construction industry has been rarely investigated. A review of the most commonly used maturity models are presented below.

<u>2.2.3.1. Capability Maturity Model (CMM).</u> Capability maturity model (CMM) is the first maturity model, which is developed by the software Engineering Institute of Carnegie Mellon University. The model was first developed to improve the processes in software industry and its use was widened soon after in software engineering and procurement (Yimam, 2011). Although the model was first aimed to enhance the capability of the contractors at the awarding phase, it was extended to be used as an improvement tool in software processes (Sarshar *et al.*, 1999).

The major difference of this model is that it has the whole software development processes both project management and technical parts unlike the other project management maturity models. This model consists of five maturity levels, which starts with the initial stage and ends up with the most mature level, which is the level of optimizing. Moreover, each level possesses key process areas (KPAs), which represent the level. Nevertheless, the model is stated to have descriptive manner that does not exactly describe the way improvement instead it presents principal attributes that represent organizations at specific levels (Paulk *et al.*, 1993). Subramanian *et al.*, (2007) conducted research on the effect of CMM on several different factors, which are crucial in the implementation of strategies in the information systems, software project performance and software quality. Eadie *et al.*, (2011) conducted research to examine the structure of different models, which are applicable to Information Communication Technology (ICT), and to indicate the different organizations' positioning into different levels in a CMM.

2.2.3.2. Organizational Project Management Maturity Model (OPM3). OPM3 is a maturity model, which is developed by Project Management Institute (PMI). The model has knowledge, assessment and improvement processes examined through the project, program and portfolio management practices. The OPM3 model basically has two main parts, which are "The Foundation" and "The Product Suite". The Foundation part explains the general terms of organizational project management whilst the Product Suite presents the way of applying OPM3 model and describes the steps that need to be taken during maturity assessments.

The OPM3 model consists of the capabilities and best practices, which are important steps for improvements. It is usually divided into two parts considering the three domains as project, program and portfolio management and interrelated components as best practices, capabilities and outcomes in those three domains. The model has also some general elements such as knowledge; assessment and improvement where the stages of improvement are described as standardize measure, control and continuously improve.

The maturity is measured by the proper assessment of best practices in the OPM domains in OPM3. The best practices are validated through the key performance indicators (KPIs). OPM3 differs from the other maturity models in that it does not have a specific maturity level instead maturity is assessed by the best practices' percentages in three dimensions (Yimam, 2011).

Guangshe *et al.*, (2008) investigated the feasibility and the limitation of OPM3 model for the large construction projects in China. Li *et al.*, (2010) applied organizational project management maturity model based on back propagation (BP) neural network to assess organizational project management capability. Within this scope, an assessment index system of OPM3, which consisted of three levels, was constructed and simulations models were created benefiting from the BP neural network method.

Ghorbanali (2011) conducted a case study to improve project management competency of a company by using OPM3 concept. Marzouk *et al.*, (2012) proposed a construction-based model to assess the maturity level of the enterprises. The research was based on the modification of the OPM3 by the addition of four knowledge areas to the existing ones.

The well-known maturity models and their applications to the different industries are discussed above. However, few studies concentrated on the use of maturity models applicable for the construction industry. Especially, construction is a very dynamic market in Turkey. Therefore, the constructs and the needs of the industry are changing. In order to better manage the construction projects, several organizational maturity measures need to be established to detect the inabilities when managing construction projects. Thus, the investigation of those constructs and needs within a systematic frame is crucial to understand the dynamics that affect the trend of project and construction management in construction industry.

2.2.3.3. Project Management Process Maturity Model (PM2). The PM2 model was developed by Ibbs and Kwak in 1997. The PM2 model also consists of five maturity levels like CMM. However, the terminology shows slight changes for each level. In this model, the project management processes and practices are categorized into eight project management areas and six phases included in PMBOK Guide. The project management maturity of the organizations is evaluated by the assessment of those knowledge areas and phases (Yimam, 2011).

2.2.3.4. PRINCE2 Maturity Model (P2MM). PRINCE2 Model has the same structure that Project Management Maturity Level (P3M3). It is a five level framework and it has seven process perspectives. The model has specific and generic attributes, which are defined for each process level (Williams, 2013).

2.2.3.5. Kerzner's Project Management Maturity Model (PMMM). This model is similar to those presented above in terms of consisting five maturity levels but the content of those levels differs. The major difference of this model is that the forth level of Kerzner's model is the benchmarking on the maturity model (Yimam, 2011).

2.3. Performance Measurement Frameworks

Many researchers have investigated performance and performance measurement systems so far. For example, Cox *et al.*, (2003) conducted research to assess management perceptions of commonly used key performance indicators in the construction industry. In this context, both qualitative and quantitative performance indicators were considered. The results of their study indicated that performance indicators varied according to the management perceptions and six main indicators were determined as the most useful ones in the construction industry.

Chan and Chan (2004) developed a set of key performance indicators for measuring construction projects' success. Lin and Shen (2010) developed a performance measurement framework and they determined a set of key performance indicators as the determinants of performance.

Horta *et al.*, (2010) conducted research on performance assessment of construction companies by a set of key performance indicators along with data development analysis method. In this scope, two different data development analysis models were used where one considers factors to weigh freely while the other has weigh restrictions. These models provided an efficiency score per organization by identifying whether they are efficient or not and performance improvement targets were introduced to become guide other organizations. The research showed that the benchmarking system provided several advantages by integrating key performance indicators with the data development analysis model.

Goh and Rowlinson (2013) developed a conceptual maturity model for sustainable construction. In this scope, five key domains, which consist of metrics and sub factors, were defined in the proposed model. The conceptual maturity model's domains were determined as performance, management capability and capacity, culture, development of organized and structured sustainable framework, and research and development. The study also presented characteristics of maturity levels in the conceptual framework along with the main principles of sustainable construction. The model was quite useful in developing a deeper understanding of sustainable construction practices by the determination of strengths, weaknesses, opportunities, and threats. The model had a considerable contribution to measure the evolution of sustainable construction maturity in a systematic basis.

Jin *et al.*, (2013) developed a framework to measure performance of international construction firms (ICFs). In this study, balanced scorecard was adopted with detailed measures. The research was conducted in three steps. At first step, 27 measures were determined through the careful review of past studies, in-depth interviews conducted with academics, and discussions in seminars. A questionnaire survey was also addressed subsequently to determine importance weights of 27 measures. The framework's usefulness and reliability was also tested through a case study, which compared the performance of a Chinese ICF with its counterparts in a worldwide scale. The results of the study indicated that the framework developed was quite successful in comparing performance of ICFs. The framework was also found to be effective in terms of proposing strategies for increased competitiveness. Therefore, the study contributed to the performance measurement studies by means of such a robust framework.

Liu *et al.*, (2014) proposed a framework to measure performance of Public-Private-Partnerships (PPPs). Within this context, they investigated studies conducted on KPIs at the construction project level where they determined aspects for performance measurement. In the scope of the research, a performance prism and a dynamic life-cycle framework for measuring performance of PPPs were developed. The performance prism consisted of five interrelated core indicators, which were defined as stakeholder satisfaction, strategies, processes, capabilities, and stakeholder contribution. The dynamic life-cycle framework was developed through the evaluation of business process management. The research provided significant contribution of the evaluation of PPP projects through measuring performance of those. The research also proposed a new insight into evaluating PPPs under a dynamic life-cycle framework.

Rasid *et al.*, (2014) conducted research to determine project management maturity level by adopting nine project management knowledge areas (integration, scope, time, cost, quality, human resource, communication, risk, and procurement) according to the perceptions of project managers in a public agency. Within this context, a questionnaire was addressed and a total of 65 over 124 responses were reached. The results of the study revealed that majority of the respondents underlined the importance of project management knowledge areas for the management of projects. Based on the results of the questionnaire, the current maturity level of the agency was also determined. The findings of the study indicated that the agency has to derive key performance indicators or several initiative to increase the maturity level, which was assessed as low based on the questionnaire data.

Nassar and AbouRizk (2014) developed a practical framework that integrates all attributes of project management. The framework basically measured all critical objectives of a project and Analytical Hierarchy Process (ANP) was used to assign a priority to each objective for determining overall performance index. Overall performance index was measured by the consideration of eight critical objectives. In this context, a case study was assessed, which considered determination of performance of an airport rehabilitation project. This research adopted not only quantitative measures but also qualitative measures in deriving performance index. Moreover, a case study was assessed to test the validity of the performance index and the results proved that the key performance index was quite helpful for determining overall performance and provided practical solutions.

3. RESEARCH METHODOLOGY

This study adopts a research methodology, which consists of three main steps. In the first step, through a detailed literature study, components of project management knowledge areas are determined and several research hypotheses are constructed among the performance determinants by taking expert opinions to structure the conceptual performance model. In the second step, an online questionnaire is designed and addressed to construction professionals to determine their level of success achieved in project management knowledge areas. In the third step, structural equation modeling (SEM) technique is used to test the validity of the model proposed and to test the relations constructed.

3.1. Project Management Performance Measurement Framework

The aim of this research is to construct an integrated framework to investigate the project management performance within construction projects. Hence, the determinants of performance along with its indicators should be distinguished and identified to propose an effective performance model in order to define an organization's project management performance from different perspectives. As Kagioglou *et al.*, (2001) indicate it is critical to identify those determinants and indicators to address different perspectives that organizations adopt.

The proposed model consists of different parameters, which affect the performance of construction firms. In this study, fourteen knowledge areas of PMBOK Guide are adopted as the determinants of the performance and they are proposed to be interrelated. It is also assumed that there are causal relationships between the parameters. Moreover, a performance measure, namely the project success having subcomponents, is defined in accordance with the structure of construction firms' project management performance. In the model, it is hypothesized that project management knowledge areas have a direct impact on the project management performance. In addition, it is hypothesized that there are several interdependencies among the project management knowledge areas.

The main concern of this research is to investigate Turkish construction companies' performance. Therefore, an extensive literature review is conducted to reveal the components of those fourteen knowledge areas along with the performance indicators considering the project management practices in the construction industry. The research investigates at quantifying those measures regarding each knowledge area due to the critical importance of each knowledge area for project management body of knowledge. In the initial step, 87 components regarding knowledge areas and project success are derived based on the in-depth literature review. Then, some of the components are combined or revised with the contribution of two industry practitioners (one board member, one project manager) and three university professors, who took part in the pilot studies for establishing the content validity of the proposed constructs. A total of sixty-three components are reached at the final step. To reveal the performance of construction firms achieved in their projects regarding knowledge areas and project success, a questionnaire is designed and administered to the construction professionals.

3.2. Questionnaire Survey

Although there are several performance measurement frameworks developed, the literature still lacks a generic model, which intends to reveal project management performance of construction firms. Therefore, it becomes necessary to develop a well-designed measurement system with valid project management performance measures and indicators that reflect the project management performance of construction firms along with providing long-term strategies for the companies. In the light of this approach, a project management performance model with appropriate performance measures and indicators was constructed. To test the convenience for use of the model, a questionnaire survey was designed and administered to the construction professionals. In order to collect primary data, several collection methods were investigated and it is decided that an online questionnaire would generate better results because of the nature of this research.

The most common examples of quantitative methods include survey, laboratory and field experiments and mathematics modeling (Shadish *et al.*, 2002). Surveys/questionnaires are frequently used for exploration projects that are based on descriptive and explorative research approach and this questionnaire designed was used as the quantitative method of the research.

The questionnaire was administered to Architecture, Engineering and Construction (AEC) companies established in Turkey, describing the objective of the study and requesting a fill in online for investigating project management performance of those. The list of targeted respondents was created utilizing several sources, but the main resource is the members of Turkish Contractors Association (TCA) and Turkish Construction Employers Association (TCEA). However, considering the fact that there were other construction companies in the industry which were not members of TCA or TCEA but showing similar characteristics with the member companies of these two associations in terms of size and type of work undertaken, the questionnaire survey was sent to some construction related organizations like project management companies, designers, architectural suppliers, sub-contractors and other middle/large scale contractors.

3.2.1. Administration of the Questionnaires

Based on the proposed framework, a questionnaire is designed to test the hypothesized relations between the variables. The questionnaire is administered to construction professionals and face-to-face interviews are conducted increase the response rate. The questionnaire targets a population of construction professionals, who have at least ten years of construction experience for the accuracy and reliability of responses. The sample questionnaire is presented in Appendix A.

3.2.2. Content of the Questionnaire

The questionnaire consists of the questions, which intends to collect general information about the construction company and the project. It also intends to test the hypothesized relationships among performance determinants. The questionnaire survey consists of the questions that inquire about the performance determinants that measure the latent variables. Each question is associated with constituent variables of the latent variables. The descriptions of those determinants of performance will be detailed in the following parts.

3.2.2.1. General Information about the Company and the Project. Respondents are asked provide information about their companies and the project that they performed project management activities. The main purpose of asking company and project related information is to generate a respondent profile of companies and projects. The demographic information about the companies is collected through the questions about the experience of companies in the construction industry, areas of expertise, total turnover of projects undertaken so far. Project related questions mainly focus on type of project, project budget, project start and completion times, project ownership, and title of the respondent. A total of 16 questions, five of which correspond to company-related, two of which respondent related, and nine of which belong to project related questions in this section of the questionnaire.

3.3. Performance Indicators of Project Management Performance

The construction projects are complex in nature. Therefore, companies set up different objectives to determine their project management performance in their projects. However, project management performance is strongly associated with project success, which includes several different components to decide on whether a project is successful or not. In this study, project management performance is measured by the project success. To determine success, a great portion of the research studies indicated that time, cost, quality, safety, and client satisfaction are the core components (Bower *et al.*, 2002; Gao *et al.*, 2002; El-Mashaleh, 2003; Bassioni *et al.*, 2004; Nudurupati *et al.*, 2007; Shokri-Ghasabeh *et al.*, 2009; Haponava and Al-Jibouri, 2010; Tam *et al.*, 2011; Chou *et al.*, 2013; Gu *et al.*, 2014). This study also utilized those mostly cited indicators of performance details of which are explained in below sections. In the questionnaire, a total of 5 questions are addressed regarding the project success indicators.

3.3.1. Project Success

Project Success is an indicator of how well companies performs in managing the project management processes or within the project constraints. Therefore, determination or measurement of project success deserves special emphasis. Process success definition and measurement is also critical for the construction projects. Therefore, researchers have previously determined different success indicators for the construction projects' success. For example, majority of the research conducted on the determination of success factors or success criteria have implied that time, cost, and quality (iron triangle) are the most important success factors (Pinto and Slevin, 1988; Egan, 1998; Atkinson, 1999; Lim and Mohamed, 1999; Brown and Adams, 2000; Meredith and Mantel, 2000; Bower *et al.*, 2002; Chan *et al.*, 2002; Gao *et al.*, 2002; El-Mashaleh, 2003; Cox *et al.*, 2003; Shields *et al.*, 2003; Mullaly, 2006; Papke-Shields *et al.*, 2010; Berssaneti and Carvalho, 2014).

The construction industry is rather a project-based industry. Therefore, the operational success of construction firms should be evaluated in terms of project success. Project management performance is defined as the extent to which project objectives are realized. In this context, researchers mostly defined project goals as on time completion, under budget completion, meeting quality requirements, and safely completed project (Lim and Mohamed, 1999; Alarcon *et al.*, 2002; Shields *et al.*, 2003; Cheung *et al.*, 2004; Rankin *et al.*, 2008; Almahmoud *et al.*, 2012). Client satisfaction is one of the most commonly used subjective measures in terms of project management performance and it has been considered one of the core elements of measuring project management performance in many studies so far (Egan, 1998; El-Mashaleh, 2003; Rad, 2003; Cheung *et al.*, 2004; Nudurupati *et al.*, 2007; Luu *et al.*, 2008; Horta *et al.*, 2010; Khosravi and Afshari, 2011; Gayatri and Saurabh, 2013; Cserháti and Szabó, 2014; Liu *et al.*, 2014; Rijke *et al.*, 2014).

There are also various studies that have focused on determining different success factors or criteria rather than relying on iron triangle. For example, Munns and Bjeirmi (1996) investigated success through processes such as conception, planning, production, handover, utilization, and closedown. In another study, Shenhar *et al.*, (1997) developed the dimensions of success by classifying into four main groups as project efficiency (short term measure, completed on time, within the specified budget); impact on customer (related to the customer of user of the result, meeting performance measures, functional requirements, technical specifications); business success (measures of performance time, cycle time, yield and quality, and total improvement of organization performance); preparing for the future (long term dimension, preparing organization for future).

Chan *et al.*, (2002) developed a framework of success criteria in design build projects and they determined several success criteria such as technical performance, health and safety, completion, educational, social and professional aspects, satisfaction, absence of conflicts, functionality, productivity, profitability, environmental sustainability, professional image, and aesthetics in addition to the time, cost and quality.

Takim and Akintoye (2002) developed a conceptual model for measuring construction project performance. In this context, they identified several success factors such as client attributes, project attributes, delivery strategy, management structure and project interfaces, fragmentation and conflicts, external forces, contractors' performances, stakeholders' attributes, and communities' attributes.

Rad (2003) determined a set of project success attributes as scope as needed, quality as needed, schedule on time, cost on budget, team morale, and client satisfaction. In a study conducted by Chan *et al.*, (2004), factors affecting the success of a construction project were grouped as project management actions, project procedures, external environment, project related factors, and human related factors.

Kog and Loh (2012) indicated that constructability, of plans and specifications, project manager competency, realistic obligations, project manager commitment and involvement, contractual motivation/incentives, adequacy of funding, economic risks, construction control meeting, technical approval authorities, project manager authority, pioneering status, project size, site limitation and location, client top management support, contractor key personnel capability, and contractor team competency were the critical success factors for different components of construction projects.

Tabish and Jha (2012) emphasized that project managers' competency, commitment of all project participants, owners' competency, good coordination between project participants, availability of trained resources, monitoring and feedback by project participants, regular budget update were the success traits for construction projects. In a recent study conducted by Alzahrani and Emsley (2013) demonstrated that financial attributes, management attributes, technical attributes, past experience attribute, past performance attributes, organization attributes, environmental attributes, health and safety attributes, quality attributes, and resources attributes were the most important contractors' attributes on project success.

Ngacho and Das (2014) developed a performance measurement framework where they determined time, cost, quality, safety, site disputes and environmental impact as the key performance indicators. Finally, Mir and Pinnington (2014) explored the value of project management and they identified the links between project management performance and project success. Their study implied that project success depends on project efficiency, impact on the customer, impact on the team, business success, and preparing for the future.

3.3.1.1. Time. Timely completion is essential in the successful execution of the projects. To determine project success, several research studies indicated that timely completion and effective time management are crucial. For example, Pinto and Slevin (1987) stated that time is among the critical factors in successful project implementation. Moreover, Shenhar *et al.*, (1997) revealed that timely completion of projects is among the dimensions of project success. Egan (1998) indicated that completion time is one of the core parameters of the success of construction business. Lim and Mohamed (1999) listed time among the micro and macro viewpoints of project success. Chan *et al.*, (2002) emphasized time as the success criteria for design build projects. Rad (2003) indicated that schedule on time is among the success attributes of the projects.

3.3.1.2. Cost. Similar to timely completion of project, under budget completion of projects is also essential in successful execution of projects. In this issue, Shields *et al.*, (2003) listed cost as an important parameter in the measurement of phase success of construction projects. Bassioni *et al.*, (2004) also claimed that performance measurement in construction is achieved by the consideration of under budget completion of projects. Moreover, Nudurupati *et al.*, (2007) defined cost as the core element of determination of construction projects' success. Papke-Shields *et al.*, (2010) also stated that project success is determined by cost along with the time and the quality.

3.3.1.3. Quality. Quality is also among the attributes of project success. Research studies also prove that successful projects are those, which were completed by meeting the quality needs and requirements. In this issue, Tam *et al.*, (2011) indicated that quality is among the parameters for determining project management performance. Chang *et al.*, (2013) also listed quality as one of the success attributes of construction projects. Furthermore, Chou *et al.*, (2013) stated that meeting quality requirements is one of the most important success attributes.

3.3.1.4. Safety. The construction industry is a risky business. Therefore, completion of projects without hazards and accidents is one of the success objectives of construction firms. Several research studies also indicated safely completed work as one of the most important success attributes of projects. For example, Almahmoud *et al.*, (2012) stated that safety is among the most important indicators of project performance. Chovichien and Nguyen (2013) emphasized safety among the indicators of evaluation of project success. Khosravi and Afshari (2011) developed a success measurement model for construction projects and they indicated that safety is among the success indicators of construction projects.

3.3.1.5. Client Satisfaction. Most of the construction projects are executed to satisfy the client. In the light of this objective, projects are executed in accordance with client expectations. Therefore, projects are considered as successful when client satisfaction is achieved. Ali *et al.*, (2013) revealed that customer satisfaction is among the indicators of performance. In addition, Gayatri and Saurabh (2013) defined a set of indicators for construction projects among which client satisfaction also exists. In Nassar and Abourizk's (2014) study, performance measurement attributes are listed where the client satisfaction is shown among the most important attributes.

The proposed performance construct is supposed to reflect all aspects of project management performance thereby facilitating measurement of performance of construction firms. This research measures performance in terms of project success, which comprises timely completion of the project, under budget delivery of the project, reaching quality objectives, and safely completed work without hazards and accidents, and client satisfaction.

3.4. Determinants of Project Management Performance

In this section of the questionnaire, it is aimed to reveal project management performance of construction firms under each knowledge area. Therefore, the questions were designed using a Likert Scale (1-5) and the respondents were asked to rate their capability in each knowledge area. A total of 58 questions are addressed regarding the sub components of knowledge areas. Below sections presents the detailed information regarding the determinants of performance.

3.4.1. Project Integration Management

Project integration management includes the processes for the combination, unifications and coordination of project management processes (PMI, 2013). In this study, below parameters are defined as the core components of project integration management.

- Development of Project Charter: Development of the document, which authorizes the start of a project and defines project manager's authorization over the whole project. The approval of the project charter officially announces the authorization of the project. Project charter also authorizes the project manager in assigning the organizational resources to the project activities (PMI, 2013).

- Knowledge Integration: Knowledge integration refers to the exchange of knowledge among all stakeholders, project parties and sharing of previous and current knowledge, and input of all data into the current knowledge transfer system. The integration of knowledge and ideation in project portfolio management is indicated as the key element of sustainable success (Heising, 2012); Mitropoulos and Tatum (2000) revealed that integration brings the need for exchange of information of knowledge between the interdependent subsystems and they indicated that knowledge is one of the crucial elements of successful integration. Tatum (1989) also indicated that construction knowledge is a necessity for integrating construction methods and design approaches. Knowledge integration for successful projects, organizations, and process groups has also been stated as the core element of project integration management and project management performance (Nonaka, 1994; Grant, 1996; Tether, 2002; Carlile and Rebentisch, 2003; Newell *et al.*, 2004; Soderlund, 2004; Kellogg *et al.*, 2006; Schmickl and Kieser, 2008; Ritala and Hurmelinna-Laukkanen, 2009; Song and Song, 2010; Un *et al.*, 2010; Brettel *et al.*, 2011; Enberg, 2012; Too, 2012).

- Process Integration: Process integration simply refers to the organized sequence of all activities in an appropriate manner and well-developed logical relationships among processes. In Birkinshaw *et al.*, (2000) study, it is indicated that integrated process in terms of human integration and task integration may foster value creation. Tatum's (1989) study revealed that concurrently designing a product and processing its production lead to increased quality and lowered cost. Mitropoulos and Tatum (2000) stated that there has been an increased emphasis in integrating design of new products or processes with the cost, time, and quality efficiency. Yanwei *et al.*, (2012) listed process integration as one of the dimensions of project integration management. A great portion of the research studies have also investigated process integration and underlined the importance of process integration in project management performance (Wheelwright and Clark, 1992; Enberg, 2012; Kleinschmidt *et al.*, 2007).

- Staff Integration: Staff integration refers to the integration of project staff into the current project processes. Staff integration also includes staff's support for integration and management-driven integration for the tools and techniques needed for the successful execution of projects. Mitropoulos and Tatum (2000) stated that organizational integration is one of the integration mechanisms including the components such as partnering, cross-functional teams, and training in-group skills at the project level. In addition, Egan (2002) indicated that teamwork effectiveness is increased by the integration. The study also underlined that integration is desirable for effectively working teams. Staff or team integration is highly investigated in project management research (Lahti, 1999; Carmeli and Schaubroeck , 2006; Dammer , 2008; Carmeli and Meyrav , 2009; Zajac , 2009; Jonas , 2010; Enberg , 2012; Tiller , 2012).

- Supply Chain Integration: Supply Chain Integration simply defines the integration of customers and suppliers into the whole processes and development of knowledge sharing mechanisms among customers, suppliers and project teams. Therefore, supply chain integration is heavily investigated in previous studies conducted on project management area (Wheelwright and Clark, 1992; Gemu¨nden *et al.*, 1996; Griffin and Hauser, 1996; Gruner and Homburg, 2000; Henard and Szymanski, 2001; Ernst, 2002; Cooper *et al.*, 2004; Kleinschmidt *et al.*, 2007; Ernst *et al.*, 2010; Enberg, 2012).

- Integration of Changes: Integration of changes refers to the review and evaluation of all change requests in the project, making modifications, updates in project management plan and project documents, and integration of all changes into project deliverables. Mitropoulos and Tatum (2000) indicated that changes might occur severe consequences for project budget and schedule. They also stated that lack of integration in project planning might cause to uncertainty in scope, unclear priorities, and unidentified needs and constraints, which might lead to changes, rework, and delays. Tatum (1989) also indicated that integration of construction methods and design approaches is very effective in managing projects with the successful handling of changes. Previous literatures also prove that effective change management and leadership are strongly associated with successful implementation of organizational initiatives (Gilley *et al.*, (2008); Jones *et al.*, (2005); Turner & Mu¨ller (2005)). Moran and Brightman (2001) also indicated that change management is the capability of an organization towards handling changes in accordance with customer needs. Therefore, it constitutes special emphasis in the project integration management since effective integration of changes into the current project deliverables is critical. Previous studies also prove the importance of the integration of changes into the current project conditions in terms of successful project management (Kolodny, 2004; Leybourne, 2007; Hassner-Nahmias and Crawford, 2008; Cummings and Worley, 2009; Soderlund, 2010; Hwang and Low, 2011; Yanwei *et al.*, 2012; Kerzner, 2013; PMI, 2013; Hornstein, 2015).

3.4.2. Project Scope Management

Project scope management is a project management knowledge area, which defines the inclusion of all work required for the successful completion of project (PMI, 2013). In this study, below parameters are determined as the key components of project scope management.

- Scope Planning: Scope planning refers to the planning of all scope requirements, boundaries, and out of scope highlights. Scope planning ensures the definition, validation, and control of the project scope (PMI, 2013). Dumont *et al.*, (1997) indicated scope planning as one of the core processes of scope management. In addition, Qureshi *et al.*, (2009) listed scope planning as one of the leading elements of project management life cycle. A successful scope planning is ensured with the evaluation of environmental factors, expert judgments, and project charter. Therefore, scope management planning has also been highly investigated in previous research (Levene and Braganza, 1996; Cho and Gibson, 2001; Nevo and Chan, 2007; Gumus *et al.*, 2008; Gordon and Azambuja, 2012; Mustapha *et al.*, 2013; PMI, 2013).

- Scope Definition: Scope definition refers to the process of defining and preparing projects for execution in terms of scope requirements, project scale, and applications (Cho and Gibson, 2001). The accurate determination of project scope definition is important in successfully managing the project. In this issue, it is stated that poor scope definition is one of the main reasons of project failures (Levene and Braganza, 1996; Dumont *et al.*, 1997; Cho and Gibson, 2001). In addition, Song and Abourizk (2005) clearly underlined the importance of scope definition for productivity modeling, which includes the measurement, evaluation, and quantification of productivity. The importance of accurate determination of scope in terms of project success and successful project management has also been previously underlined in several research studies (Smith and Tucker, 1983; Hackney, 1992; Hamilton and Gibson, 1996; Griffith and Gibson, 2001; Shane, 2006; Qureshi *et al.*, 2009; Gordon and Azambuja, 2012; Fageha and Aibinu, 2013; Mustapha *et al.*, 2013; Abrantes and Figueiredo, 2014).

- Scope Changes: Scope changes deserve special emphasis in the project scope management. Ibbs and Nguyen (2007) determined three types of change in the execution of projects including scope changes and they added that disruptions might occur due to those changes. Abrantes and Figueiredo (2014) stated that the changes in scope have a significant impact on dynamic environments. Since scope changes might create serious problem in effective scope management, effective handling of scope changes is critical. Scope changes encompass investigation of factors that create scope changes, and detection of effect of scope changes, and taking corrective action if necessary. Scope changes have been widely investigated in previous studies as well (Levene and Braganza, 1996; Cho and Gibson, 2001).

3.4.3. Project Time Management

Project Time Management consists of the processes for the timely completion of projects (PMI, 2013). The key components of the time management are explained below.

- Activity Definition: Activity Definition refers to the processes required for the identification and documentation of specific actions to produce project deliverables (PMI, 2013). Therefore, appropriate definition all project activities is critical so that no conflict occurs. Thus, activity definition is among the most important steps of time management and is also listed one of the core elements of successful time management in previous studies (Abeyasinghe *et al.*, 2001; Love *et al.*, 2002; Mustaro and Rossi, 2013; PMI, 2013).

- Activity Sequencing: Activity Sequencing is the process of documenting and constructing the logical relationships among project activities (PMI, 2013). Accuracy of activity sequencing is very important in terms of project time management (Liberatore and Pollack-Johnson, 2006; PMI, 2013).

- Time Estimation: Time Estimation refers to the estimation of activity durations for accurate forecasting of project completion time. Accurate time estimation leads to the successful project management (Gong and Hugsted, 1997; Cookie-Davies, 2002; Brown *et al.*, 2007; Guerrero *et al.*, 2014; Berssaneti and Carvalho, 2014). Therefore, time estimation constitutes an important part in project management research.

- Development of Project Schedule: Development of Project Schedule consist of the process of analysis of activity sequences, durations, resource requirements and schedule constraints to develop the project schedule (PMI, 2013). This process is essential in terms of accurately scheduling all project activities. Development of project schedule for the right follow-up of the processes within the given time constraints has been investigated in several research studies so far (Abeyasinghe, *et al.*, 2001; Irfan *et al.*, 2011; Khamooshi and Golafshani, 2013; Moosavi and Moselhi, 2014; Berssaneti and Carvalho, 2015). This proves the importance of project schedule in terms of project time management.

- Schedule Monitoring, Control and Revision: This process refers to the monitoring and controlling all project activities, detection of possible time delays, managing changes to the baseline schedule and making necessary modifications in project schedule if needed (PMI, 2013). The necessity of schedule monitoring, control and revision has been previously investigated in several research studies as well (Kraiem and Diekmann, 1987; Carr, 1993; Abeyasinghe, *et al.*, 2001; Ibbs and Nguyen, 2007; Irfan *et al.*, 2011; Meng, 2012; Guerrero *et al.*, 2014).

3.4.4. Project Cost Management

Project Cost Management consists of the processes where planning, budgeting, financing, funding and controlling of costs are achieved within the approved budget (PMI, 2013). In this study, below components are determined as the key parameters of project cost management.

- Cost Estimation: Cost Estimation refers to the process of framing an approximate monetary resource scheme for the completion of all project activities (PMI, 2013). Therefore, accuracy of cost estimation is critical for the successful execution of projects and therefore it has been highlighted in several research studies (Morrison, 1984; Cooper *et al.*, 1985; Franke, 1987; Laufer, 1991; Touran and Wiser, 1992; Berny and Townsend, 1993; Akintoye and Fitzgerald, 2000; Elkjaer, 2000; Wang and Huang, 2000; Artto *et al.*, 2001; Flyvbjerg *et al.*, 2002; Wang, 2002; Touran, 2003; Chou *et al.*, 2006; Hyväri, 2006; Niazi *et al.*, 2006; Jung and Kang, 2007; Aibinu and Pasco, 2008; PMI, 2008; Young and Markley, 2008; Chou, 2011; Doloi, 2011; Tawfek *et al.*, 2012; Yildiz *et al.*, 2014; Khodakarami and Abdi, 2014). Thus, cost estimation takes a great portion of the successful project management in that project success is mainly governed by the within budget completion.

- Determination of Budget: Determination of Budget refers to the evaluation of estimated costs of individual activities to compose a sound cost baseline (PMI, 2013). Determination of project budget, consideration of additional works, and effective planning of budgetary resources have been important elements of successful project management and have been mostly emphasized in several research studies (Atkinson, 1999; Ahsan and Gunawan, 2010; Doloi, 2011; Kim *et al.*, 2012; Xu *et al.*, 2012).

- Cost Control: Cost control refers to the monitoring the project status and making necessary updates to the cost baseline (PMI, 2013). In addition, cost control consists of the controlling and monitoring of all costs and taking corrective action in case of cost overruns. The necessity of cost control and its importance in project management research have already been emphasized in several research studies (Rasdorf and Abudayyeh, 1991; Atkinson, 1999; Jung and Gibson, 1999; Jung and Woo, 2004; Winter, 2006; Jung and Kang, 2007; Doloi, 2011; Kim *et al.*, 2012; Xu *et al.*, 2012).

3.4.5. Project Quality Management

Project Quality Management refers to the processes, which include the determination of quality objectives, policies, and responsibilities for meeting the quality needs of the undertaken project (PMI, 2013). This study identified below core components of project quality management.

- Quality Definition: Quality Definition simply refers to the definition of quality in an appropriate manner in terms of several perspectives such as customer perspective and specification-based perspective. Therefore, appropriateness of quality definition has a critical role in successfully managing projects and several research studies also stated that quality definition should be clear in that all parties beware about what the quality actually means (Qureshi *et al.*, 2009; Marques *et al.*, 2011; Wanberg *et al.*, 2013).

- Quality Standardization: Quality Standardization refers to the standardization of quality documents in firm and making effort to improve quality standards by the composition of a single quality frame. Therefore, efficiency of quality standardization is essential in project management. Several research studies also emphasized the importance of quality and quality standardization in terms of project management (Qureshi *et al.*, 2009; Marques *et al.*, 2011; Rezaei *et al.*, 2011; Jabbour *et al.*, 2014).

- Quality Assurance and Control: Quality Assurance and Control consist of the processes where the quality requirements and standards are ensured. In addition, it allows monitoring and recoding the results of quality activities' execution (PMI, 2013). Effectiveness of quality assurance and control in project management has been previously investigated in several research studies (Kagan, 1989; Bayless, 1986; Tukel and Rom, 2001; Wanberg *et al.*, 2013; Aliverdi *et al.*, 2013; Flyvbjerg, 2014).

3.4.6. Project Human Resource Management

Project Human Resource Management refers to the identification and coordination of a staff management plan along with the accurate assignment project roles, responsibilities and definition of required skills (PMI, 2013). In this research, below parameters are listed as the core components of project human resource management.

- Project Team Composition: This process refers to the composing and choosing skillful project teams that best fit the project needs. The effectiveness and importance of project team composition has been highlighted in several research studies so far (Huselid, 1995; Harris and Ogbonna, 2001; Jiang *et al.*, 2002; Belout and Gauvreau, 2004; Liu *et al.*, 2007; Cho *et al.*, 2006; Tabassi and Bakar, 2009; Zwikael and Aviram, 2010; Buller and McEvoy, 2012; Khan and Rasheed, 2014; Lapina *et al.*, 2014).

- Workforce Planning: Workforce planning refers to successful planning of workforce and developing appropriate plans for managing potential workforce. Workforce planning and its essential impact on project performance has been investigated in several research studies (Harris and Ogbonna, 2001; Jiang *et al.*, 2002; Belout and Gauvreau, 2004; Clark and Colling, 2005; Cho *et al.*, 2006; Liu *et al.*, 2007; Tabassi and Bakar, 2009; Zwikael and Aviram, 2010; Buller and McEvoy, 2012; Khan and Rasheed, 2014; Lapina *et al.*, 2014).

- Staff Training: This process consists of effective training of project teams for clarifying arising issues during project execution for enhancing project performance. The researchers have also indicated that frequency of staff training, effectiveness of training and resolution of issues during staff training sessions are the important parameters for optimized project performance (Huselid, 1995; Jiang *et al.*, 2002; Belout and Gauvreau, 2004; Clark and Colling, 2005; Minbaeva, 2005).

- Performance Development: This process considers the importance of tracking staff performance, managing resolution of the issues, providing necessary feedback and motivation for enhancing project performance. Therefore, the importance of performance development in project management research has been underlined in several research studies (Cho *et al.*, 2006; Liu *et al.*, 2007; Tabassi and Bakar, 2009; Masood, 2010; Menezes *et al.*, 2010; Zwikael and Aviram, 2010; Buller and McEvoy, 2012; Birasnav, 2014; Lapina *et al.*, 2014).

- Performance Evaluation: Performance evaluation or performance appraisal consists of the processes where employee performance is evaluated based on several performance measures. Performance appraisal might be conducted in both behavior-based and results-oriented measures (Delery and Doty, 1996). The importance of performance appraisal is strongly highlighted in several research studies as one of the core components of human resources (HR) practices and is indicated as one of the most important determinants of firm performance (Huselid, 1995; Delery and Doty, 1996; Youndt *et al.*, 1996; Huselid *et al.*, 1997; Dransfield, 2000).

3.4.7. Project Communications Management

Project Communications Management refers to the timely distribution, planning, coordination, management, control, and planning of the project information (PMI, 2013). In this study, below parameters are determined as the key components of project communications management.

- Communication Strategies: This process consists of the development of well-set communication strategies to enhance knowledge sharing among project personnel. PMBOK Guide of PMI (2013) also indicates that planning communication among project parties is among the main strategies for effective project communications management. Development of sound communication strategies has been investigated in several research studies (Ochieng and Price, 2010; Meng, 2012; Badir *et al.*, 2012; Senescu *et al.*, 2013).

- Communication Technology: Use of communication technology is an important part of the project communications management and communication technology allows using latest communication tools, methods and technologies to effectively follow up all processes. Therefore, several research studies emphasized that effective use of communication technology is one of the core elements of project communications management (Loosemore and Muslmani, 1999; Chinowsky *et al.*, 2007; Meng, 2012; Zhang and Ng, 2013; Arriagada and Alarcon, 2014).

- Coordination and Collaboration: This process consists of the development of efficient coordination and collaboration among project personnel so that work assignments are properly made and the needs of stakeholders are met. Much of research has emphasized the critical role of efficient coordination and collaboration for the successful execution of projects (Chinowsky *et al.*, 2007; Ochieng and Price, 2010; Badir *et al.*, 2012; Senescu *et al.*, 2013; Zhang and Ng, 2013; Arriagada and Alarcon, 2014).

- Knowledge Sharing: This process consists of the developing efficient knowledge sharing mechanism so that all stakeholders and project parties are aware of the project phases. The review of literature strongly proves that an effective knowledge sharing mechanism is crucial for speeding up the processes and for the success of the projects (Ardichvili *et al.*, 2003; Chinowsky *et al.*, 2007; Meng, 2012; Badir *et al.*, 2012; Senescu *et al.*,2013; Zhang and Ng, 2013; Arriagada and Alarcon, 2014).

- Multi-Cultural Communication: This process consists of developing ways to succeed inter-cultural communication and finding strategies to remove cultural barriers. Multi-cultural communication has been highly underlined in several studies and listed as one of components of project communications management (Loosemore and Muslmani, 1999; Pheng and Leong, 2000; Ochieng and Price, 2010).

3.4.8. Project Risk Management

Project Risk Management refers to the risk identification, analysis, response planning, and controlling (PMI, 2013). In this study, below parameters are determined as the key components of project risk management.

- Risk Identification: This process consists of the accurate identification and documentation of project risks that might cause adverse effects for the future of the project. The necessity of the risk identification for the successful execution of projects has been stated in several research studies (Al-Bahar and Crandall, 1990; Zhi, 1995; Ward, 1999; Tah and Carr, 2000; Harland *et al.*, 2003; Zoysa and Russell, 2003; Hallikas *et al.*, 2004; Hopkinson and Lovelock, 2004; Kwak and Stoddard, 2004; Wang *et al.*, 2004; Kleindorfer and Saad, 2005; Berg *et al.*, 2008; Han *et al.*, 2008; Imbeah and Guikema, 2009; Mullai, 2009; Bakker *et al.*, 2010;Liu *et al.*, 2010; Zou *et al.*, 2010; Eybpoosh *et al.*, 2011; Aloini *et al.*, 2012; Kern *et al.*, 2012; Zhao *et al.*, 2013; Vahdat *et al.*, 2014; Hoffmann *et al.*, 2013; Teller and Kock, 2013; Hwang *et al.*, 2014; Sousa *et al.*, 2014; Oehmen *et al.*, 2014).

- Risk Analysis: This process consists of analyzing project risks and estimating their impact and, evaluating the probability of occurrence and risk consequences, and prioritization of the risks to determine the most critical ones. Effectiveness of risks analysis in terms of project risk management has been highlighted in several research studies (Zhi, 1995; Hastak and Shaked, 2000; Harland *et al.*, 2003; Hallikas *et al.*, 2004; Hopkinson and Lovelock, 2004; Wang *et al.*,2004; Kleindorfer and Saad, 2005; Berg *et al.*,2008; Han *et al.*, 2008; Imbeah and Guikema, 2009; Mullai, 2009; Bakker *et al.*, 2010; Liu *et al.*, 2010; Zou *et al.*, 2010; Eybpoosh *et al.*, 2011; Aloini *et al.*, 2012; Kern *et al.*, 2012; Hoffmann *et al.*,2013; Teller and Kock, 2013; Zhao *et al.*,2013; Vahdat *et al.*, 2014; Hwang *et al.*,2014; Sousa *et al.*, 2014).

- Risk Allocation: Risk Allocation refers to the evaluation of the risks identified and allocation of those to the party that can best bear the risk. Appropriateness and importance of risk allocation for successfully managing projects has been underlined in several research studies (Klemetti, 2006; Zou *et al.*, 2010; Zhao *et al.*, 2013; Hwang *et al.*, 2014; Sousa *et al.*, 2014; Yildiz *et al.*, 2014; Oehmen *et al.*, 2014).

- Risk Control: This process consists of the implementation of risk response plans, monitor and detection of the impact of critical risks assessed and taking corrective action when necessary. Effectiveness of risk control and development of appropriate risk response plans have been emphasized in much of the project management literature (Zhi, 1995; Harland *et al.*, 2003; Hallikas *et al.*, 2004; Wang *et al.*, 2004;Kleindorfer and Saad, 2005; Berg *et al.*, 2008; Han *et al.*, 2008; Kutsch and Hall, 2009; Mullai, 2009; Liu *et al.*, 2010; Zou *et al.*, 2010; Eybpoosh *et al.*, 2011; Aloini *et al.*, 2012; Kern *et al.*, 2012; Zhao *et al.*, 2013; Hoffmann *et al.*, 2013; Teller and Kock, 2013; Hwang *et al.*, 2014; Sousa *et al.*, 2014; Oehmen *et al.*, 2014).

3.4.9. Project Procurement Management

Project Procurement Management consists of the purchasing goods, services, and results of a project (PMI, 2013). This study has identified below parameters as the core components of project procurement management.

- Supplier Selection: This process of project procurement management consists of accurate determination of selection criteria for supplier selection, and consideration of previous experiences of suppliers in the selection process. The critical role of supplier selection in the project procurement management has been indicated in several research studies (Hampton, 1994; Beard *et al.*, 2001; Shen and Tam, 2002; Chen *et al.*, 2004; Elfving *et al.*, 2005; Weinstein *et al.*, 2005; Cox *et al.*, 2006; Elwardani *et al.*, 2006; Karim *et al.*, 2006; Wardani *et al.*, 2006; Eriksson *et al.*, 2007; Errasti *et al.*, 2007; Rwamamara, 2007; Manley, 2008; Meng *et al.*, 2011; Eriksson and Westerberg, 2011; Ruuska *et al.*, 2013; Ruparanthna and Hewage, 2014).

- Type of Contract: Determination of the type of contract to be signed with the supplier is one of the most important steps of in successful project management. To be evidenced by several research studies, accuracy of the type of contract has been listed as one of the most important components of project procurement management (Heide and John, 1990; Williamson, 1991; Hampton, 1994; Cox, 1996; Elwardani *et al.*, 2006; Eriksson and Westerberg, 2011; Meng *et al.*, 2011; Sutt, 2011; Ruparanthna and Hewage, 2014).

- Supply of Resources: Supply of Resources refers to the organization of purchasing, delivery and handling process of goods and allowing timely logistics and distribution. Timely supply of resources has been listed as one of the most critical steps of project procurement management in different studies (Caron and Marchet, 1998; Chen *et al.*, 2004; Bhagwat and Sharma, 2007; Schiele, 2007; Feng *et al.*, 2008; Eriksson and Westerberg, 2011; Meng *et al.*, 2011; Ruparanthna and Hewage, 2014).

- Risk Management in the Supply Process: This component of project procurement management refers to the timely handling of risks that might arise in the supply and purchase of goods or services. Therefore, management of those risks is critical for the success of procurement process. In this issue, Zsidisin *et al.*, (2000) stated that understanding of supply risks allow organizations taking corrective action in the purchasing process and trigger organizations to achieve for process improvement, buffer strategies, strategic alliances, and developing suppliers. In addition, Chopra and Sodhi (2004) also indicated that organizations should understand the drivers and sources of risks before producing risk mitigation strategies, which might require adding capacity, increasing inventories, having redundant suppliers, and increasing flexibility etc.

3.4.10. Project Stakeholder Management

Project Stakeholder Management consists of the process, which include the true identification of people, groups, and organizations in the project, determination of the stakeholder needs, responsibilities, and expectations, and the developing sound strategies for the effective engagement of stakeholders in the project execution processes (PMI, 2005). This study determined below parameters as the key components of project stakeholder management.

- Identification of Stakeholders: This component includes people, groups, or organizations that might affect or be affected by the outcomes of the project. Therefore, relevant information should be collected regarding the interest, involvement, interdependencies, influence and their impact on the project success. Much of research has indicated that complete identification of stakeholders is critical for the project success (Karlsen, 2002; Elias *et al.*, 2002; Young, 2006; Walker *et al.*, 2008; Achterkamp and Vos, 2008; Jepsen and Eskerod, 2009; Yang *et al.*, 2011).

- Stakeholder Needs, Interests, and Influences: This component refers to determination of stakeholders' needs, expectations, perceptions and interests so as not to come across with conflicts. Therefore, previous research proves that accurate determination of stakeholder needs, interests, and impacts has a considerable effect on project success (Mitchel *et al.*, 1997; Olander, 2007; Jepsen and Eskerod, 2009; Yang *et al.*, 2011; Beringer *et al.*, 2013; Missonier and Loufrani-Fedida, 2014; Mok *et al.*, 2015).

- Stakeholder Engagement: This component refers to making stakeholders part of the project design, execution and implementation processes and deriving strategies to integrate stakeholders into the project management processes (PMI, 2013). Effectiveness of stakeholder engagement and its critical role as part of the project stakeholder management in the successful project execution has clearly been emphasized in several research studies so far (Jepsen and Eskerod, 2009; Yang *et al.*, 2011; Beringer *et al.*, 2013; Missonier and Loufrani-Fedida, 2014; Mok *et al.*, 2015).

- Stakeholder Conflicts: This component refers to estimation of possible conflicts and coalitions among stakeholder in order to best manage stakeholder relations, and produce effective strategies to resolve conflicts. Timely handling of stakeholder conflicts has been indicated in several research studies so far (McElroy and Mills, 2000; Aaltonen and Kujala, 2010; Yang *et al.*, 2011; Missonier and Loufrani-Fedida, 2014).

3.4.11. Project Stakeholder Management

Project Safety Management consists of the assurance of project execution with the zero injury policy and taking necessary measures to prevent potential accidents (PMI, 2005). In this study, below parameters are determined as the key components of project safety management.

- Safety Awareness and Culture: Safety Awareness and Culture consists of creating an environment towards high safety awareness and development of a work safe culture. Enhancing safety awareness and safety culture as part of successful project management scheme has been listed as one of the most important components of project safety management in several research studies (Hinze, 1997; Molenaar *et al.*, 2002; Mohamed, 2003; Mitropoulos *et al.*, 2009; Molenaar *et al.*, 2009; Goggin *et al.*, 2010; Cheng *et al.*, 2012; Hsu *et al.*, 2012; Choudhry, 2014; Tappura *et al.*, 2015; Sousa *et al.*, 2014).

- Safety Planning: This component consists of the planning all safety activities in order to prevent all potential hazards and determining high risk activities, and defining necessary measures for a safe work site as well as developing safety approach for a work safe environment during the project execution (PMI, 2005). Effectiveness of safety planning and its critical role in creating a work safe culture and zero accident policy work have been investigated in several research studies so far (Hinze, 1997; Mohamed, 2003; Mitropoulos *et al.*, 2009; Molenaar *et al.*, 2009; Cheng *et al.*, 2012; Hsu *et al.*, 2012; Choudhry, 2014; Tappura *et al.*, 2015).

- Safety Training: Safety Training consists of Organizing regular trainings in the use safety equipment on site, following safety regulations and procedures, and organizing toolbox meetings for site safety. Therefore, the frequency of training given to workers is critical. Several research studies prove that safety training plays a critical role in project safety management (Mohamed, 2003; Mitropoulos *et al.*, 2009; Molenaar *et al.*, 2009; Cheng *et al.*, 2012; Hsu *et al.*, 2012; Choudhry, 2014; Tappura *et al.*, 2015; Sousa *et al.*, 2014; Demirkesen and Arditi, 2015).

- Safety Implementation: Safety Implementation refers to ensuring all tasks are completed in a work safe environment and implementing safety standards and requirements. The criticality of safety implementation for safety management has been highlighted in several research studies (Mohamed, 2003; Mitropoulos *et al.*, 2009; Cheng *et al.*, 2012; Hsu *et al.*, 2012; Tappura *et al.*, 2015; Sousa *et al.*, 2014; Choudhry, 2014).

- Safety Inspection and Monitoring: This component consists of evaluating whether safety standards are met, safety procedures and requirements are fulfilled, and monitoring whether safety performance has improved or not. Much of research has also implied the critical role of safety inspection and monitoring in project safety management (Baxendale and Jones, 2000; Mohamed, 2003; Molenaar *et al.*, 2009; Mitropoulos *et al.*, 2009; Cheng *et al.*, 2012; Hsu *et al.*, 2012; Choudhry, 2014; Tappura *et al.*, 2015; Ramli *et al.*, 2014).

3.4.12. Project Environmental Management

Project Environmental Management consists of the process for ensuring the project is executed with respect to the legal permits in accordance with environmental standards (PMI, 2005). This study determined below parameters as the key components of project environmental management.

- Environmental Implementation and Control Measures: This component refers to determining environmental implementation and control measures and assessing elements that might potentially create environmental damage. Accurate determination of those measures and the critical role of environmental implementation have been emphasized in several research studies so far (Chen *et al.*, 2004; Shen *et al.*, 2005; Gangolells *et al.*, 2009; Shen *et al.*, 2011; Rodriguez *et al.*, 2011; Testa *et al.*, 2011; Zeng *et al.*, 2011; Park and Ahn, 2012; Fuertes *et al.*, 2013).

- Environmental Impact: This component refers toaccurate identification of environmental aspects to recognize their impacts. Environmental impact has been investigated in several research studies so far (Shen *et al.*, 2005; Gangolells *et al.*, 2009; Zeng *et al.*, 2011; Rodriguez *et al.*, 2011; Testa *et al.*, 2011; Shen *et al.*, 2011; Goh and Rowlinson, 2013; Fuertes *et al.*, 2013).

- Environmental Policies and Regulations: This component refers to creating an environmental policy scheme and committing to the environmental regulations. It also consists of an effective environmental planning where the characteristics of the environment surrounding the construction site are determined (PMI, 2005). The careful consideration of environmental policies and regulations, and commitment to those have been clearly indicated in several research studies before

(Hart, 1995; Klassen and Whybark, 1999; Russo and Fouts, 1997; Sharma and Vredenburg, 1998; Kuntze, 1999; Silvo *et al.*, 2002; Chen *et al.*, 2004; Shen *et al.*, 2005; Lanoie *et al.*, 2007; Telle and Larsson, 2007; Shen *et al.*, 2011; Rodriguez *et al.*, 2011; Testa *et al.*, 2011; Zeng *et al.*, 2011; Park and Ahn, 2012; Fuertes *et al.*, 2013; Goh and Rowlinson, 2013).

3.4.13. Project Financial Management

Financial Management consists of the managing, acquiring, and controlling financial resources for revenue source, and analysis and update of cash flows (PMI, 2005). This study identified below parameters as the key components of project financial management.

- Cash Flow Planning: Project cash flow planning is essential for predicting the net cash in and cash out in the project. In this issue, several research studies implied that companies usually bankrupt due to inefficient management of cash flow (Pate Cornell *et al.*, 1990; Singh and Lakanathan, 1992; Kaka and Price, 1993; Boussabaine and Kaka, 1998; Melik, 2010). Therefore, accurate planning of cash flow is crucial for the success of the projects.

- Cash Flow Analysis: Project Cash Flow Analysis constitutes an important part in evaluating project's financial viability (PMI, 2005). In this issue, much of research has focused on the essentially of project cash flow analysis for cash flow forecasting. For example, Maravas and Pantouvakis (2012) proposed a project cash flow analysis method in the presence of uncertainty in activity duration and cost. Cash flow analysis is also listed among the most important steps in the financial management (PMI, 2005). In addition, Odeyinka *et al.*, (2008) implied that evaluation of the risk factors impacting cash flow forecasting is essential.

- Foreign Exchange Risk: Foreign Exchange Risk refers to experience of risk, which leads to lower financial performance or position due to fluctuations in the exchange rates between currencies (CPA Australia, 2009). Much of the research focused on the foreign exchange risk as a potential reason for lower firm performance and listed foreign exchange risk as an important component of project financial management (He and Ng, 1998; Marshall, 2000; Kapila and Handrickson, 2001; Mbabazize *et al.*, 2014).

- Cash Flow Monitoring and Control: Cash flow monitoring and control is an important indicator of project success. Therefore, firms tend to develop several cash flow monitoring systems to evaluate the project progress and monitor the status. The critical role of net present worth in project control, success or failure has also been clearly implied in the study conducted by Gardiner and Stewart (2000). In addition, research studies also indicated that effectiveness of financial monitoring and control is essential in terms of evaluating organizations' all financial activities, and detecting deviations (Bradley and Tomasides, 1991; Kao *et al.*, 2009; Akanni *et al.*, 2015).

3.4.14. Project Claim Management

Project Claim Management consists of the processes for the prevention of construction claims from arising or effective handling of those claims when they occur (PMI, 2005). This study determined below parameters as the key components of project claim management.

- Claim Identification: Claim Identification refers to having sufficient knowledge about the contract terms in especially judging whether the activity is a change or not. Claim identification starts with the accurate interpretation of the contract requirements and presentation of the documented description of the activity, which is stated to be extra according to the contract terms (PMI, 2005). Therefore, accurate identification of claims is essential in the successful management of claims. Research studies prove that accurate claim identification is very important in terms of determining claim causes and successful execution of projects and listed as one of the most important processes of project claim management (Vidogah and Ndekugri, 1997; Abdul-Malak and El-Sadi, 2000; Kululanga *et al.*, 2001; Abdul-Malak *et al.*, 2002; Zaneldin, 2006; Fawzy and El-adaway, 2012; LaBarre and El-adaway, 2014).

- Claim Notification: This component refers to preparing claim notification forms and notifying the interested party within the notification period. Therefore, timely handling of claim notification is essential in successful project claim management. This issue has also been highlighted in several research studies so far (Easton, 1989; Kartam, 1999; Abdul-Malak and El-Sadi, 2000; Kululanga *et al.*, 2001).

- Claim Resolution: This component refers to arranging strategies for the resolution of claims in short time and preventing situations that might create conflicts. Thus, timely handling of claim resolution is crucial for a successful claim management process. The critical role of claim resolution and its timely handling have been investigated in several research studies so far (Vidogah and Ndekugri, 1997; Abdul-Malak and El-Sadi, 2000; Abdul-Malak *et al.*, 2002; Fawzy and El-adaway, 2012; LaBarre and El-adaway, 2014).

- Claim Prevention: This component refers to producing strategies such and taking measures for the prevention of claims in an effective manner by the deep understanding of claim prevention inputs as also indicated by PMI (2005). In this issue, research studies indicated that effectiveness of claim prevention is important in the successful execution of projects (Easton, 1989; Kartam, 1999; Abdul-Malak and El-Sadi, 2000; Kululanga *et al.*, 2001).

A short description for components and key references can be found in Table 6.

Table 3.1. The Description of Components of Project Management Knowledge Areas and Key References.

Knowledge Area	Component	Definition	Key Reference
Project	Development of	Development of the document which authorizes the start of a project	
Integration	Project Charter	and defines project manager's authorization over the whole project	Larson and Gray (2011); Mustaro and Rossi (2013); PMI (2013).
Management	Knowledge	The exchange of knowledge among all stakeholders, project	Tatum (1989); Mitropoulos and Tatum (2000); Tether (2002);
	Integration	parties and sharing previous and current knowledge, and input	Carlile and Rebentisch (2003); Newell *et al.*, (2004); Soderlund (2004);
		of all data into the current knowledge transfer system	Kellogg *et al.*, (2006); Schmickl and Kieser (2008);
			Ritala and Hurmelinna-Laukkanen (2009); Song and Song (2010);
			Un *et al.*, (2010); Brettel *et al.*, (2011); Enberg (2012); Heising (2012).
	Process	The organized sequence of all activities in an appropriate manner	Tatum (1989); Birkinshaw *et al.*, (2000); Mitropoulos and
	Integration	and well developed logical relationships among processes	Tatum (2000); Kleinschmidt *et al.*, (2007); Yanwei *et al.*, (2012).
	Staff Integration	Integration of project staff into the current project processes	Lahti (1999); Egan (2002); Carmeli and Schaubroeck (2006);
			Dammer (2008); Carmeli and Meyrav (2009); Zajac (2009);
			Jonas (2010); Enberg (2012); Tiller (2012).
	Supply	The integration of customers and suppliers into the whole processes,	Wheelwright and Clark (1992); Gemu¨nden *et al.*, (1996);
	Chain	development of knowledge sharing mechanisms among customers,	Gruner and Homburg (2000); Henard and Szymanski (2001);
	Integration	suppliers and project teams	Ernst (2002); Cooper *et al.*, (2004); Kleinschmidt *et al.*, (2007);
			Ernst *et al.*, (2010); Enberg (2012).
	Integration	The review and evaluation of all change requests, making	Tatum (1989); Moran and Brightman (2001); Kolodny (2004);
	of Changes	modifications or updates in project management plan and project	Jones *et al.*, (2005); Turner and Mu¨ller (2005); Leybourne (2007);
		documents, and integration of changes into the project deliverables	Gilley *et al.*, (2008); Cummings and Worley (2009);
			Soderlund (2010); Hwang and Low (2011); Yanwei *et al.*, (2012);
			Kerzner (2013); PMI (2013); Hornstein (2015).
Project	Scope	The planning of all scope requirements, boundaries, out of	Levene and Braganza (1996); Dumont *et al.*, (1997);
Scope	Planning	scope highlights, and scope management plan	Cho and Gibson (2001); Nevo and Chan (2007);
Management			Gumus *et al.*, (2008); Qureshi *et al.*, (2009); Gordon and
			Azambuja (2012); Mustapha *et al.*, (2013); PMI (2013).
	Scope	Definition of project scope, scale and applications,	Hackney (1992); Hamilton and Gibson (1996);
	Definition	and things to be included in the project	Levene and Braganza (1996); Cho and Gibson (2001);
			Griffith and Gibson (2001); Song and Abourizk (2005);
			Shane (2006); Qureshi *et al.*, (2009); Gordon and Azambuja (2012);
			Fageha and Aibinu (2013); Mustapha *et al.*, (2013);
			Abrantes and Figueiredo (2014).
	Scope	Changes in the project scope, which might create disruptions	Levene and Braganza (1996); Cho and Gibson (2001);
	Changes	in the project execution	Ibbs and Nguyen (2007); Abrantes and Figueiredo (2014).

Table 3.1. The Description of Components of Project Management Knowledge Areas and Key References.

Project	Activity	Identification and documentation of specific actions	Abeyasinghe *et al.*, (2001); Love *et al.*, (2002);
Time	Definition	to produce project deliverables	Mustaro and Rossi (2013), PMI (2013).
Management	Activity	Documenting and constructing the logical relationships	
	Sequencing	among project activities	Liberatore and Pollack-Johnson (2006); PMI (2013).
	Time	Estimation of durations for project activities and	Gong and Hugsted (1997); Cookie-Davies (2002);
	Estimation	forecasting completion times	Brown *et al.*, (2007); Guerrero *et al.*, (2014);
			Berssaneti and Carvalho (2015).
	Development of	Analysis of activity sequences, durations, resource	Abeyasinghe *et al.*, (2001); Irfan *et al.*, (2011);
	Project Schedule	requirements and schedule constraints to develop	Khamooshi and Golafshani, (2013); Moosavi and
		the project schedule	Moselhi (2014); Berssaneti and Carvalho (2015).
	Schedule	Monitoring and controlling all project activities, detection of possible	Kraiem and Diekmann (1987); Carr (1993);
	Monitoring,	time delays, managing changes to the baseline schedule and	Abeyasinghe *et al.*, (2001); Ibbs and Nguyen (2007);
	Control and Revision	making necessary modifications in project schedule if needed	Irfan *et al.*, (2011); Meng, (2012); Guerrero *et al.*, (2014).
Project	Cost	Framing an approximate monetary resource scheme for the	Akintoye and Fitzgerald (2000); Elkjaer (2000);
Cost	Estimation	completion of all project activities	Wang and Huang (2000); Artto *et al.*, (2001); Flyvbjerg *et al.*, (2002);
Management			Wang (2002); Touran (2003); Chou *et al.*, (2006); Hyväri (2006);
			Niazi *et al.*,(2006); Jung and Kang (2007); Aibinu and Pasco (2008);
			Doloi (2011); Tawfek *et al.*, (2012); PMI (2013);
			Khodakarami and Abdi (2014); Yildiz *et al.*, (2014).
	Determination	Evaluation of estimated costs of individual activities	Atkinson (1999); Ahsan and Gunawan (2010);
	of Budget	to compose a sound cost baseline	Doloi (2011); Kim *et al.*, (2012); Xu *et al.*, (2012); PMI (2013).
	Cost Control	Monitoring the project status and making necessary	Rasdorf and Abudayyeh (1991); Atkinson, (1999);
		updates to the cost baseline	Jung and Gibson (1999); Jung and Woo (2004); Winter (2006);
			Jung and Kang (2007); Doloi (2011); Kim *et al.*, (2012);
			Xu *et al.*, (2012); PMI (2013).
Project	Quality	Definition of quality based on several perspectives such	Qureshi *et al.*, (2009); Marques *et al.*, (2011);
Quality	Definition	as customer perspective or specification-based perspective	Wanberg *et al.*, (2013).
Management	Quality	Standardization of quality documents in firm and making	Qureshi *et al.*, (2009); Marques *et al.*, (2011);
	Standardization	effort to improve quality standards by the composition of a	Rezaei *et al.*, (2011); Jabbour *et al.*, (2014).
		single quality frame	
	Quality Assurance	Ensuring the quality in the processes and in the products	Kagan (1989); Bayless (1986); Tukel and Rom (2001);
	and Control		Aliverdi *et al.*, (2013); Wanberg *et al.*, (2013); PMI (2013);
			Flyvbjerg (2014).

Table 3.1. The Description of Components of Project Management Knowledge Areas and Key References.

Project	Project Team	Composing and choosing skillful project teams that	Huselid (1995); Harris and Ogbonna (2001); Jiang *et al.*, (2002);
Human	Composition	best fit the project needs	Belout and Gauvreau (2004); Cho *et al.*, (2006); Liu *et al.*, (2007);
Resource			Tabassi and Bakar (2009); Zwikael and Aviram (2010);
Management			Buller and McEvoy (2012); Khan and Rasheed (2014);
			Lapina *et al.*, (2014).
	Workforce	Planning of workforce and developing appropriate plans	Harris and Ogbonna (2001); Jiang *et al.*, (2002);
	Planning	for managing potential workforce	Belout and Gauvreau (2004); Clark and Colling (2005);
			Cho *et al.*, (2006); Liu *et al.*, (2007); Tabassi and Bakar (2009);
			Zwikael and Aviram (2010); Buller and McEvoy (2012);
			Khan and Rasheed (2014); Lapina *et al.*, (2014).
	Staff Training	Effective training of project teams for clarifying arising	Huselid (1995); Jiang *et al.*, (2002); Belout and Gauvreau (2004);
		issues during project execution for enhancing project performance	Clark and Colling (2005); Minbaeva (2005).
	Performance	Tracking staff performance, managing resolution of the issues,	Cho *et al.*, (2006); Liu *et al.*, (2007); Tabassi and Bakar, (2009);
	Development	providing necessary feedback and motivation for	Masood (2010); Menezes *et al.*, (2010); Zwikael and Aviram (2010);
		enhancing project performance	Buller and McEvoy (2012); Birasnav (2014); Lapina *et al.*, (2014).
	Performance	Processes where employee performance is evaluated based	Delery and Doty (1996); Huselid (1995); Youndt *et al.*, (1996);
	Evaluation	on several performance measures	Huselid *et al.*, (1997); Dransfield (2000).
Project	Communication	Development of well-set communication strategies to	Ochieng and Price (2010); Meng (2012); Badir *et al.*, (2012);
Communications	Strategies	enhance knowledge sharing among project personnel	Senescu *et al.*, (2013); PMI (2013).
Management	Communication	Using latest communication tools, methods and	Loosemore and Muslmani (1999); Chinowsky *et al.*, (2007);
	Technology	technologies to effectively follow up all processes	Meng (2012); Zhang and Ng (2013); Arriagada and Alarcon (2014).
	Coordination and	Development of efficient coordination and collaboration	Chinowsky *et al.*, (2007); Ochieng and Price (2010);
	Collaboration	among project personnel so that work assignments	Badir *et al.*, (2012); Senescu *et al.*, (2013); Zhang and Ng (2013);
		are properly made and the needs of stakeholders are met	Arriagada and Alarcon (2014).
	Knowledge	Developing efficient knowledge sharing mechanism	Ardichvili *et al.*, (2003); Chinowsky *et al.*, (2007); Meng (2012);
	Sharing	so that all stakeholders and project parties are aware	Badir *et al.*, (2012); Senescu *et al.*, (2013); Zhang and Ng (2013);
		of the project phases	Arriagada and Alarcon (2014).
	Multi-Cultural	Developing ways to succeed inter-cultural communication	Loosemore and Muslmani (1999); Pheng and Leong (2000);
	Communication	and finding strategies to remove cultural barriers	Ochieng and Price (2010).

Table 3.1. The Description of Components of Project Management Knowledge Areas and Key References.

Project	Risk	Identification and documentation of project risks that	Al-Bahar and Crandall (1990); Zhi (1995); Ward (1999);
Risk	Identification	might cause adverse effects for the future of the project	Harland *et al.*, (2003); Zoysa and Russell (2003);
Management			Hallikas *et al.*, (2004); Hopkinson and Lovelock (2004);
			Kwak and Stoddard (2004); Wang *et al.*, (2004);
			Kleindorfer and Saad (2005); Han *et al.*, (2008); Mullai (2009);
			Bakker *et al.*, (2010); Liu *et al.*, (2010); Zou *et al.*, (2010);
			Eybpoosh *et al.*, (2011); Aloini *et al.*, (2012); Kern *et al.*, (2012);
			Zhao *et al.*, (2013); Hoffmann *et al.*, (2013); Teller and Kock (2013);
			Hwang *et al.*, (2014); Oehmen *et al.*, (2014); Sousa *et al.*, (2014).
	Risk	Analyzing project risks and estimating their impact and,	Zhi (1995); Hastak and Shaked (2000); Harland *et al.*, (2003);
	Analysis	evaluating the probability of occurrence and risk	Hallikas *et al.*, (2004); Wang *et al.*, (2004);
		consequences to determine the most critical ones	Kleindorfer and Saad (2005); Berg *et al.*, (2008);
			Mullai (2009); Bakker *et al.*, (2010); Liu *et al.*, (2010);
			Zou *et al.*, (2010); Eybpoosh *et al.*, (2011); Aloini *et al.*, (2012);
			Hoffmann *et al.*, (2013); Teller and Kock (2013); Zhao *et al.*, (2013);
			Hwang *et al.*, (2014); Sousa *et al.*, (2014).
	Risk	Evaluation of the risks identified and allocation of	Klemetti (2006); Zou *et al.*, (2010); Zhao *et al.*, (2013);
	Allocation	those to the party that can best bear the risk	Hwang *et al.*, (2014); Oehmen *et al.*, (2014); Sousa *et al.*, (2014);
			Yildiz *et al.*, (2014).
	Risk Control	Implementation of risk response plans, monitor and	Zhi (1995); Harland *et al.*, (2003); Hallikas *et al.*, (2004);
		detection of the impact of critical risks assessed	Wang *et al.*, (2004); Kleindorfer and Saad (2005); Berg *et al.*, (2008);
		and taking corrective action when necessary	Han *et al.*, (2008); Mullai (2009); Liu *et al.*, (2010); Zou *et al.*, (2010);
			Aloini *et al.*, (2012); Kern *et al.*, (2012); Zhao *et al.*, (2013);
			Teller and Kock (2013); Hwang *et al.*, (2014); Oehmen *et al.*, (2014);
			Sousa *et al.*, (2014).
Project	Supplier	Determination of selection criteria for supplier selection,	Beard *et al.*, (2001); Shen and Tam (2002); Chen *et al.*, (2004);
Procurement	Selection	and consideration of previous experiences of suppliers	Weinstein *et al.*, (2005); Cox *et al.*, (2006); Karim *et al.*, (2006);
Management		in the selection process	Wardani *et al.*, (2006); Eriksson *et al.*, (2007); Errasti *et al.*, (2007);
			Rwamamara (2007); Manley (2008); Meng *et al.*, (2011);
			Eriksson and Westerberg (2011); Ruuska *et al.*, (2013);
			Ruparanthna and Hewage (2014).
	Type of	Determination of the type of contract to be signed with the	Heide and John (1990); Williamson (1991); Hampton (1994);
	Contract	supplier is one of the most important steps of in	Cox (1996); Elwardani *et al.*, (2006); Eriksson and Westerberg (2011);
		successful project management	Meng *et al.*, (2011); Sutt (2011); Ruparanthna and Hewage (2014).
	Supply of	Organization of purchasing, delivery and handling	Caron and Marchet (1998); Chen *et al.*, (2004);
	Resources	process of goods and allowing timely logistics and distribution	Bhagwat and Sharma (2007); Schiele (2007); Feng *et al.*, (2008);
			Eriksson and Westerberg (2011); Meng *et al.*, (2011);
			Ruparanthna and Hewage (2014).
	Risk Management in	Handling of risks that might arise in the supply and	Zsidisin *et al.*, (2000); Chopra and Sodhi (2004).
	the Supply Process	purchase of goods or services	

Table 3.1. The Description of Components of Project Management Knowledge Areas and Key References.

Project Stakeholder Management	Identification of Stakeholders	Identification of people, groups, or organizations that might affect or be affected by the outcomes of the project.	Karlsen (2002); Elias *et al.*, (2002); Young (2006); Walker *et al.*, (2008); Achterkamp and Vos (2008); Jepsen and Eskerod (2009); Yang *et al.*, (2011); PMI (2013).
	Stakeholder Needs, Interests, and Influences	Determination of stakeholders' needs, expectations, perceptions and interests so as not to come across with conflicts	Mitchel *et al.*, (1997); Olander (2007); Jepsen and Eskerod (2009); Yang *et al.*, (2011); Beringer *et al.*, (2013); Missonier and Loufrani-Fedida (2014); Mok *et al.*, (2015).
	Stakeholder Engagement	Making stakeholders part of the project design, execution and implementation processes	Jepsen and Eskerod (2009); Yang *et al.*, (2011); Beringer *et al.*, (2013); PMI (2013); Missonier and Loufrani-Fedida (2014); Mok *et al.*, (2015).
	Stakeholder Conflicts	Estimation of possible conflicts and coalitions among stakeholder in order to best manage stakeholder relations, and produce effective strategies to resolve conflicts	McElroy and Mills (2000); Aaltonen and Kujala (2010); Yang *et al.*, (2011); Missonier and Loufrani-Fedida (2014).
Project Safety Management	Safety Awareness and Culture	Creating an environment towards high safety awareness and development of a work safe culture	Hinze (1997); Molenaar *et al.*, (2002); Mohamed (2003); Mitropoulos *et al.*, (2009); Molenaar *et al.*, (2009); Goggin *et al.*, (2010); Cheng *et al.*, (2012); Hsu *et al.*, (2012); Choudhry (2014); Sousa *et al.*, (2014); Tappura *et al.*, (2015).
	Safety Planning	Planning all safety activities in order to prevent all potential hazards and determining high risk activities, and defining necessary measures for a safe work	Hinze (1997); Mohamed (2003); PMI (2005); Mitropoulos *et al.*, (2009); Molenaar *et al.*, (2009); Cheng *et al.*, (2012); Hsu *et al.*, (2012); Choudhry (2014); Tappura *et al.*, (2015).
	Safety Training	Organizing regular trainings in the use safety equipment on site, following safety regulations and procedures, and organizing toolbox meetings for site safety	Mohamed (2003); Mitropoulos *et al.*, (2009); Molenaar *et al.*, (2009); Cheng *et al.*, (2012); Hsu *et al.*, (2012); Choudhry (2014); Tappura *et al.*, (2015); Sousa *et al.*, (2014); Demirkesen and Arditi (2015).
	Safety Implementation	Ensuring all tasks are completed in a work safe environment and implementing safety standards and requirements	Mohamed (2003); Mitropoulos *et al.*, (2009); Cheng *et al.*, (2012); Hsu *et al.*, (2012); Tappura *et al.*, (2015); Sousa *et al.*, (2014); Choudhry (2014).
	Safety Inspection and Monitoring	Evaluating whether safety standards are met, safety procedures and requirements are fulfilled, and monitoring whether safety performance has improved or not	Baxendale and Jones (2000); Mohamed (2003); Molenaar *et al.*, (2009); Mitropoulos *et al.*, (2009); Cheng *et al.*, (2012); Hsu *et al.*, (2012); Choudhry (2014); Ramli *et al.*, (2014); Tappura *et al.*, (2015).
Project Environmental Management	Environmental Implementation and Control Measures	Determining environmental implementation and control measures and assessing elements that might potentially create environmental damage	Chen *et al.*, (2004); Shen *et al.*, (2005); Gangolells *et al.*, (2009); Shen *et al.*, (2011); Rodriguez *et al.*, (2011); Testa *et al.*, (2011); Zeng *et al.*, (2011); Park and Ahn (2012); Fuertes *et al.*, (2013).
	Environmental Impact	Accurate identification of environmental aspects to recognize their impacts	Shen *et al.*, (2005);Gangolells *et al.*, (2009); Zeng *et al.*, (2011); Rodriguez *et al.*, (2011); Testa *et al.*, (2011); Shen *et al.*, (2011); Goh and Rowlinson (2013); Fuertes *et al.*, (2013).
	Environmental Policies and Regulations	Creating an environmental policy scheme and committing to the environmental regulations	Chen *et al.*, (2004); PMI (2005); Shen *et al.*, (2005); Telle and Larsson (2007); Shen *et al.*, (2011); Rodriguez *et al.*, (2011); Testa *et al.*, (2011); Zeng *et al.*, (2011); Park and Ahn (2012); Fuertes *et al.*, (2013); Goh and Rowlinson (2013).

Table 3.1. The Description of Components of Project Management Knowledge Areas and Key References.

Project	Cash Flow Planning	Predicting the net cash in and cash out in the project	Pate-Cornell *et al.*, (1990), Singh and Lakanathan (1992),
Financial			Kaka and Price (1993), Boussabaine and Kaka (1998), Melik (2010).
Management	Cash Flow	Evaluating project's financial viability and analysis of	(PMI, 2005); Odeyinka *et al.*, (2008); Maravas and Pantouvakis (2012).
	Analysis	cash flow in the project	
	Foreign	Experience of risk, which leads to lower financial performance or	He and Ng (1998); Marshall (2000); Kapila and Handrickson (2001);
	Exchange Risk	positiondue to fluctuations in the exchange rates between currencies	CPA Australia (2009); Mbabazize *et al.*, (2014).
	Cash Flow	Evaluating the project progress and monitoring the status	Gardiner and Stewart (2000); Bradley and Tomasides (1991);
	Monitoring and Control		Kao *et al.*, (2009); Akanni *et al.*, (2015).
Project	Claim	Extracting sufficient knowledge about the contract	Vidogah and Ndekugri (1997); Abdul-Malak and El-Sadi (2000);
Claim	Identification	terms in especially judging whether the activity is a change or not	Abdul-Malak *et al.*, (2002); PMI (2005); Zaneldin (2006);
Management			Kululanga *et al.*, (2001); Fawzy and El-adaway (2012);
			LaBarre and El-adaway (2014).
	Claim	Preparing claim notification forms and notifying the	Easton (1989); Kartam (1999); Abdul-Malak and El-Sadi (2000);
	Notification	interested party within the notification period	Kululanga *et al.*, (2001); PMI (2005).
	Claim	Developing strategies for the resolution of claims	Vidogah and Ndekugri (1997); Abdul-Malak and El-Sadi (2000);
	Resolution	in short time and preventing situations that might create conflicts	Abdul-Malak *et al.*, (2002); PMI (2005); Fawzy and El-adaway (2012);
			LaBarre and El-adaway (2014).
	Claim	Devising strategies such and taking measures for the	Easton (1989); Kartam (1999); Abdul-Malak and El-Sadi (2000);
	Prevention	prevention of claims in an effective manner	Kululanga *et al.*, (2001); PMI (2005).A161:E190AA1:E190

3.5. Hypotheses of the Research

In the context of this research, several hypotheses are constructed regarding the interrelationships among the determinants of the performance and the relationship between the determinants and the performance construct. The hypotheses are constructed though getting expert opinions and review of past studies in greater detail. In the beginning, several interrelations are detected. However, more dominant relations are emphasized and hypotheses are set based on the heavily investigated relations in the literature.

3.5.1. Hypotheses between the Determinants and the Performance Construct

PMBOK Guide indicates that project integration management is one of the core components of project management performance. Heising (2012) underlined the critical role of integration in terms of project portfolio management. In addition, Mitropoulos and Tatum (2000) also indicated that degree of project integration affects project performance. Based on this information, following hypothesis was developed.

- H1: Effectiveness of "project integration management" has a direct and positive effect on project management performance.

PMBOK Guide clearly states that project scope management is among the most important components of project management performance. Fageha and Aibinu (2014) also indicated that effective scope management has a direct impact on the project outcome. Based on this information provided, following hypothesis was developed.

- H2: Effectiveness of "project scope management" has a direct and positive effect on project management performance.

PMBOK Guide indicates that project time management is among the most important attributes of project management performance. As previously conducted studies prove

(Gayatri and Saurabh, 2013; Ngacho and Das, 2014), effective time management provides enhanced project management performance. Following hypothesis was developed based on the information provided herein.

- H3: Effectiveness of "project time management" has a direct and positive effect on project management performance.

PMBOK Guide indicates that project cost management is among the most important attributes of project management performance. In Salazar-Aramayo *et al.*, (2013) study cost is also indicated among the most important attributes of project management model that they have developed. Following hypothesis was developed based on the provided information herein.

- H4: Effectiveness of "project cost management" has a direct and positive effect on project management performance.

PMBOK Guide indicates that project quality management is among the most important attributes of project management performance. In Ali *et al.*, (2013) study, it is also emphasized that quality of work done is among the most important attributes of project performance measurement. Following hypothesis was developed based on the information provided.

- H5: Effectiveness of "project quality management" has a direct and positive effect on project management performance.

PMBOK Guide indicates that project human resource management is among the most important attributes of project management performance. According to the study conducted by Popaitoon and Siengthai (2014), it is also emphasized that project performance and knowledge absorptive capacity of project teams are highly affected by project human resource management practices. Based on the information provided above, following hypothesis was developed.

- H6: Effectiveness of “project human resource management” has a direct and positive effect on project management performance.

PMBOK Guide indicates that project communications management is among the most important attributes of project management performance. As evidenced by Badir *et al.*, (2012) study, communication is one of the key components of improved performance. Based on the information provided above, following hypothesis was developed.

- H7: Effectiveness of “project communications management” has a direct and positive effect on project management performance.

PMBOK Guide indicates that project risk management is among the most important attributes of project management performance. As evidenced by Hwang *et al.*, (2014) study, effective risk management leads to enhanced project performance. Based on the information provided above, following hypothesis was developed.

- H8: Effectiveness of “project risk management” has a direct and positive effect on project management performance.

PMBOK Guide indicates that project procurement management is among the most important attributes of project management performance. In this issue, Eriksson and Westerberg (2011) indicate that collaborative procurement practices have a positive influence on construction project performance. Based on the information provided above, following hypothesis was developed.

- H9: Effectiveness of “project procurement management” has a direct and positive effect on project management performance.

PMBOK Guide indicates that project stakeholder management is strongly linked to project management performance. In this issue, Atkinson (1999) implied that benefits to stakeholders are among the most important success criteria. Lim and Mohamed

(1999) also indicated that stakeholder satisfaction is one of the key components of project success. Moreover, Kagioglu *et al.*, (2001) emphasized that stakeholder satisfaction is directly associated with the performance management in construction. Takim and Akintoye (2002) also listed stakeholder attributes among the success factors for measuring performance. Rad (2003) also indicated stakeholder satisfaction as one of the project success attributes. Bassioni *et al.*, (2004) stated that stakeholder satisfaction is one of the measuring components of performance in construction. Freeman *et al.*, (2010) state that project stakeholder management has a direct influence on project success. Based on the provided information above, following hypothesis has been developed.

- H10: Effectiveness of "project stakeholder management" has a direct and positive effect on project management performance.

Construction Extension to A Guide to the PMBOK Guide of PMI (2005) indicates that project safety management is among the most important attributes of project management performance. In this issue, Cheng *et al.*, (2012) clearly stated that successful safety management practices have a positive contribution to improved project performance. Based on the on information provided, following hypothesis was developed.

- H11: Effectiveness of "project safety management" has a direct and positive effect on project management performance.

Construction Extension to A Guide to the PMBOK Guide of PMI (2005) indicates that project environmental management is among the most important attributes of project management performance. In addition, Montabon *et al.*, (2007) study also indicated that there is a strong link between the effectiveness of project environmental management and business performance. Based on the provided information above, following hypothesis was developed.

- H12: Effectiveness of "project environmental management" has a direct and positive effect on project management performance.

Construction Extension to A Guide to the PMBOK Guide of PMI (2005) indicates that project financial management is among the most important attributes of project management performance. As evidenced by Akanni *et al.*, (2015) study, financial attributes are highly effective on project performance. Based on the information provided above, following hypothesis was developed.

- H13: Effectiveness of "project financial management" has a direct and positive effect on project management performance.

Construction Extension to A Guide to the PMBOK of PMI (2005) indicates that project claim management is among the most important attributes of project management performance. According to the study conducted by Vidogah and Ndekugri (1997) effectiveness of claim management is essential in terms of successful completion of project, which in turn leads to enhanced project performance. Jastaniah (1997) also indicated that successful handling of claims is one of the most important components of enhanced performance. Based on the provided information, following hypothesis was developed.

- H14: Effectiveness of "project claim management" has a direct and positive effect on project management performance.

3.5.2. Hypotheses among the Determinants of Project Management Performance

Project integration management is strongly related to the project scope management in that high level of integration leads to successful planning of scope management (PMI, 2013). In this issue, Crawford (2005) states that program or project director, who use high level of integration and scope practices are more likely to be top performers. Huang and Newell (2003) also indicated that knowledge integration is determined by three important components namely the efficiency of integration, scope of integration, and the flexibility of integration. This is important to reflect how scope and integration are strongly related to each other. Based on this information, following hypothesis has been developed.

- H15: The level of "project integration management" has a direct and positive effect on "project scope management".

Project scope management simply consists of the collecting requirement, defining scope, and creating work breakdown structure (PMI, 2013). Therefore, timely handling of those tasks is important in the successful management of projects. Chou *et al.*, (2013) indicated that project scope management has a positive relation with the project time management. Koskela and Howell (2002) revealed that project-planning processes consist of the outputs of scope, time, and cost management, which are the strongly connected processes. Based on the information provided, following hypothesis has been developed.

- H16: Effectiveness of "project scope management" has a direct and positive effect on "project time management".

PMBOK Guide enlightens that project scope management is associated with project procurement management (PMI, 2013). Chou *et al.*, (2013) study also revealed that there is a positive association between project scope and procurement management. Based on this information provided, following hypothesis has been developed.

- H17: Effectiveness of "project scope management" has a direct positive effect on "project procurement management".

PMBOK Guide also underlines that project scope management is a knowledge area, which is strongly linked to the processes involved in project risk management (PMI, 2013). The study conducted by Chou *et al.*, (2013) also stated that project scope management has a direct positive relation with the project cost management. Based on this information, following hypothesis has been developed. Arditi and Gunaydin (1997) also revealed that the clarity of scope is one of the most important elements of total quality management. Based on the provided information, following hypothesis was developed.

- H18: Effectiveness of “project scope management” has a direct positive effect on “project risk management”.

Khan (2006) indicated that effective scope management ensures the successful management of project quality management, which evidences that project scope management is strongly linked to the project quality management area. In addition, project scope management is strongly associated with project quality management as evidenced by the study of Chou *et al.*, (2013). PMBOK Guide indicates that project scope planning is linked to the project quality management processes. Based on the information provided, following hypothesis has been developed.

- H19: Effectiveness of “project scope management” has a direct positive effect on “project quality management”

Early completion of projects is essential in project management research (Liberatore and Pollack-Jonhson, 2006). Therefore, successful time management is important in the early completion. However, early completion might bring additional costs. Thus, time-cost trade off problems becomes a challenge for a successful project management since crashing an activity ensures time saving but increases the cost (Babu and Suresh, 1996). This brings the need for efficient time management in the successful completion of projects without having additional costs. Based on this information, following hypothesis has been developed.

- H20: Effectiveness of “project time management” has a direct positive effect on “project cost management”.

Construction Extension to A Guide to the PMBOK of PMI (2005) indicates that schedule analysis is very important in terms of dealing with claims. It is indicated that schedule analysis is essential in comparing as planned and as-built schedule for supporting the validity of time extension for claims. Based on this information, following hypothesis has been developed.

- H21: Effectiveness of "project time management" has a direct positive effect on "project claim management".

Bowen *et al.*, (2012) stated that time; cost and quality are the key components for conducting a successful project. Alshawi and Ingirige (2003) indicated that clients are in greater demand of quality at the lowest price in the projects. Therefore, cost, quality, and schedule objectives should be achieved for successful project management. It is therefore clear that efficient time management brings the high quality at the lowest price. Based on this information provided, following hypothesis has been developed.

- H22: Effectiveness of "project cost management" has a direct positive effect on "project quality management".

Delivering projects successfully depends on time, cost, and quality criteria. Therefore, meeting quality requirement has a strong effect on the successful execution of projects. Chou *et al.*, (2013) indicated that project quality management is strongly associated with project procurement management in that quality is a strong indicator of project success. Based on the information provided, following hypothesis was developed.

- H23: Effectiveness of "project quality management" has a direct positive effect on "project procurement management".

The relation between project human resource management and project safety management was clearly emphasized in Lai *et al.*, (2011) study. According to this research, it is indicated that human resources practices are strongly related to the effective safety management when the workers are provided with feedback about the unsafe behavior or when the age criteria taken into consideration in the selection process. Based on this information given, following hypothesis was developed.

- H24: Effectiveness of "project human resource management" has a direct positive effect on "project safety management".

Human resource management is one of the fundamental elements of project success (Belout, 1998). Several research studies also indicated that effective human resource management facilitates the successful execution of projects (Belout, 1998; Cooke-Davies, 2002; Belout and Gauvreau, 2004). Since recruiting costs, cost of human capital, and training costs of employees are strongly linked to the cost management processes, there is a considerable association between project human resource and cost management. Based on this information, following hypothesis was developed.

- H25: Effectiveness of "project human resource management" has a direct positive effect on "project cost management".

Project communications management in essential in terms of coordinating all project parties. It is also indicated that stakeholder engagement in the project is essential in terms of preventing conflicts. According to Pinto and Slevin (1987) communication with client and all stakeholders is one of the most important project success factors. Yang *et al.*, (2010) also indicated that prompt communication is strongly associated with the successful stakeholder management. Based on the information provided, following hypothesis has been developed.

- H26: Effectiveness of "project communications management" has a direct positive effect on "project stakeholder management".

Environmental impacts might have harmful consequences (Moore *et al.*, 2004). Therefore, effective management of environmental risks is essential. Construction is a risky business mainly due to the lack of environmental information about the construction site and lack of overseas experience. Therefore, effective management of environmental impacts, which are also so called as environmental risks, is essential for successful execution of projects (Zhi, 1995). Al-Bahar and Crandall (1990) also indicated that environmental risks are among the risk categories for the construction projects. This proves that effective risk management strategies lead to successful environmental management. Based on this information, following hypothesis has been developed.

- H27: Effectiveness of "project risk management" has a direct positive effect on "project environmental management".

Effective management of project risk management processes leads to the successful schemes in project risk management. Froot and Stein (1998) indicated that financial institutions face several risks such as currency risk, which is highly associated with financial management of the company. In this issue, Miller and Lessard (2001) stated that prior risk management constitutes the basis for the market for financial inputs. Project financial management is very important in terms of effectively managing projects. Therefore, careful consideration of financial measures and evaluation of alternatives are critical for the projects to reach the project objectives. Espinoza (2014) indicated that financial performance ratio has a positive linear relationship with the risk performance ratio. Based on the information provided, following hypothesis was developed.

- H28: Effectiveness of "project risk management" has a direct positive effect on "project financial management.

Environmental problems are usually complex in nature. Therefore, effective management of those requires the active participation of stakeholders in the decision-making processes. In Reed's (2008) study, it is indicated that stakeholder participation should be institutionalized in terms having a more comprehensive and systematic approach for the solution to the technical and environmental problems. Based on this information, following hypothesis has been developed.

- H29: Effectiveness of "project environmental management" has a direct positive effect on "project stakeholder management".

Project financial management requires sound decisions in terms of managing a company's revenue and financial resources. Therefore, financial planning, cash flow analysis and monitoring, currency risk in the investments need special care for the success of project financial management. In this issue, Yosha (1995) indicated that disclosure costs are important in the choice of financial resources. This proves the strong link between project financial and cost management. Based on the information provided, following hypothesis was developed.

- H30: Effectiveness of "project financial management" has a direct positive effect on "project cost management".

3.5.3. Hypotheses of the Research

Below is the total of 30 hypotheses developed in this research:

- H1: Effectiveness of "project integration management" has a direct positive effect on project management performance.
- H2: Effectiveness of "project scope management" has a direct positive effect on project management performance.
- H3: Effectiveness of "project time management" has a direct positive effect on project management performance.
- H4: Effectiveness of "project cost management" has a direct positive effect on project management performance.
- H5: Effectiveness of "project quality management" has a direct positive effect on project management performance.
- H6: Effectiveness of "project human resource management" has a direct positive effect on project management performance.
- H7: Effectiveness of "project communications management" has a direct positive effect on project management performance.
- H8: Effectiveness of "project risk management" has a direct positive effect on project management performance.
- H9: Effectiveness of "project procurement management" has a direct positive

effect on project management performance.

- H10: Effectiveness of “project stakeholder management” has a direct positive effect on project management performance.
- H11: Effectiveness of “project safety management” has a direct positive effect on project management performance.
- H12: Effectiveness of “project environmental management” has a direct positive effect on project management performance.
- H13: Effectiveness of “project financial management” has a direct positive effect on project management performance.
- H14: Effectiveness of “project claim management” has a direct positive effect on project management performance.
- H15: The level of “project integration management” has a direct positive effect on “project scope management”.
- H16: Effectiveness of “project scope management” has a direct positive effect on “project time management”.
- H17: Effectiveness of “project scope management” has a direct positive effect on “project procurement management”.
- H18: Effectiveness of “project scope management” has a direct positive effect on “”project risk management”.
- H19: Effectiveness of “project scope management” has a direct positive effect on “project quality management”.
- H20: Effectiveness of “project time management” has a direct positive effect on “project cost management”.
- H21: Effectiveness of “project time management” has a direct positive effect on “project claim management”.
- H22: Effectiveness of “project cost management” has a direct positive effect on “project quality management”.
- H23: Effectiveness of “project quality management” has a direct positive effect on “project procurement management”.
- H24: Effectiveness of “project human resource management” has a direct positive effect on “project safety management”.
- H25: Effectiveness of “project human resource management” has a direct positive

effect on “project cost management”.

- H26: Effectiveness of “project communications management” has a direct positive effect on “project stakeholder management”.
- H27: Effectiveness of “project risk management” has a direct positive effect on “project environmental management”.
- H28: Effectiveness of “project risk management” has a direct positive effect on “project financial management”.
- H29: Effectiveness of “project environmental management” has a direct positive effect on “project stakeholder management”.
- H30: Effectiveness of “project financial management” has a direct positive effect on “project cost management”.

Figure 3.1 presents the proposed model along with the hypotheses.

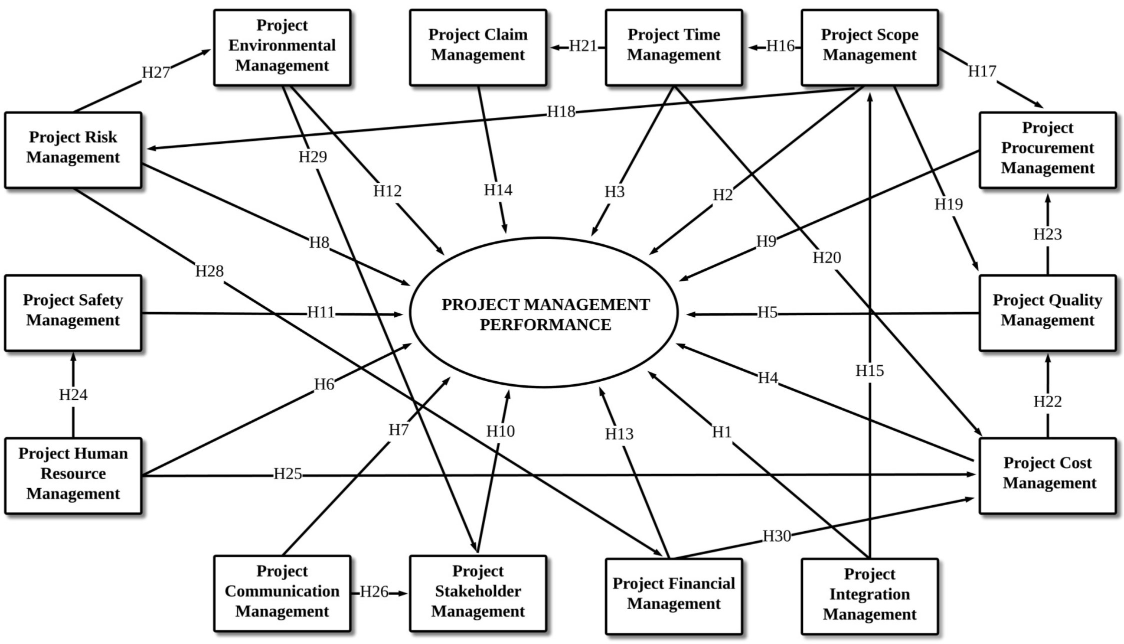

Figure 3.1. Hypothesized Relationships.

4. ANALYSIS OF THE PROJECT MANAGEMENT PERFORMANCE MODEL

This chapter presents the statistical analysis of the collected data. The target population chosen for the data collection comprises the members of members of Turkish Contractors Association (TCA), Association of Turkish Consulting Engineers and Architects (ATCEA), The Turkish Employers' Association of Construction Industries (TEACI), and Architectural Archive of Turkey (ARKIV). A total of 121 questionnaires were returned out of 508 sent out, which resulted in a 24% response rate. The respondents were asked to fill in the questionnaires based on the project management performance of their completed projects. In the first section of this chapter, statistical findings are summarized and descriptive statistics are presented (Descriptive statistics including sums, averages, standard deviations etc. can be found in Appendix A). Moreover, studies adopting SEM are also mentioned along with the model that is analyzed with SEM.

4.1. Descriptive Statistics

The data analysis starts with the detailed presentation of descriptive statistics to reveal the general characteristics of the responding companies. Therefore, following information is herein given to discuss descriptive statistics related to the characteristics of the respondent companies and the projects.

4.1.1. General Information about the Respondent Companies

Demographic information regarding the respondent companies presents herein the general profile of companies that took part in the questionnaire survey. Below figures presents important information about the profile of respondents and characteristics of the projects.

Figure 4.1 shows the distribution of companies in terms of their business area. A total of 121 questionnaires were collected from 82 firms. According to this figure, majority of the respondents involves contractors (64%), while small portion consists of structural designers (16%) and architectural designers (7%); subcontractors (6%), owners (5%) and others project executors (2%).

- Type of Business Area

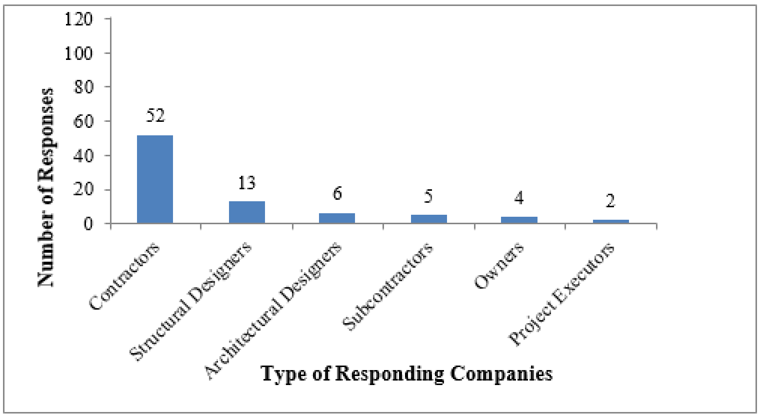

Figure 4.1. Distribution of Companies in terms of Their Business Area.

Figure 4.2 shows the distribution of firms' age. According to this figure, it is seen that majority of the responding firms have 50 years or more of experience in the construction industry. The average firm age was found to be 33 years where the maximum age is 70 years and minimum to be 2.

- Number of years of operation in construction sector

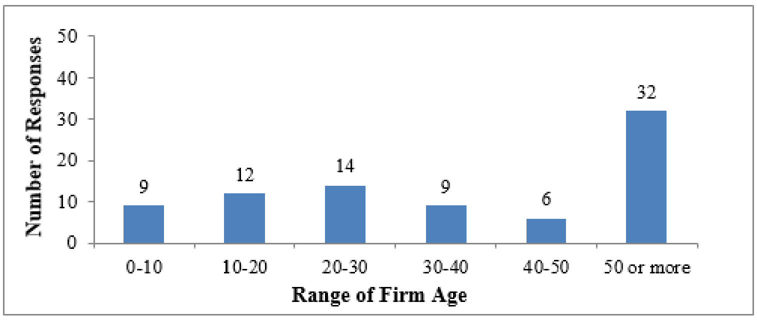

Figure 4.2. Distribution of Firms in terms of Their Ages.

Figure 4.3 indicates the distribution of average firm ages depending on the type of respondent. According to this figure, it is shown that average firm age of contractors is 46 where structural and architectural designers are 22 and 21, respectively. It is also provided that subcontractors have an average firm age of 29 where owners and project executors are 38 and 41, which shows a similar trend with contractors.

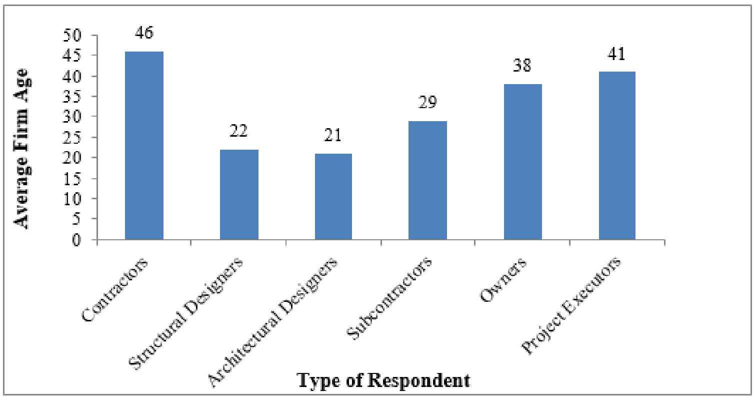

Figure 4.3. Distribution of Average Firm Ages according to the Respondent Type.

- Total turnover

The average turnover of the respondent companies is 612 Million USD and the maximum value for turnover is 6.5 billion USD. Figure 4.4 shows the range of turnover of respondent companies. According to this figure, it is seen that majority of the responding firms are in the 600-800 and 800-1000 million USD range.

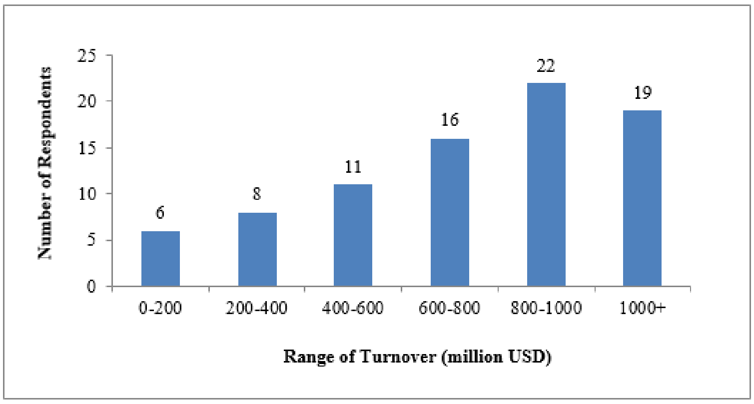

Figure 4.4. Distribution of Firms in terms of Total Turnover.

Figure 4.5 shows distribution firms in terms of total turnover according to their types. It is seen that contractors are the dominators in terms of achieving the total turnover.

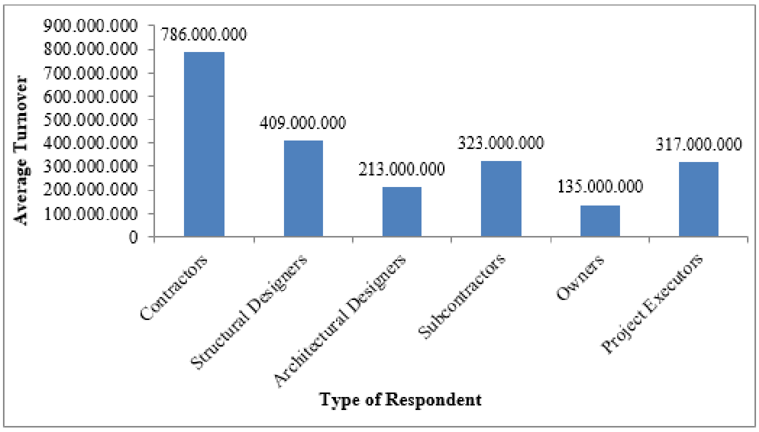

Figure 4.5. Distribution of Type of Respondent Firm in terms of Total Turnover.

4.1.2. General Information about the Projects

The figures below present various information about the projects of the responding firms.

- Type of Project

Figure 4.6 presents the distribution of projects according to the project type. It is seen that most of the projects are building projects where minority involves transportation, industrial, water structures, infrastructure, and other projects respectively.

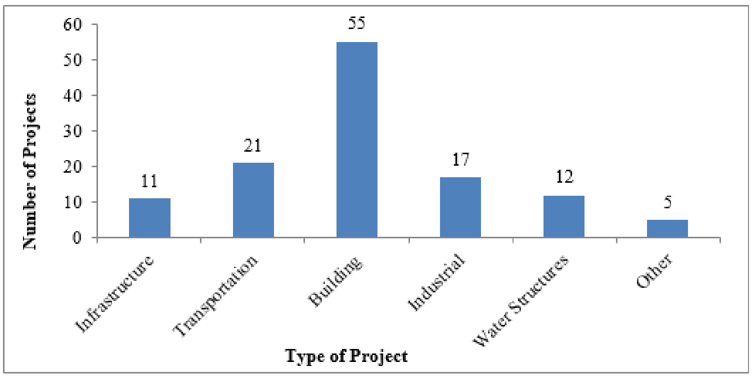

Figure 4.6. Distribution of Projects in terms of Project Type.

- Project Ownership

Figure 4.7 presents the distribution of the projects according to the project ownership. It is indicated that most of the firms executed their projects by the sole ownership.

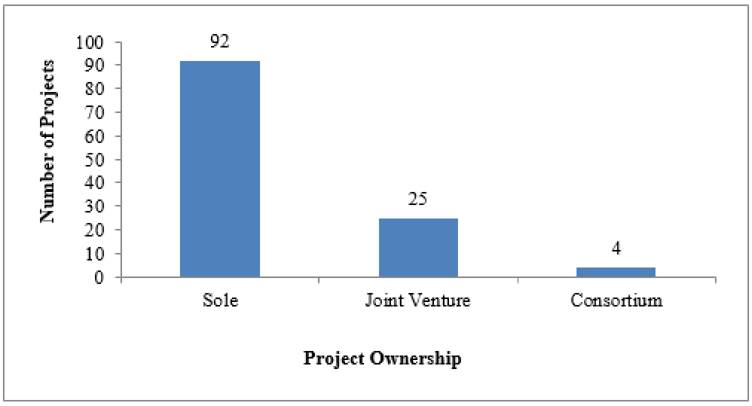

Figure 4.7. Distribution of Projects in terms of Project Ownership.

- Role in the Project

Figure 4.8 presents the role of the responding firms in the projects. According to this figure, it is reported that most of the firms were involved in the projects as contractor.

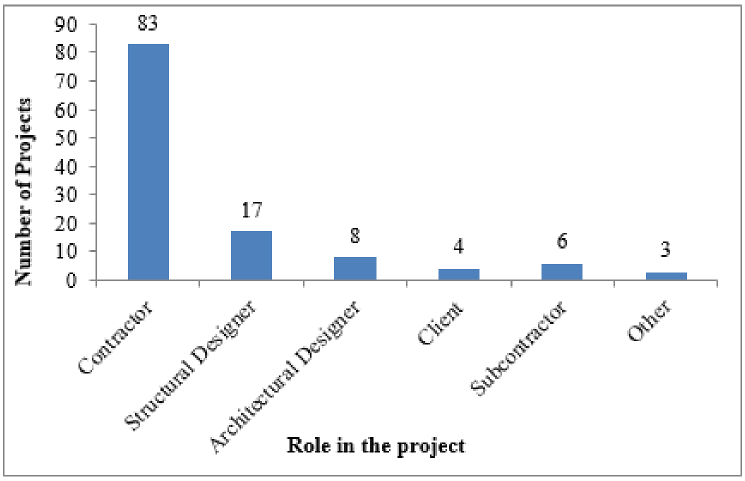

Figure 4.8. Distribution of the Projects in terms of Role of Firms in the Project.

- Project Completion Time

Figure 4.9 presents the project completion time according to the type of respondent. According to this figure, it is reported that the longest project duration belongs to contractors and subcontractors with the completion time of 3.5 and 3.3 years, respectively. Next longest project completion time belongs to project executors, structural designers, architectural designers, and owners respectively.

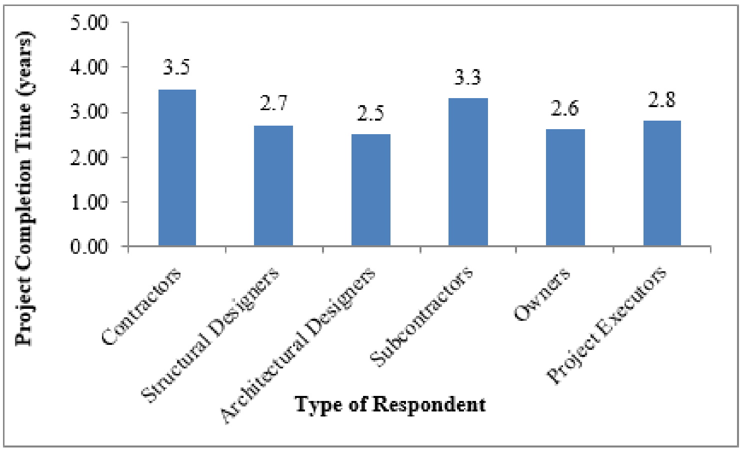

Figure 4.9. Project Completion Time in terms of Respondent Type.

- Contract Duration for Projects

Figure 4.10 presents the average contract duration for the completed projects based on type of respondents. According to this figure, it is seen that subcontractors have the longest contract duration for execution of projects with a 3.2 years of contract. Following subcontractors, contractors (2.6 years), project executors (2.5 years), owners (2.2 years), structural designers (1.6 years), and architectural designers (1.8 years) have the longest contract durations respectively. Moreover, it is also seen that there are slight deviations between actual project completion time and contract duration for projects. This indicates that some of the projects were completed with delays in project schedule.

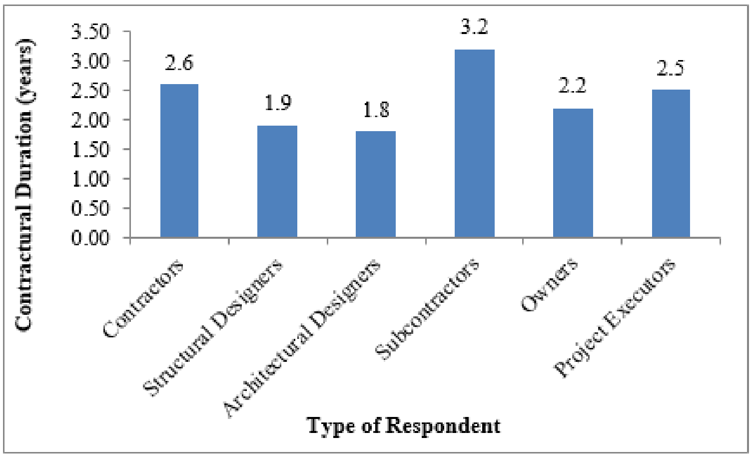

Figure 4.10. Average Contract Duration of Projects in terms of Respondent Type.

- Contractual Budget

Figure 4.11 indicates the contractual budget vs. number of projects. According to this figure, it might be seen that majority of the projects (37) have the average contractual budget (between 400-600 million USD). Moreover, a considerable portion of the projects was executed with a contractual budget ranging between 200-400 million USD and 600-800 million USD. A minority of projects was executed ranging between 800-1000 and over 1000 million USD. Finally, 13 projects were reported that they were executed s with a contractual budget ranging between 0-200 million USD. This proves that respondents who took part in the online questionnaire are large-scale firms, which executed several high budgeted projects.

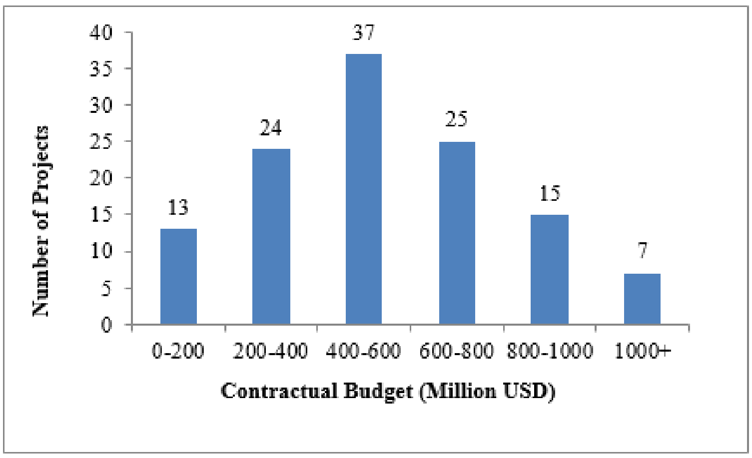

Figure 4.11. Number of Projects in terms of Contractual Budget.

- Contract Type

Figure 4.12 presents the contract type according to the number of projects. According to this figure, it is seen that majority of the projects were executed with unit price contracts. 27 projects were executed with turnkey contract type where 16 projects were with lump sum. Finally, 6 of the projects were executed with cost-plus fee type contract where 2 were delivered with build-operate-transfer type of contract.

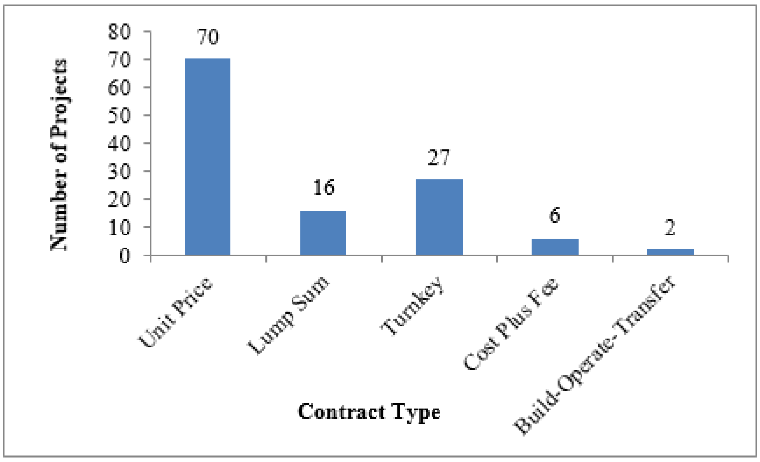

Figure 4.12. Contract Type according to the Number of Projects.

4.1.3. Distribution of Rating Levels of Performance Model Components

The components of performance model are investigated through the ratings of respondent companies. Below figures present the average ratings for each component developed under each knowledge area and project management performance. The figures report that all components are evaluated to be valid and comprehensive based on the perceptions of respondent companies considering the high ratings. This proves that the study has reached its target population and revealed the need for a more comprehensive and generic approach to evaluate project management performance model by the construction specific components, which help companies with measuring and improving their project management performance.

4.1.3.1. Project Integration Management. Table 4.1 presents the abbreviations for the components of project integration management.

Table 4.1. Components of Integration Management.

Abbreviation	Component
I1	Development of Project Charter
I2	Knowledge Integration
I3	Process Integration
I4	Staff Integration
I5	Supply Chain Integration
I6	Integration of Changes

Figure 4.13 shows the distribution of components of project integration management. According to this figure, it can be seen that all components are rated around 3.5, which proves the reliability of the components in terms of explaining its construct. Among those, majority of the responding firms indicated that they perform very well in "staff integration" in their projects. Enberg (2012) implied the critical role of "staff integration" for project success. Secondly, firms reported that they successfully handle with the "integration of changes" to perform well in project integration management. In this respect, Hornstein (2015) emphasized that dealing with integration of changes in a successful manner is essential for a successful project management scheme. The high ratings for "supply chain integration", "knowledge integration", "process integration" and "development of project charter" prove that firms perform well in the achievement of those components for the project success. Previous studies also reported that high performance in the realization of integration management functions such as process integration, knowledge integration, and supply chain integration are keys to achieve project success (Ernst *et al.*, 2010; Heising, 2012; Kleinschmidt *et al.*, 2007).

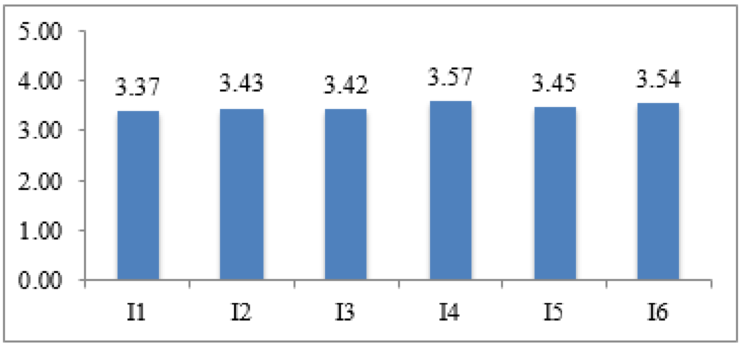

Figure 4.13. Distribution of Components of Project Integration Management.

4.1.3.2. Project Scope Management. Table 4.2 presents the abbreviations for the components of project scope management.

Table 4.2. Components of Project Scope Management.

Abbreviation	Component
S1	Scope Planning
S2	Scope Definition
S3	Scope Changes

Figure 4.1 presents the distribution of components of project scope management. According to this figure, firms reported that they cope with "scope changes" in a successful manner so that they ensure the higher performance in scope management. Previous studies underlined that dealing with scope changes in an effective manner leads to project success (Ibbs and Nguyen, 2007; Abrantes and Figueiredo, 2014). Firms also responded that they perform well in "scope definition" and "scope planning". Research studies also indicated the level of success of those components leads to successfully executed projects (Song and Abourizk, 2005; Qureshi *et al.*, 2009).

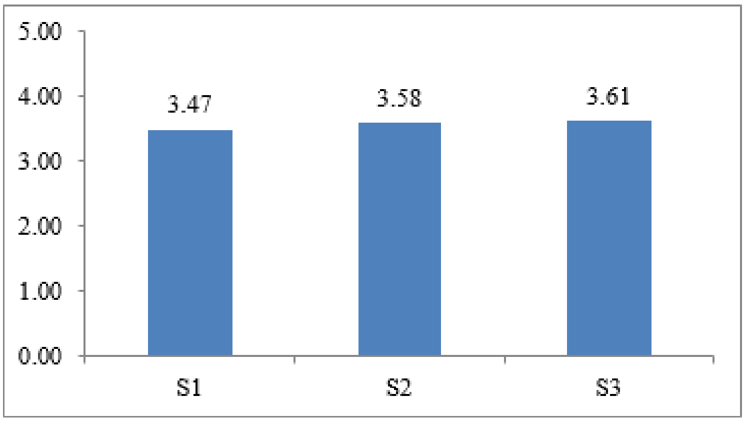

Figure 4.14. Distribution of Components of Project Scope Management.

4.1.3.3. Project Time Management. Table 4.3 presents the abbreviations for the components of project time management.

Table 4.3. Components of Project Time Management.

Abbreviation	Component
T1	Activity Definition
T2	Activity Sequencing
T3	Time Estimation
T4	Development of Project Schedule
T5	Schedule Monitoring, Control and Revision

Figure 4.15 presents the distribution of components of project time management. According to this figure, it is indicated that firms perform well in the "development of project schedule" in their projects. Indeed, project time management starts with developing a project schedule, which shows the progress of the project. The critical role of project schedule in achieving higher performance in time management practices was highlighted in most of the research studies (Moosavi and Moselhi, 2014; Berssaneti and Carvalho, 2015). Firms reported that they are good at "activity definition" in realizing time management in their projects. They also indicated that they perform well in "time estimation" and "schedule monitoring, control and revision". Previous studies implied the addressing those components to achieve higher success in the projects is essential

(Guerrero *et al.*, 2014; Berssaneti and Carvalho, 2015). Finally, firms rated "activity sequencing" as one the most successfully addressed components of time management for which it was demonstrated essential role of this component in obtaining higher performance in the projects (Liberatore and Pollack-Johnson, 2006).

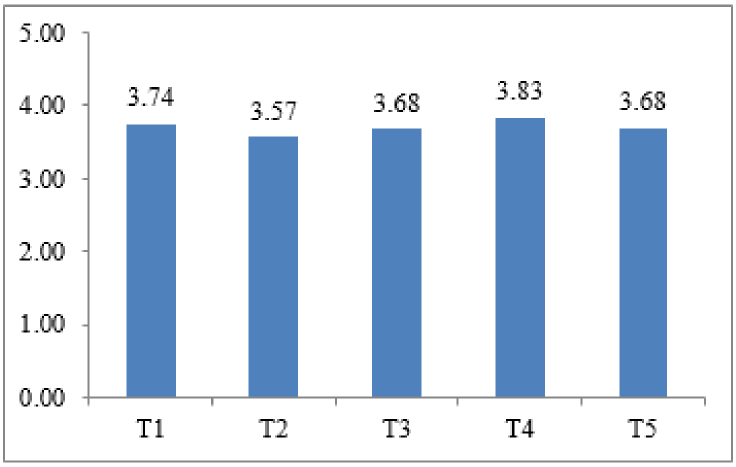

Figure 4.15. Distribution of Components of Project Time Management.

4.1.3.4. Project Cost Management. Table 4.4 presents the abbreviations for the components of project cost management.

Table 4.4. Components of Project Cost Management.

Abbreviation	Component
C1	Cost Estimation
C2	Determination of Budget
C3	Cost Control

Figure 4.16 presents the distribution of components of project cost management. According to this figure, firms responded that they are mostly good at "determination of budget", which is among the most critical components of project cost management. Previous studies also proved that budget determination is one of the most important steps of cost management to achieve higher success rate (Kim *et al.*, 2012; Xu *et al.*, 2012). Firms responded that they are successful in achieving "cost control" and "cost

estimation" practices. Indeed, majority of the research underlined the importance of performing well in those components to experience enhanced performance in the projects (Xu *et al.*, 2012; Yildiz *et al.*, 2014; Khodakarami and Abdi, 2014).

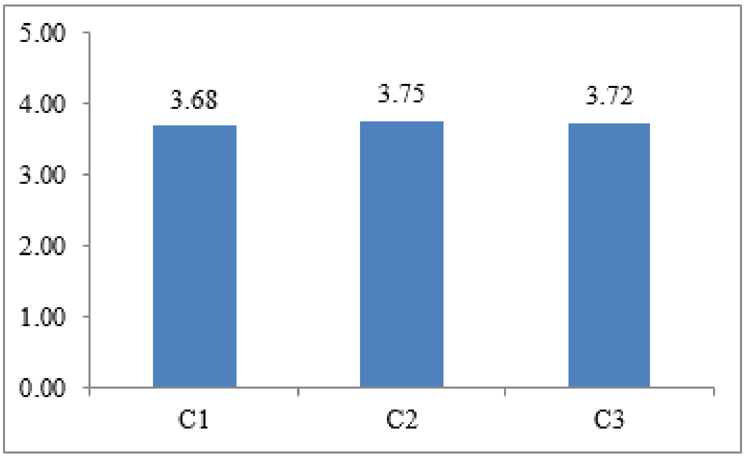

Figure 4.16. Distribution of Components of Project Cost Management.

4.1.3.5. Project Quality Management. Table 4.5 presents the abbreviations for the components of project quality management.

Table 4.5. Components of Project Quality Management.

Abbreviation	Component
Q1	Quality Definition
Q2	Quality Standardization
Q3	Quality Assurance and Control

Figure 4.17 shows the components of project quality management. According to this figure, it might be seen that "quality standardization" and "quality assurance and control" were rated as the most successfully realized components of project quality management. The necessity for careful consideration of those components to experience higher success rates was previously underlined in several studies (Jabbour *et al.*, 2014; Wanberg *et al.*, 2013; Flyvbjerg, 2014). Firms responded that they perform well in "quality definition" in their projects as evidenced by Wanberg *et al.*, (2013) study indicating that quality should be defined clearly in order to have improved performance.

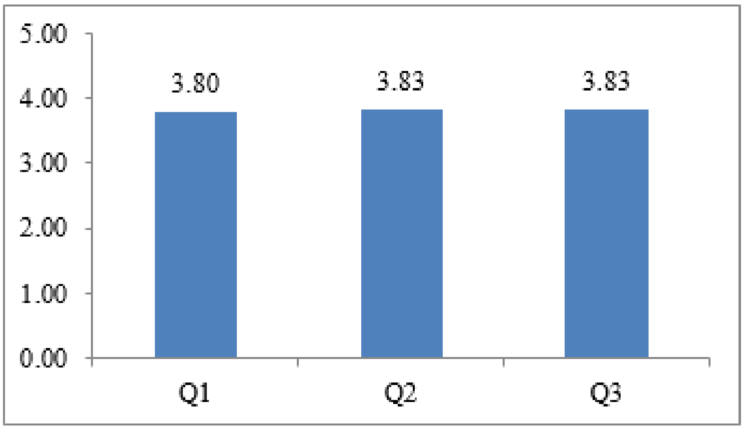

Figure 4.17. Distribution of Components of Project Quality Management.

4.1.3.6. Project Human Resource Management. Table 4.6 presents the components of human resource management.

Table 4.6. Components of Project Human Resource Management.

Abbreviation	Component
H1	Project Team Composition
H2	Workforce Planning
H3	Staff Training
H4	Performance Development
H5	Performance Evaluation

Figure 4.18 demonstrates the distribution of the components of project quality management. According to this figure, it is reported that “project team composition” has the highest ranking. Indeed, well-set project team plays a critical role in the fast progress of the projects as indicated in several research studies (Buller and McEvoy, 2012; Khan and Rasheed, 2014). Firms reported that they are good at “workforce planning”, which is among the essential components of project human resource management. Since projects are successfully executed with the planned resources and work force, the efficient handling of those has a critical impact on the project management performance as previously stated in majority of the research studies (Tabassi and Bakar,

2009; Zwikael and Aviram, 2010). "Performance evaluation" was also rated as another important component, which is frequently conducted by responding firms. Furthermore, firms reported that they extensively conduct "staff training" and "performance development" to perform well in human resource management. The frequency of staff training and performance development for the project success was previously shown in past studies (Huselid *et al.*, 1997; Minbaeva, 2005; Birasnav, 2014).

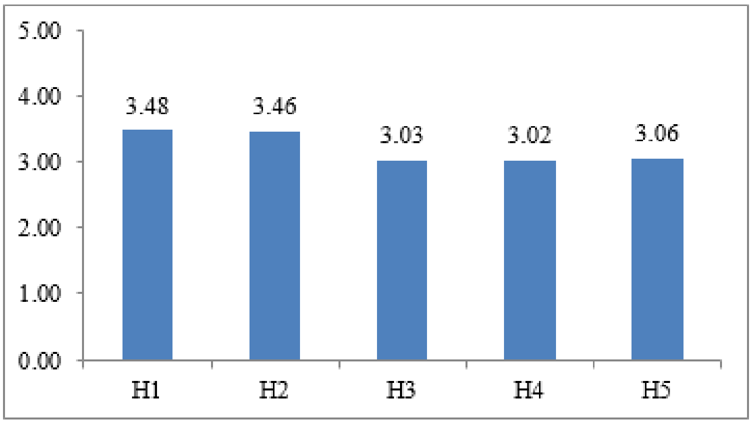

Figure 4.18. Distribution of Components of Human Resource Management.

4.1.3.7. Project Communications Management. Table 4.7 presents the components of project communications management.

Table 4.7. Components of Project Communications Management.

Abbreviation	Component
C1	Communication Strategies
C2	Communication Technology
C3	Coordination and Collaboration
C4	Knowledge Sharing
C5	Multi-Cultural Communication

Figure 4.19 presents the distribution of components of project communications management. According to this figure, it is seen that firms perform well in "coordination and collaboration" in the context of communications management in their projects.

As previously underlined in most the studies (Senescu *et al.*, 2013; Zhang and Ng, 2013; Arriagada and Alarcon, 2014), construction firms, which implement better coordination and collaboration practices are more likely to achieve higher success. Similarly, firms responded that they achieve "knowledge sharing" up to a great extent in their projects. Arriagada and Alarcon (2014) also mentioned that projects are executed with enhanced communication when knowledge sharing is performed in a successful manner. Firms stated that they extensively benefit from the "communication technology", which enables easy knowledge transfer and information sharing. Firms indicated that they mostly set up "communication strategies" and care about "multi-cultural communication" in performing better in communications management. Majority of the past studies underlined the importance of setting communication strategies and enhancing multi-cultural communication for the success of projects (Pheng and Leong, 2000; Ochieng and Price, 2010; Meng, 2012; Badir *et al.*, 2012).

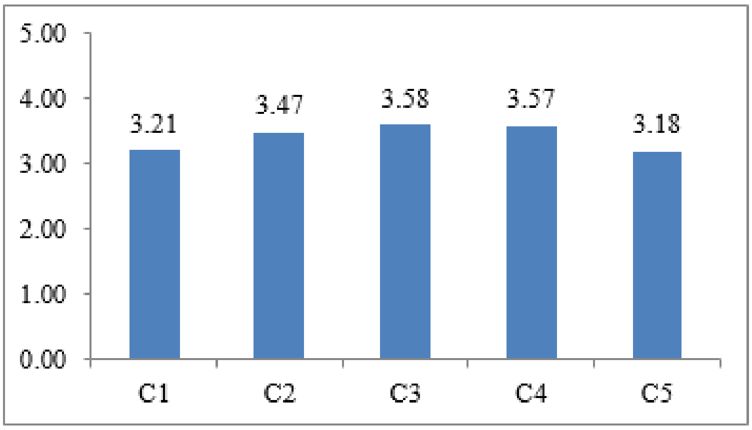

Figure 4.19. Distribution of Components of Project Communications Management.

4.1.3.8. Project Risk Management. Table 4.8 presents the components of project risk management.

Table 4.8. Abbreviations for Components of Project Risk Management.

Abbreviation	Component
R1	Risk Identification
R2	Risk Analysis
R3	Risk Allocation
R4	Risk Control

Figure 4.2 shows the distribution for the components of project risk management. Firms reported that they perform well in "risk identification" more than the other components of risk management. Several studies emphasized that accurate identification of risks is critical for achieving higher success in projects (Hoffmann *et al.*, 2013; Hwang *et al.*, 2014; Oehmen *et al.*, 2014; Sousa *et al.*, 2014). Secondly, firms indicated that they are good at "risk analysis", which is another essential component of risk management. It is implied that a successful risk analysis leads to improved performance and risk management practices (Teller and Kock, 2013). Finally, firms reported that they successfully cope with "risk control" and "risk allocation" components in their projects. Past studies mentioned that risk management practices are effectively conducted through the careful consideration of risk control and allocation (Sousa *et al.*, 2014; Yildiz *et al.*, 2014).

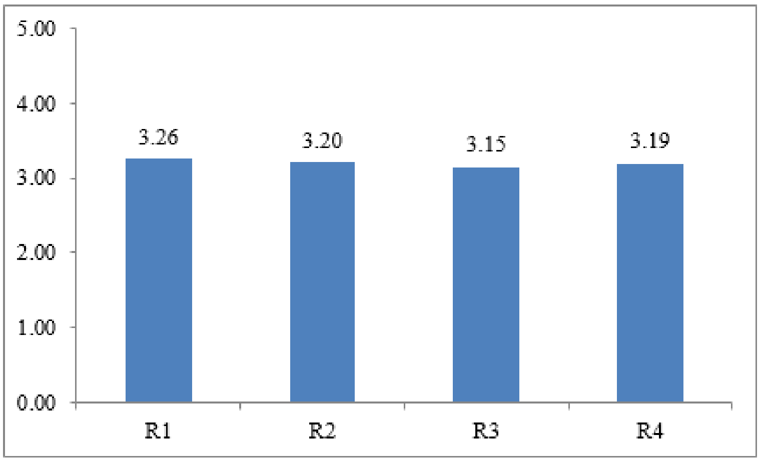

Figure 4.20. Distribution of Components of Project Risk Management.

<u>4.1.3.9. Project Procurement Management.</u> Table 4.9 presents the components of project procurement management.

Table 4.9. Abbreviations for Components of Project Procurement Management.

Abbreviation	Component
P1	Supplier Selection
P2	Type of Contract
P3	Supply of Resources
P4	Risk Management in the Supply Process

Figure 4.21 indicates the distribution of the components of project procurement management. According to this figure, it is seen that firms are successful in selecting the right "type of contract" with the procurers. The importance of selecting the accurate type of contract for the success of procurement management was previously stated in several studies (Meng *et al.*, 2011; Ruparathna and Hewage, 2014). Responding firms reported that they are quite good at "supplier selection", which is one of the critical components of procurement management. In this respect, it was shown that selecting the right supplier strongly contributes to the success of procurement management (Ruparathna and Hewage, 2014). The high ratings for "supply of resources" and "risk management in the supply process" reflect that firms are successful in timely supply of resources and managing risks in the supply process. Past studies prove that supplying resources in a timely manner and managing risks in the procurement process have a strong contribution to the success of procurement practices (Chopra and Sodhi, 2004; Meng *et al.*, 2011).

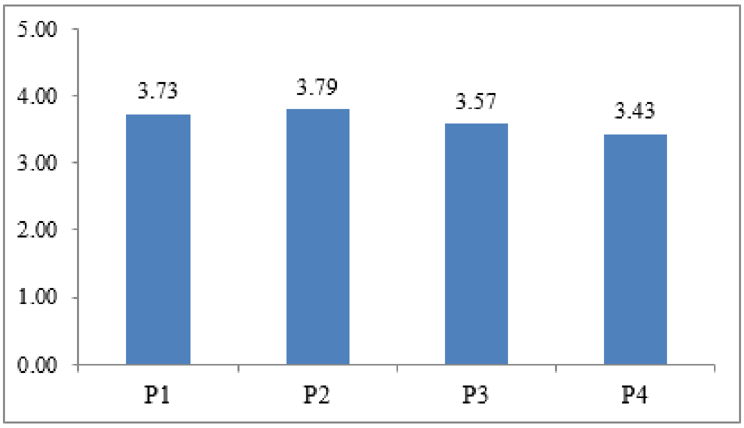

Figure 4.21. Distribution of Components of Project Procurement Management.

<u>4.1.3.10. Project Stakeholder Management.</u> Table 4.10 presents the components of project stakeholder management.

Table 4.10. Components of Project Stakeholder Management.

Abbreviation	Component
S1	Identification of Stakeholders
S2	Stakeholder Needs, Interests, and Influences
S3	Stakeholder Engagement
S4	Stakeholder Conflicts

Figure 4.22 presents the distribution for the components of project stakeholder management. Firms reported that they deal with "stakeholder engagement" well in their projects as evidenced by several studies highlighting the strong effect of stakeholder engagement in the project success (Missonier and Loufrani-Fedida, 2014; Mok *et al.*, 2015). "Stakeholder needs, interests, and influences" was rated high by the respondents proving their expertise in addressing stakeholder inquiries. Mok *et al.*, (2015) underlined the necessity for the determination of stakeholder needs and interests for achieving success in stakeholder management. Moreover, accurate "identification of stakeholders" and successful handling of "stakeholder conflicts" were reported as essential for achieving improved performance in stakeholder management as previously evidenced by several research studies (Yang *et al.*, 2011; Missonier and Loufrani-Fedida, 2014).

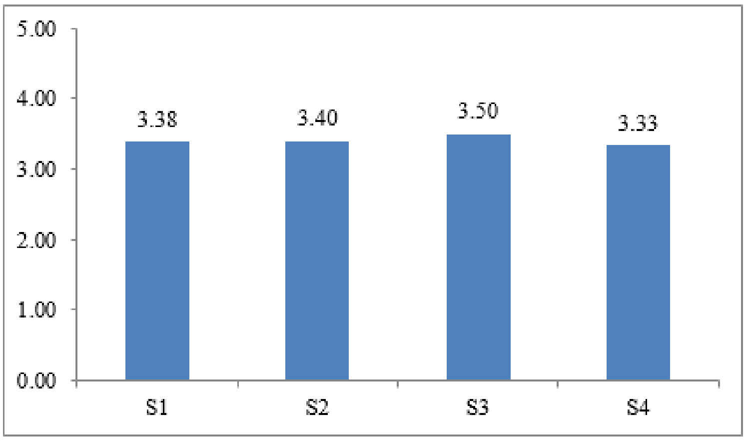

Figure 4.22. Distribution of Components of Project Stakeholder Management.

4.1.3.11. Project Safety Management. Table 4.11 presents the components of project safety management.

Table 4.11. Components of Project Safety Management.

Abbreviation	Component
S1	Safety Awareness and Culture
S2	Safety Planning
S3	Safety Training
S4	Safety Implementation
S5	Safety Inspection and Monitoring

Figure 4.23 indicates the distribution of components of project safety management. According to this figure, it is seen that firms are good at "safety implementation", which is one of the most essential components of safety management. Studies prove that success in implementing safety leads to a more effective safety management system (Sousa *et al.*, 2014; Choudhry, 2014; Tappura *et al.*, 2015). Similarly, firms reported that they perform well in "safety inspection and monitoring". In this respect, Hsu *et al.*, (2012) revealed that safety inspection and monitoring is crucial for a successful safety management scheme. Firms responded that they are successful in "safety planning" in their projects. Research studies revealed that an efficient safety plan results in improved performance (Molenaar *et al.*, 2009; Cheng *et al.*, 2012). It is seen that firms are sensitive about "safety awareness and culture" and they mostly consider safety awareness as one of the most critical elements of project success. As evidenced by Demirkesen and Arditi (2015), enhancing a safe aware culture among workers is very important in terms of achieving high safety performance in construction projects. Finally, firms reported that they frequently organize "safety training" sessions for better managing safety. Previous studies indicated that frequently organized safety trainings are paths to success in safety management practices (Choudhry, 2014; Tappura *et al.*, 2015; Demirkesen and Arditi, 2015).

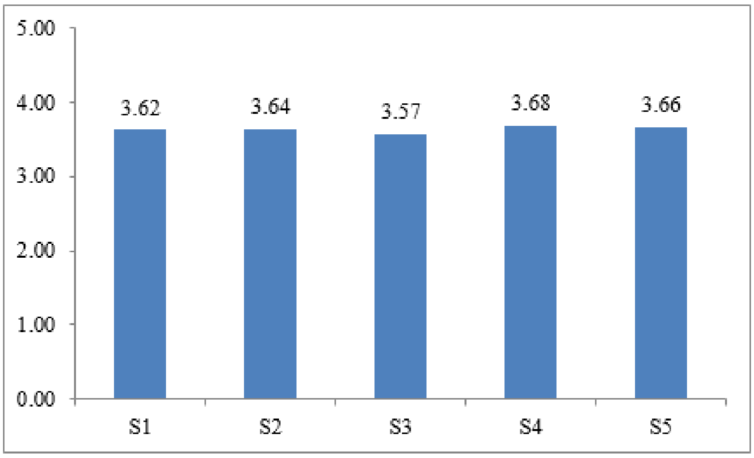

Figure 4.23. Distribution of Components of Project Safety Management.

4.1.3.12. Project Environmental Management. Table 4.12 presents the components of project environmental management.

Table 4.12. Components of Project Environmental Management.

Abbreviation	Component
E1	Environmental Implementation and Control Measures
E2	Environmental Impact
E3	Environmental Policies and Regulations

Figure 4.24 presents the distribution for the components of project environmental management. According to this figure, it is seen firms accurately determine "environmental impact" in their projects. The importance of accurate determination of environmental impact was mentioned in several studies (Shen *et al.*, 2011; Goh and Rowlinson, 2013; Fuertes *et al.*, 2013). Moreover, firms responded that they perform well in the accurate development of "environmental implementation and control measures" and in the commitment to "environmental policies and regulations". Previous studies showed that commitment to environmental issues such as policies, regulations, control measures and implementation are the facilitators for a successful environmental management scheme (Park and Ahn, 2012; Fuertes *et al.*, 2013; Goh and Rowlinson, 2013).

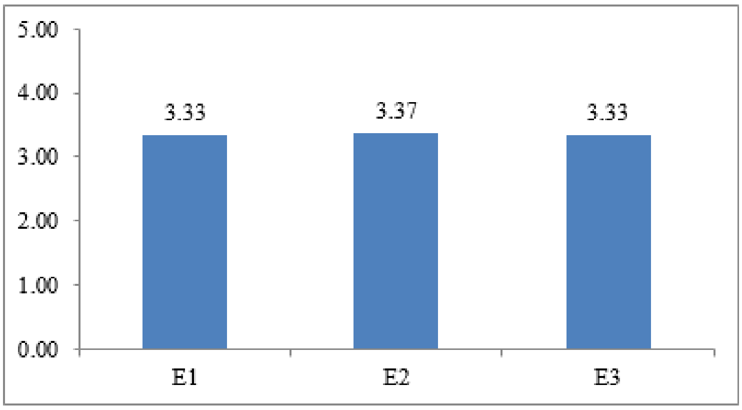

Figure 4.24. Distribution of Components of Project Environmental Management.

4.1.3.13. Project Financial Management. Table 4.13 presents the components of project financial management.

Table 4.13. Components of Project Financial Management.

Abbreviation	Component
F1	Cash Flow Planning
F2	Cash Flow Analysis
F3	Foreign Exchange Risk
F4	Cash Flow Monitoring and Control

Figure 4.25 presents the distribution for components of project financial management. As the figure shows, firms reported that they perform well in "cash flow monitoring and control" in their projects. Indeed, several research studies emphasized the importance of improved performance in cash flow monitoring and control for the successful execution of projects (Kao *et al.*, 2009; Akanni *et al.*, 2015). Moreover, firms responded that they are good at "cash flow planning" and "cash flow analysis", which are the essential components of financial management. Finally, it was shown that firms have considerable success in considering "foreign exchange risk". Research studies also implied that accurate prediction and evaluation of foreign exchange risk has a considerable contribution to the success of financial management practices (Boussabaine and Kaka, 1998; Maravas and Pantouvakis, 2012; Mbabazize *et al.*, 2014).

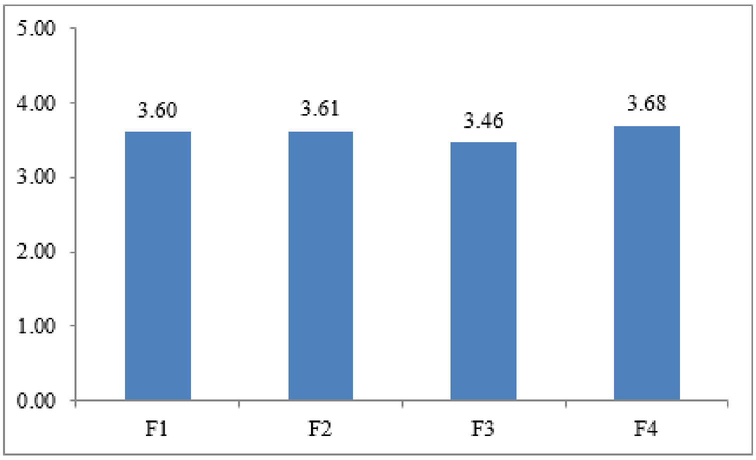

Figure 4.25. Distribution of Components of Project Financial Management.

4.1.3.14. Project Claim Management. Table 4.14 presents the components of project claim management.

Table 4.14. Components of Project Claim Management.

Abbreviation	Component
C1	Claim Identification
C2	Claim Notification
C3	Claim Resolution
C4	Claim Prevention

Figure 4.26 shows the distribution for the components of project claim management. According to this figure, it is seen that firms perform well in accurate "claim identification". Furthermore, it is shown that firms are good at timely "claim notification". There are several studies, which indicated that timely notification of claims results in success of claim management processes (Kartam, 1999; Kululanga *et al.*, 2001).The results revealed that firms are good at "claim prevention" and "claim resolution", which are the essential components of claim management. Past studies demonstrated that timely resolution of claims and effectiveness in claim prevention leads to a more successful project management (Kululanga *et al.*, 2001; LaBarre and El-adaway, 2014).

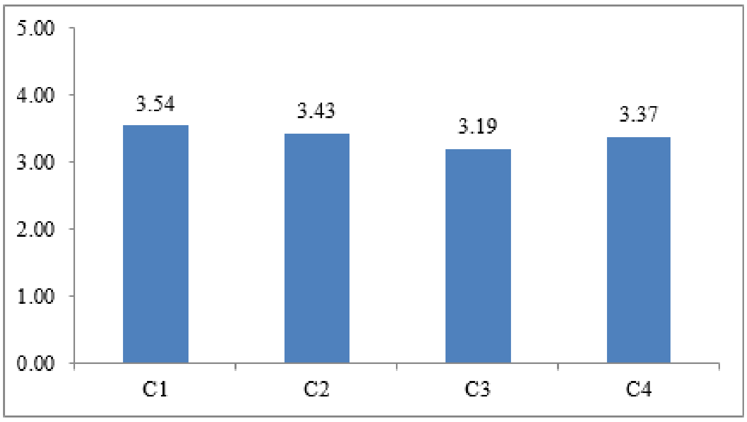

Figure 4.26. Distribution of Components of Project Claim Management.

4.1.3.15. Project Management Performance. Table 4.15 presents the components of project management performance.

Table 4.15. Components of Project Management Performance.

Abbreviation	Component
P1	Time
P2	Cost
P3	Quality
P4	Safety
P5	Client Satisfaction

Figure 4.27 presents the distribution for the components of project management performance. According to this figure, it is seen that firms are more successful in achieving “quality” in their projects. It is shown that firms satisfy “safety” objectives as well as “time”. Several research studies also prove that safely completed work and on time completion are the most important project success indicators (Khosravi and Afshari, 2011; Chan *et al.*, 2002). Firms provided that they mostly achieve “client satisfaction” and “cost” objectives in their projects. The importance of satisfying the client and completing the project under budget in terms of project success was previously shown in several studies (Shields *et al.*, 2003; Nassar and Abourizk, 2014).

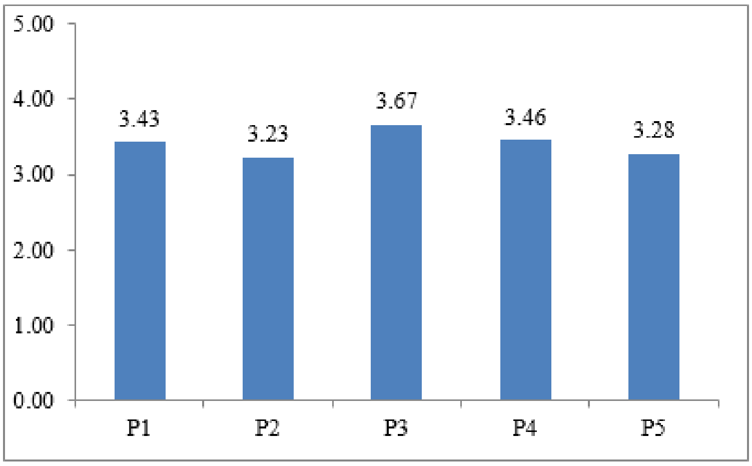

Figure 4.27. Distribution of Components of Project Management Performance.

Figure 4.28 presents the distribution of ratings for the individual knowledge areas based on the success level of respondents of the survey. The figure is generated by the assumption of same importance weight for the variables of knowledge areas. According to this Figure, respondents indicated that quality, time, and cost management are the top three knowledge areas that they perform. However, risk management, human resource management, and safety management are rated as the lowestthree performing knowledge areas.

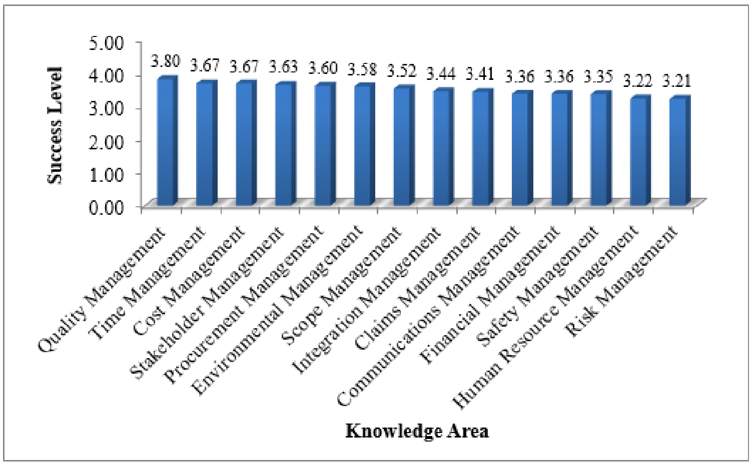

Figure 4.28. Success Level for Individual Knowledge Areas.

4.2. Structural Equation Modeling (SEM)

Structural equation models (SEMs) are multivariate regression models, which are also called as simultaneous equation models. SEM is a multivariate statistical methodology, which takes confirmatory approach into account to analyze a structural theory based on a phenomenon and, which tests hypotheses among observed and latent variables (Bollen and Long, 1993; Hoyle, 1995; Kline, 1998; Bryne, 2006). In a structural equation model, variables might be both continuous and discrete. SEM is used to investigate direct and indirect relationships between one or more independent variables and one or more dependent variables. SEM is also known as causal modeling, causal analysis, simultaneous equation modeling, analysis of covariance structures, path analysis, dependence analysis, or confirmatory factor analysis (Kline, 1998).

A typical SEM has two parts as the measurement and the structural model (Kline, 1998). The measurement model represents the extent to which latent variables or the hypothetical constructs are measured by means of the observed variables while the structural equation model represents the causal relationships among latent variables. It is assumed that the latent variables have causal relationships among themselves while the observed variables have the symptoms of the latent variables in SEM. A measured variable might be simply defined as a variable, which might be observed directly and is measurable. A latent variable is a variable, which cannot be directly observed and must be inferred from the measured variables. Latent variables are also known as factors, constructs, or unobserved variables.

SEM technique has several superiorities over the other methods. For example, SEM goes beyond the conventional multiple regression, factor analysis and analysis of variance (ANOVA). In addition, SEM allows carrying out factor analysis and path analysis simultaneously unlike the factor analysis and multivariate regression (Xiong *et al.*, 2015). Constructing structural equations also offer several advantages when compared to the regression parameters in the cases where the observed variables have not been measured or the observed variables contain measurement errors, and when there is interdependence or simultaneous causation among the observed response variables (Gefen *et al.*, 2000; Kline, 2005; Xiong *et al.*, 2014). Moreover, SEM also allows estimating constant intercept terms, mean values of latent variables, and interaction effects. One other benefit of using SEM is that it allows group comparisons by the use of a holistic model, which brings up more sound impressions than traditional ANOVA. Longitudinal designs where time lag variables are used might be also handled by SEM.

SEM has some assumptions in that there is a “causal” structure among a set of latent variables, and the observed variables are indicators or symptoms of the latent variables. Latent variables might be also linear combination of the observed variables or intervening variables in a causal chain. SEM adopts a methodology where the models might include latent variables, measurement errors, reciprocal causation, interdependence, and simultaneity. Therefore, it is a sound technique to analyze complex and multidimensional relationships.

4.2.1. Definitions of Terms

A typical SEM has the following concepts:

- Path diagram presents the investigator visually for examining the outputs.
- Measurement models represent a priori hypothesis regarding the relations between observed variables and latent variables. Confirmatory Factor Analysis (CFA) can be used for measurement models. Those models aim to reveal how well the observed variables serve as a measurement instrument for latent variables.
- Structural models involve relationships among the latent constructs. In a structural model, one-headed arrows represent regression relationships where two-headed arrows represent correlation relations.
- Observed variables, which are also called indicator or manifest variable are variables that can be manipulated by researchers and their effects can be observed.
- Latent variables are the variables, which can only be measured indirectly. They are unobservable, hypothetical constructs and their effects cannot be observed directly. Rather, effects of observed variables are used to represent the latent variables’ effects.

- Latent endogenous variables, which are also called as latent dependent variables represent the effects of other latent variables. Measurements of these variables are made on observed dependent variables.
- Latent exogenous variables, which are also called as latent independent variables affect other variables in the model. Measurements of these variables are made on observed independent variables.
- Direct effect depicts causal effects that are presumed to flow from one latent variable to another. Statistical estimates of direct effects are called path coefficients.
- Indirect effect, also called as mediator effect, involves one or more intervening variables that transmit some of the casual effects of prior variables onto subsequent variables.
- Diagrammatic Syntax is where the latent variables or factors are indicated by circles. The observed variables are indicated by squares.

Figure 4.29 represents a simple example of a structural equation model. This model shows the effect of latent variable Y1 on latent variable Y2, and it also pictures that manifest variables are used to represent the latent variables. In the figure, manifest variables are presented in the rectangles where the latent variables in the ellipses, and measurement errors are shown in circles and with arrows representing the direction of the effects. According to the Figure 4.29, when the directional arrow between Y1 and Y2 is presented by a correlation on a two-way arrow form, it is stated that the model is a confirmatory factor analysis (CFA), which aims to test whether manifest variables explain latent variables well (convergent validity), and whether Y1 and Y2 are different (discriminant validity) (Xiong *et al.*, 2015).

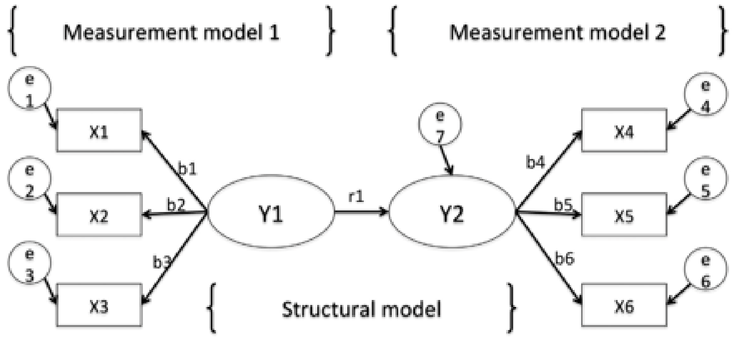

Figure 4.29. Schematic Diagram of Structural Equation Model (Xiong *et al.*, 2015).

4.2.2. Steps of SEM

SEM is conducted in four main steps; model specification, model identification, test of model fit, and model modification.

- Model specification: describes the formal statement of a model where the relationships between variables are derived by setting fixed or free parameters. Researcher's priori hypothesis should comply with the selection of which parameters are to be used as fixed or free. A theory-based model comes up with a unique covariance matrix.
- Model identification: consists of the determination of the estimation method for model and specification of the fixed, free or constrained parameters. It must be obtained a unique value for each free parameter from the observed data. There are different model estimation methods such as maximum likelihood (MLE), generalized least squares (GLS), asymptotically distribution free (ADF) estimator, weighted least-squares (WLS), unweighted least-squares (ULS), and two-stage least-squares (TSLS). The selection of estimation method relies on the sample size and distribution of the data.
- Model fit: or goodness of fit is assessed by the examination of analyses results based on several fit indices, which are explained below.
  - Chi-Square (X^2): This statistic relies on generalized likelihood ratio. Chi-square is the measure of how close the observed values are to the values

that would be expected under the fitted model. In chi-square goodness of fit test, low and non-significant values are desired. However, this statistic is very sensitive to sample size, which comes up with higher and significant values as the sample size increases. Therefore, there is no agreed way of interpreting this statistic.

– Goodness of Fit Index (GFI): This index is less sensitive to sample size and is more standardized compared to other indices. The value of GFI ranges between 0 (poor fit) and 1 (perfect fit). The values greater than 0.9 are acceptable for GFI.
– Comparative fit index (CFI): CFI is a widely used test statistic in the model fit interpretation in SEM. CFI compares the existing model fit with a null model also called as independence model having the assumption of uncorrelated latent variables. Values of CFI ranges between 0 and 1 where valuesapproaching 1 indicate a very good fit. Values greater than 0.9 are acceptable in CFI, which explains that 90% of the covariance in the data might be reproduced by the given model.
– Incremental Fit Index (IFI): This index is similar to CFI in that it compares the researcher's model to a null model. It is insensitive to sample size. Values greater than 0.9 are regarded as acceptable and the maximum value of perfect fit might exceed 1.
– Normed Fit Index (NFI): This index represents the proportion by which the researcher's model improves fit compared to the null model. The values of NFI lie between 0 (poor fit) and 1 (perfect fit). Values below 0.9 bring the need for specification of the model.
– Non-normed Fit Index (NNFI): NNFI, also called as Tucker-Lewis index, is another comparison index where the researcher's model is compared to a baseline model. Its range lies between 0 (poor fit) and 1 (perfect fit).
– Adjusted Goodness of Fit Index (AGFI): This index is mostly used in complex models. This index corrects GFI that is affected by the number of indicators of each latent variable. Similar to GFI, its range varies from 0 to 1 and values greater than 0.9 are acceptable for GFI.
– Root Mean Square Error of Approximation (RMSEA): This measure is used

to analyze discrepancy between the hypothesized model and the population covariance matrix. RMSEA values range from 0 to 1 where smaller values indicate good fit. A value of .06 or less is acceptable for RMSEA.

- Model modification: This step is must when the model is inconsistent with the data collected and when the estimated covariance matrix does not provide a reasonable and parsimonious explanation of the data. In this step, the model may be re-specified by changing model parameters. For the analysis of samples from several populations simultaneously, some or all of the parameters may be constrained to be equal across groups.

4.2.3. SEM Software Packages

There are several software programs for SEM such as LISREL, SIMPLIS, SAS CALIS, AMOS, and EQS. In this research, AMOS (Analysis of Moment Structures) is used since it is a user-friendly program and it is easy to follow the processes.

4.2.4. Benefits of SEM

SEM is very similar to multiple regression but it has some superiorities since it involves the modeling of interactions, nonlinearities, correlated independents, measurement error, correlated error terms, multiple latent independents each measured by multiple indicators, and one or more latent dependents also each with multiple indicators. SEM is more of an extension of the general linear model (GLM), which includes multiple regression. SEM is efficient in comparing alternative models in order to assess relative model fit since regression is susceptible to error of interpretation by misspecification (Isik, 2009). The ease of use in SEM's graphical modeling interface, desirability of testing models overall rather than individual coefficients, the ability to test models with multiple dependents, modeling mediating variables without the need of an additive model, modeling error terms, testing coefficients across multiple between-subjects groups, handling difficult data such as auto correlated error, non-normal data, and incomplete data makes the use of SEM more attractive than any other methods in modeling. SEM has three distinct features as specified by Hair *et al.*, (2006):

- Ability to estimate multiple and interrelated dependence relationships
- Ability to represent unobserved concepts in these relationships and to correct measurement errors in the estimation process
- Ability to define a model explaining the entire set of relationships.

4.2.5. SEM Approach in Construction Research

SEM has been widely used in several research studies since 1980s (Xiong *et al.*, 2015). The SEM applications have been still accelerating and SEM has given reasonable results in especially in measurement and structural analyses so far (Bentler, 1989; Joreskog and Sorbom, 1996; Byrne, 2001; Hairet *et al.*, 2006; Bagozzi and Yi, 2012). Although SEM applications are widespread in different research areas, the use of SEM in construction research is relatively new. For example, Sarkar *et al.*, (1998) investigated the strategic role of relational bonding between variables such as role clarity, the collaborative behavioral processes of global construction firms, resource interdependence, and termination costs. In their study, they have constructed causal relationships between the variables and proposed a structural equation model. In another study conducted by Molenaar *et al.*, (2000) developed a structural equation model to investigate the effects of a range of factors on contract disputes between owners and contractors. Mohamed (2003) conducted research on performance of international joint ventures. In his study, he investigated the effect of key processes such as partner selection, venture formation, and operation on venture performance by constructing a structural equation model. Ahuja *et al.*, (2010) investigated causal relationships between factors affecting ICT adoption for building project management. In this context, they constructed a structural equation model to test the causal relationships between quantitative factors.

Ding and Ng (2010) explored personal construct-based factors and their impacts on interpersonal trust in a design project team. Within this context, they constructed a structural equation model to test the factors explored. Lee and Yu (2012) developed a success model for project management system. In their study, they used SEM to investigate the effects of three antecedent variables on the intention to use project management information system, on the user satisfaction and the effect on the construction management efficiency. In a similar study, Yang ,, (2012) assessed the impacts of information technology on project success through a structural equation model. Their conclusion was that project performance is not directly affected by the information technology except the mediator role of knowledge management. In another study, Son *et al.*, (2012) developed a structural equation model to measure technology acceptance and usage of mobile computing devices among construction professionals. In a similar study, Park *et al.*, (2012) expanded the research on technology acceptance model and they investigated the acceptance of web-based training among construction professionals through a structural equation model.

4.3. Analysis of the Measurement Model

Specification of the relationships among the latent variables and determination of the measurement method of those latent variables constitute the first step in constructing a structural model. In this study, 63 variables were identified as the key components of project management knowledge areas and project success. Then, the hypotheses were constructed among those latent variables. The data collected from a total of 121 questionnaires were analyzed using AMOS, an SEM tool. SEM has several sample size requirements. For example, Kline (2011) recommends a sample size at least 200 or 5 or 10 cases per parameter. Smilarly, Bentler and Chou (1987) recommended 5 cases for each parameter in SEM. Loehlin (1994) demonstrated that at least 100 cases should exist for SEM and a sample size of 200 would generate better results. Wolf *et al.*, (2013) reported that size requirements for structural equation models range from 30 (simple CFA with four indicators and loadings around 0.80) up to 450 cases (mediation models). However, as indicated by MacCallum and Tucker (1991), it is not possible to derive an appropriate minimum sample size in accordance with all conditions. Although the sample size used in this research meets majority of the researchers' recommendations regarding a minimum sample size of 100 cases (Tinsley and Tinsley, 1987; Anderson and Gerbing, 1988; Ding, *et al.*, 1995; Tabachnick and Fidell, 2001), there is still no strict rule in determining an accurate sample size requirement.

4.3.1. Validity of the Performance Measures and Indicators

Construct validity refers to the degree to which a latent variables measures what it intends to measure. Construct validity testing involves several sub-dimensions and those sub-dimensions, namely the “content validity”, “scale reliability”, “convergent validity”, and discriminant validity need to be satisfied to ensure construct validity.

- Content Validity Testing: Content validity is expressed as the degree that a construct is represented by its components or facets, which cover the domain of meaning for the construct (Dunn *et al.*, 1994). The concept domain is entitled by the theoretical definition that must reflect the meanings related to the concept depending on the prior research to clarify the dimensions behind (Bollen, 1989). Researcher judgment and insight is applied to satisfy content validity since there is no formal statistical test (Garver and Mentzer, 1999). In this respect, an extensive literature survey was conducted to reveal variables that define latent variables. The content validity testing is conducted based on the interviews made with the academic and professional experts regarding the construction specific performance measures. Table 4.3.1 shows the latent and constituent variables developed.

Table 4.16. Latent and Constituent Variables.

Model Variables
Project Integration Management
Development of Project Charter
Knowledge Integration
Process Integration
Staff Integration
Supply Chain Integration
Integration of Changes
Project Scope Management

Table 4.16. Latent and Constituent Variables.

Model Variables
Scope Planning
Scope Definition
Scope Changes
Project Time Management
Activity Definition
Activity Sequencing
Time Estimation
Development of Project Schedule
Schedule Monitoring, Control and Revision
Project Cost Management
Cost Estimation
Determination of Budget
Cost Control
Project Quality Management
Quality Definition
Quality Standardization
Quality Assurance and Control
Project Human Resource Management
Project Team Composition
Workforce Planning
Staff Training
Performance Development
Performance Evaluation
Project Communications Management
Communication Strategies
Communication Technology
Coordination and Collaboration
Knowledge Sharing
Multi-Cultural Communication

Table 4.16. Latent and Constituent Variables.

Model Variables
Project Risk Management
Risk Identification
Risk Analysis
Risk Allocation
Risk Control
Project Procurement Management
Supplier Selection
Type of Contract
Supply of Resources
Risk Management in the Supply Process
Project Stakeholder Management
Identification of Stakeholders
Stakeholder Needs, Interests and Influences
Stakeholder Engagement
Stakeholder Conflicts
Project Safety Management
Safety Awareness and Culture
Safety Planning
Safety Training
Safety Implementation
Safety Inspection and Monitoring
Project Environmental Management
Environmental Implementation and Control Measures
Environmental Impact
Environmental Policies and Regulations
Project Financial Management
Cash Flow Planning

Table 4.16. Latent and Constituent Variables.

Model Variables
Cash Flow Analysis
Foreign Exchange Risk
Cash Flow Monitoring and Control
Project Claim Management
Claim Identification
Claim Notification
Claim Resolution
Claim Prevention
Project Management Performance
Time
Cost
Quality
Safety
Client Satisfaction

- Scale Reliability Testing: Reliability refers to consistency of measurement. The reliability of a measure is expressed as the magnitude of the direct relations that all variables excluding the error terms have on that measure in a structural model (Bollen, 1989). The scale reliability refers to internal consistency of a latent variable and is assessed by a coefficient called Cronbach's alpha. The main purpose of reliability testing is to investigate the degree to which an observed indicator represents its correspondent latent variable.

This study conducted analyses on SPSS (Statistical Package for the Social Sciences) and the results provided that Cronbach's alpha values were all above 0.70 and found as satisfactory as per Nunally's recommendation (1978). Table 4.17 presents the Cronbach's alpha coefficients of all latent variables.

Table 4.17. Cronbach's Alpha Coefficients of the Latent Variables.

Latent Variables	Cronbach's Alpha Values
Project Integration Management	0.896
Project Scope Management	0.864
Project Time Management	0.898
Project Cost Management	0.898
Project Quality Management	0.917
Project Human Resource Management	0.875
Project Communications Management	0.898
Project Risk Management	0.945
Project Procurement Management	0.892
Project Stakeholder Management	0.935
Project Safety Management	0.954
Project Environmental Management	0.953
Project Financial Management	0.916
Project Claim Management	0.875
Project Management Performance	0.822

- Convergent Validity Testing: Convergent validity involves testing of whether all items measuring a latent variable cluster together and form a single latent variable. There are two ways of assessing convergent validity; overall goodness of fit and examination of factor loadings.

Anderson and Gerbing (1988) stated that convergent validity might be examined by the investigation of the statistical significance of the each construct's factor loadings. As explained above, convergent validity is simply tested by the examination of if all items in a scale converge or load together on a single construct in the measurement model. Convergent validity is satisfied when factor loadings are statistically significant (Dunn *et al.*, 1994). Overall fit of the measurement model, magnitude, direction, and statistical significance of the estimated parameters between latent variables and their indicators also need careful consideration to assess convergent validity. The analyses conducted in AMOS revealed that all factor loadings are significant at $\alpha = 0.05$ (Table ??).

Table 4.18. Latent and Constituent Variables of the Model with Factor Loadings.

No	Model Variables	Factor Loadings
F1	Project Integration Management	
V1	Development of Project Charter	0.761
V2	Knowledge Integration	0.834
V3	Process Integration	0.836
V4	Staff Integration	0.663
V5	Supply Chain Integration	0.71
V6	Integration of Changes	0.759
F2	Project Scope Management	
V7	Scope Planning	0.831
V8	Scope Definition	0.81
V9	Scope Changes	0.732
F3	Project Time Management	
V10	Activity Definition	0.835
V11	Activity Sequencing	0.8
V12	Time Estimation	0.763
V13	Development of Project Schedule	0.844
V14	Schedule Monitoring, Control and Revision	0.865
F4	Project Cost Management	
V15	Cost Estimation	0.954
V16	Determination of Budget	0.89
V17	Cost Control	0.74
F5	Project Quality Management	
V18	Quality Definition	0.861
V19	Quality Standardization	0.944
V20	Quality Assurance and Control	0.895

Table 4.18. Latent and Constituent Variables of the Model with Factor Loadings.

No	Model Variables	Factor Loadings
F6	Project Human Resource Management	
V21	Project Team Composition	0.61
V22	Workforce Planning	0.651
V23	Staff Training	0.824
V24	Performance Development	0.901
V25	Performance Evaluation	0.817
F7	Project Communications Management	
V26	Communication Strategies	0.816
V27	Communication Technology	0.778
V28	Coordination and Collaboration	0.892
V29	Knowledge Sharing	0.838
V30	Multi-Cultural Communication	0.708
F8	Project Risk Management	
V31	Risk Identification	0.883
V32	Risk Analysis	0.925
V33	Risk Allocation	0.913
V34	Risk Control	0.9
F9	Project Procurement Management	
V35	Supplier Selection	0.901
V36	Type of Contract	0.875
V37	Supply of Resources	0.859
V38	Risk Management in the Supply Process	0.76
F10	Project Stakeholder Management	
V39	Identification of Stakeholders	0.872
V40	Stakeholder Needs, Interests and Influences	0.913
V41	Stakeholder Engagement	0.929

Table 4.18. Latent and Constituent Variables of the Model with Factor Loadings.

No	Model Variables	Factor Loadings
V42	Stakeholder Conflicts	0.86
F11	Project Safety Management	
V43	Safety Awareness and Culture	0.91
V44	Safety Planning	0.928
V45	Safety Training	0.894
V46	Safety Implementation	0.934
V47	Safety Inspection and Monitoring	0.912
F12	Project Environmental Management	
V48	Environmental Implementation and Control Measures	0.913
V49	Environmental Impact	0.959
V50	Environmental Policies and Regulations	0.954
F13	Project Financial Management	
V51	Cash Flow Planning	0.904
V52	Cash Flow Analysis	0.917
V53	Foreign Exchange Risk	0.789
V54	Cash Flow Monitoring and Control	0.871
F14	Project Claim Management	
V55	Claim Identification	0.822
V56	Claim Notification	0.856
V57	Claim Resolution	0.806
V58	Claim Prevention	0.773
F15	Project Management Performance	
V59	Time	0.499
V60	Cost	0.5
V61	Quality	0.591
V62	Safety	0.634
V63	Client Satisfaction	0.656

Overall fit of the model might be assessed by the examination of goodness of fit indices. For testing goodness of fit, Chi-square (X^2) test was assessed. This test is used to detect any significant difference between the actual and predicted matrices. The smaller the X^2 value, the better fit is observed. In AMOS, a ratio of X^2/df (degree of freedom) is proposed as a fit measure. Although there is no agreed consensus on $X^2$2/df value, a ratio lower than 5.0 is an acceptable range (Marsh and Hocevar, 1985). Relative fit index (RFI) (Bollen, 1986), Comparative fit index (CFI) (Bentler, 1990), and Tucker-Lewis index (TLI) (Tucker and Lewis, 1973) are measures for comparing the proposed model to the null or independence model. The values of those indices lie between 0 and 1.0 where values approaching 1.0 indicate good fit. The root mean square error of approximation (RMSEA) (Steiger and Lind, 1980) is a parsimony-adjusted index, which includes a built-in correction for model complexity. A threshold value of RMSEA was previous proposed by the researchers indicating that values less than 0.10 shows acceptable fit (Kline, 1998).

- Discriminant Validity Testing: Discriminant validity refers to not highly correlated constructs to prevent constructs from measuring the same thing. Discriminant validity is satisfied if different constructs measure different things especially when constructs are highly correlated or similar in nature. Item from one scale should not converge or load closely with items from a different scale. Highly correlated different constructs might indeed measure the same construct. Therefore, relatively low correlations between constructs ensure the presence of discriminant validity.

Within this context, intercorrelations for all constructs are researched. The correlation matrices calculated for all constructs indicate that all intercorrelations are below 0.90 evidencing that there is no multicollinearity (Hair *et al.*, 1998) and constructs have discriminant validity. The investigation of intercorrelations reveals that all variables are different from each other. Correlation matrices are provided in Appendix C.

4.4. Analysis of the Structural Model

SEM was selected as the research method for the proposed model to analyze a set of direct and indirect relations between dependent and independent variables. SEM tests the hypotheses between the validated constructs. Interrelations among the determinants of performance and effects of those on project management performance are analyzed based on the hypotheses of the model.

4.4.1. Specification of the Model

An in-depth literature review was conducted to develop a conceptual model to picture how the project management knowledge areas, called as determinants, interact directly or indirectly and affect project management performance. Based on this input, the model was structures as shown on Figure 4.30.

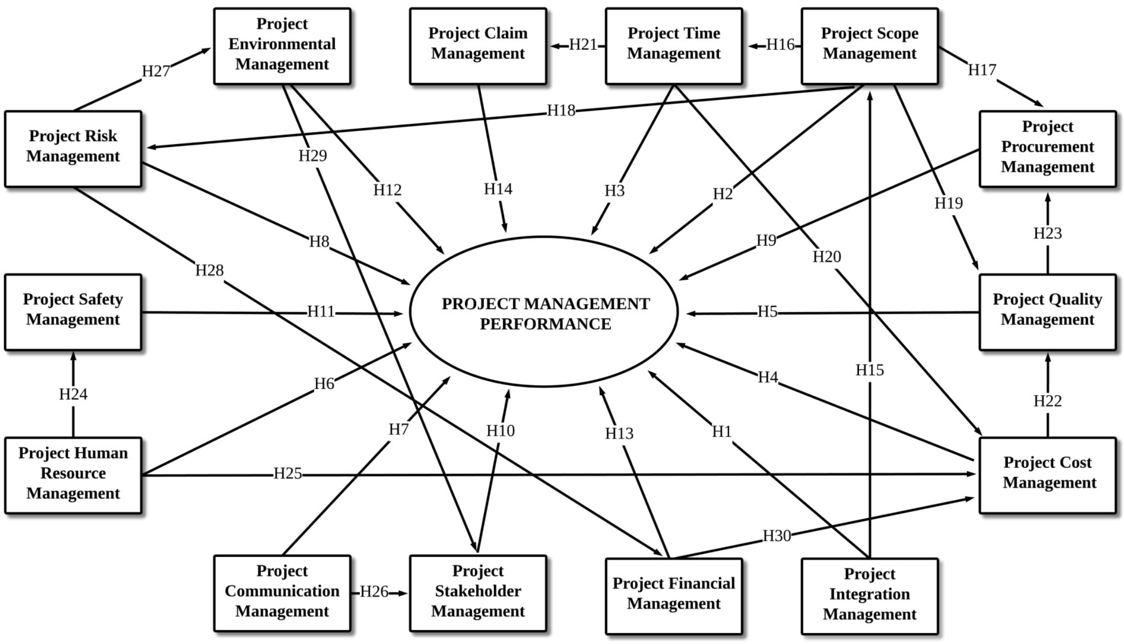

Figure 4.30. Project Management Performance Model.

The model can alternatively be described as a set of equations in addition to the diagrammatic model by which researchers usually begin the process of specification. An example of how the equations were formulated is as follows;

- Project Management Performance = pathcoefficient1*project integration management + path coefficient 2* project scope management + path coefficient 3* project time management + path coefficient 4* project cost management + path coefficient 5* project quality management + path coefficient 6* project human resource management + path coefficient 7* project communications management + path coefficient 8* project risk management + path coefficient 9* project procurement management + path coefficient 10* project stakeholder management + path coefficient 11* project safety management + path coefficient 12* project environmental management + path coefficient 13* project financial management + path coefficient 14* project claim management + error term 1

4.4.2. Estimation and Identification of the Model

Model estimation might be assessed with several methods. Some of frequently used methods are maximum likelihood (ML), generalized least squares (GLS), asymptotically distribution free (ADF) estimator, and robust statistics. ML method refers to derivation of parameter estimates, which maximize the likelihood (the continuous generalization) where the data (the observed covariances) drawn from the population. ML estimators are the maximizing parameters of a sample that is actually observed (Winer *et al.*, 1991).

One of the assumptions of ML estimations is that the population distribution for the endogenous variables is multivariate normal. Although there are other estimation methods than ML, the ease and frequency of use of ML method makes it more common among the other estimation method since the use of another estimation method requires explicit justification (Kline, 1998).

Normality is not required in robust method, which is one of its' strengths. Standard errors and non-normality case is corrected by the robust method. Satorra and Bentler (1994) stated that the Chi Square test is corrected conceptually. Moreover, Bentler and Dijsktra (1985) mentioned that robust standard errors are the outputs of the robust analysis and they are treated as correct in large samples even though the distributional assumption of the variables is wrong (Bentler, 2006). Robust statistics are shown to perform better than uncorrected statistics especially when assumption of normality fails to hold despite the demanding nature of those (Chou *et al.*, 1991; Hu *et al.*, 1992). One of the most important handicaps of robust statistics is that those statistics might be only computed from the raw data (Byrne, 2006).

The selection of estimation method relies on the sample size and the distribution of the data. Thus, non-normality assessment and sample size need to be addressed at the very beginning of the selection of the estimation method.

Multivariate normality of data generally hypothesized in SEM. Mardia (1970) reported that normality hypothesis is rejected when the estimated z-score is out of $\pm$ 1.96 interval in a 0.05 confidence level. In this study, the data was found to be non-normal. Hence, robust methodology was applied. AMOS provides a variety of estimation methods such as maximum likelihood (ML), unweighted least squares (ULS), generalized least squares (GLS), Browne's asymptotically distribution-free criterion (ADF), and scale-free least squares. AMOS evaluates the model using more than two dozen fit statistics, including Chi-square; AIC; Bayes and Bozdogan information criteria; Browne-Cudeck (BCC); ECVI, RMSEA, andPCLOSE criteria; root mean square residual; Hoelter's critical n; and Bentler-Bonett and Tucker-Lewis indices. In this study, ML was directed in AMOS with robust estimators as previously recommended by (Yuan *et al.*, 2005). Moreover, robust model fit indices such as TLI, CFI, and RMSEA are provided.

4.4.3. Evaluation of the Model Fit

Evaluation of the model fit refers to how well the model explains the data. Once the model fit is ensured, this means that the fit of the structural model to the data is adequate and the model proposed is complete. In this study, it is shown that the model explains the data well and fit is ensured. Figure 4.31 shows the initial structural equation model with the path coefficients.

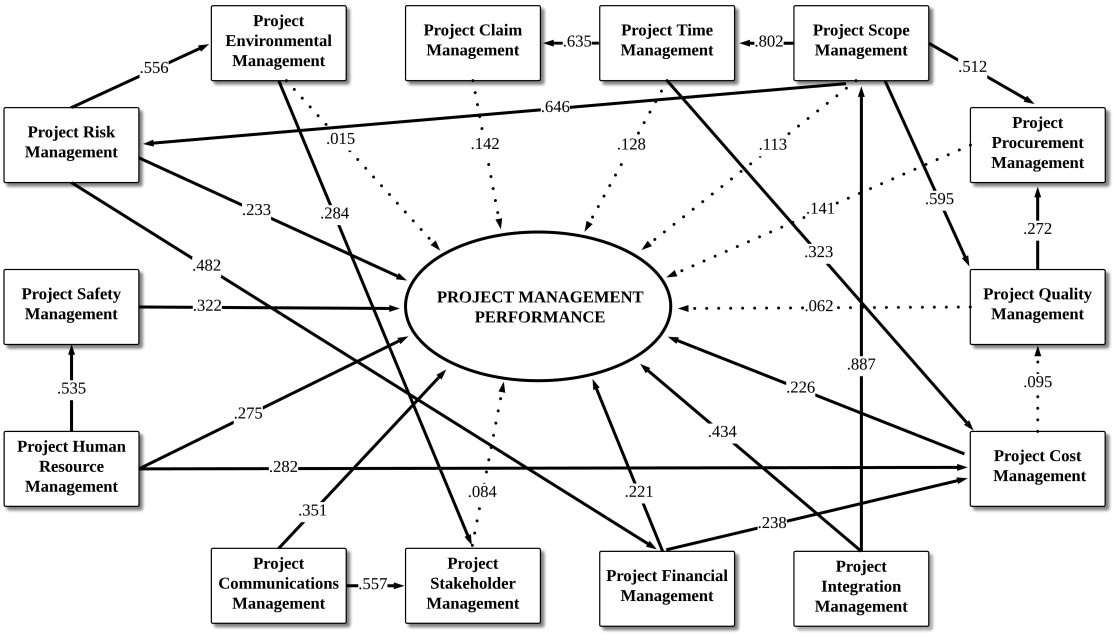

Figure 4.31. The Initial Structural Equation Model with Path Coefficients.

The equations are as follows based on the initial structural equation model;

- Project Management Performance = 0.434* project integration management + 0.113* project scope management + 0.128* project time management + 0.226* project cost management + 0.062* project quality management + 0.275* project human resource management + 0.351* project communications management + 0.233* project risk management + 0.141* project procurement management + 0.084* project stakeholder management + 0.322* project safety management + 0.015* project environmental management + 0.221* project financial management + 0.142* project claim management + 0.029D (R^2=0.753)
- Project Scope Management = 0.887* project integration management + 0.105D (R^2=0.768)
- Project Time Management = 0.802* project scope management + 0.071D (R^2=0.609)
- Project Cost Management = 0.323* project time management + 0.282* project human resource management + 0.238* project financial management + 0.062D (R^2=0.282)
- Project Quality Management = 0.595* project scope management + 0.095* project

cost management + 0.074D (R^2=0.273)

- Project Risk Management = 0.646* project scope management + 0.099D (R^2=0.372)
- Project Procurement Management = 0.512* project scope management + 0.272* project quality management + 0.076D (R^2=0.468)
- Project Stakeholder Management = 0.557* project communications management + 0.284* project environmental management + 0.091D (R^2=0.318)
- Project Safety Management =0.535* project human resource management + 0.109D (R^2=0.265)
- Project Environmental Management = 0.556* project risk management + 0.105D (R^2=0.287)
- Project Financial Management = 0.482* project risk management + 0.111D (R^2=0.202)
- Project Claim Management = 0.635* project time management + 0.080D (R^2=0.343)

Based on the analysis results, insignificant paths were found. The relation between project environmental management and project management performance (path coefficient 0.015), project claim management and project management performance (0.142), project time management and project management performance (0.128), project scope management and project management performance (0.113), project procurement management and project management performance (0.141), project quality management and project management performance (0.062), project stakeholder management and project management performance (0.084), and project cost management and project quality management (0.095) were found statistically insignificant at 0.05 level. Therefore, those paths were eliminated from the initial model. Figure 4.32 shows the modified structural equation model with path coefficients.

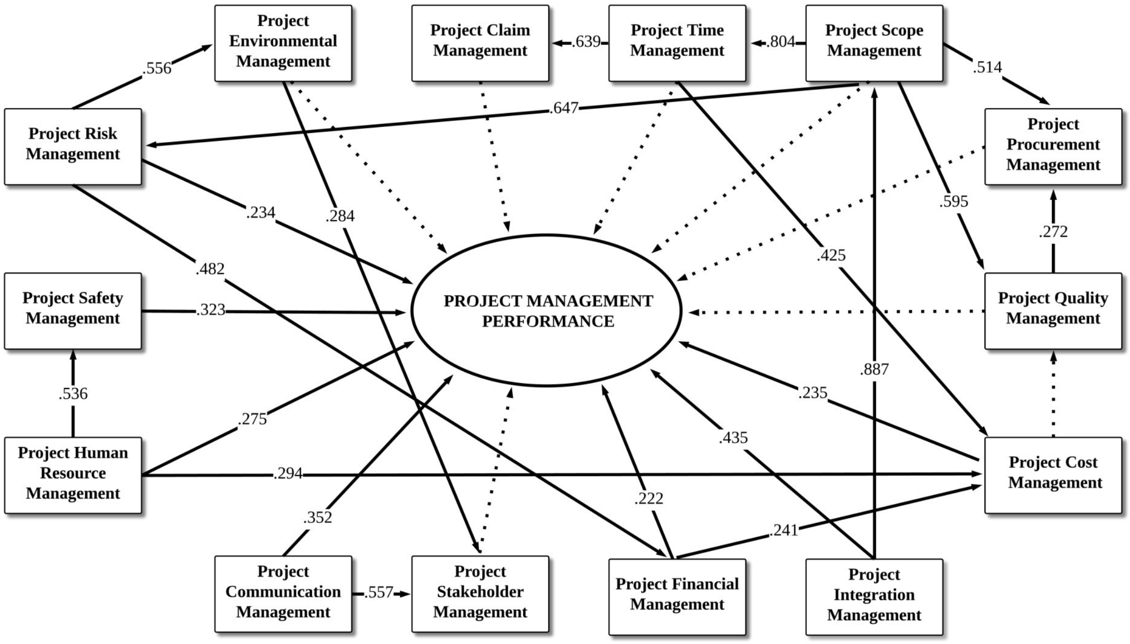

Figure 4.32. The Modified Structural Equation Model with Path Coefficients.

Following is the list of modified structural equations based on the modified structural model;

- Project Management Performance = 0.435* project integration management + 0.235* project cost management + 0.275* project human resource management + 0.352* project communications management + 0.234* project risk management +0.323* project safety management + 0.222* project financial management + 0.033D (R^2=0.638)
- Project Scope Management = 0.887* project integration management + 0.034D (R^2=0.772)
- Project Time Management = 0.804* project scope management + 0.070D (R^2=0.616)
- Project Cost Management = 0.425* project time management + 0.294* project human resource management + 0.241* project financial management + 0.073D (R^2=0.306)
- Project Quality Management = 0.595* project scope management + 0.075D (R^2=0.290)
- Project Risk Management = 0.647* project scope management + 0.098D (R^2=0.376)

- Project Procurement Management = 0.514* project scope management + 0.272* project quality management + 0.075D (R^2=0.478)
- Project Stakeholder Management = 0.557* project communications management + 0.284* project environmental management + 0.091D (R^2=0.319)
- Project Safety Management =0.536* project human resource management + 0.108D (R^2=0.269)
- Project Environmental Management = 0.556* project risk management + 0.104D (R^2=0.289)
- Project Financial Management = 0.482* project risk management + 0.111D (R^2=0.202)
- Project Claim Management = 0.639* project time management + 0.080D (R^2=0.346)

The analysis results showed that project integration management (path coefficient: 0.435), project financial management (0.222), project communications management (0.352), project cost management (0.235), project human resource management (0.275), project risk management (0.234), and project safety management (0.323) have a significant and positive effect on project management performance. In addition, significant and positive relations were detected between project integration-time (0.887), scope-time (0.804), time-claim (0.639), scope-procurement (0.514), quality-procurement (0.272), risk-environmental (0.556), human resource-safety (0.536), scope-risk (0.647), scope-quality (0.595), risk-finance (0.482), human resource-cost (0.294), and financial-cost (0.241). The hypotheses among those were all validated by the analyses results. On the other hand, effect of project environmental management on project management performance (0.015); claim-performance (0.142); time-performance (0.128); procurement-performance (0.141); quality-performance (0.062); stakeholder-performance (0.084); and cost-quality (0.095) were not found to be significant. A detailed discussions regarding why some of hypotheses were not validated is given in the "summary and discussion" section.

Table 4.19 presents the reliability values and fit indices for the constructs of the model. Reliability is traditionally defined as the internal consistency of the constructs. In a structural model, reliability refers to the magnitude of the direct relations with the measure for which the reliability is assessed excluding the error terms (Bollen, 1989). In this study, the reliability test is assessed by Cronbach's α coefficient. The reliability of the all constructs is satisfied when Cronbach's α coefficient exceeds 0.7 for all the constructs (Nunnally, 1978). For testing goodness of fit, Chi-square test was assessed. In SEM, Chi-square (X^2) is used to detect any significant difference between the actual and predicted matrices. The smaller the X^2 value, the better fit is observed. In AMOS, a ratio of X^2/df (degree of freedom) is proposed as a fit measure. Although there is no agreed consensus on X^2/df value, a ratio lower than 5.0 is an acceptable range (Marsh and Hocevar, 1985). Relative fit index (RFI) (Bollen, 1986), Comparative fit index (CFI) (Bentler, 1990), and Tucker-Lewis index (TLI) (Tucker and Lewis, 1973) are measures for comparing the proposed model to the null or independence model. The values of those indices lie between 0 and 1.0 where values approaching 1.0 indicate good fit. The root mean square error of approximation (RMSEA) (Steiger and Lind, 1980) is a parsimony-adjusted index, which includes a built-in correction for model complexity. A threshold value of RMSEA was previous proposed by the researchers indicating that values less than 0.10 shows acceptable fit (Kline, 1998). Table 4.19 proves that the reliability of all constructs meets Nunnally's (1978) recommendation since all Cronbach's α values are above 0.7. It is also demonstrated that all fit indices are in the acceptable ranges, which demonstrates that the measurement model shows a good fit to the data with two exceptions in RFI and TLI values for the performance construct. The values of those fit indices lie between 0 to 1 and values approaching 1 indicate good fit. However, most studies recommend a cutoff value of 0.9 for a measure of good fit (Mandal *et al.*, 2011; Hsieh and Tsai, 2013) These values achieved in this model are very close to the cutoff value 0.9. Finally, it is shown that all values for RMSEA of all constructs are below the threshold value proving acceptable fit for the data to the model with a few exceptions Nonetheless, research studies have previously implied that these cutoff points are subjective measures depending on the substantial amount of experience (Steiger, 1989; Browne and Cudeck, 1993). Moreover, a group of studies demonstrated that the use of precise numerical cutoff values for RMSEA should not be considered too seriously (Hayduk and Glaser 2000; Steiger 2000).

Table 4.19. Reliability and Fit Indices for the Constructs of the Model.

Index	Recommended Value	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
Cronbach's Alpha	> 0.7	0.896	0.864	0.898	0.898	0.917	0.875	0.898	0.945	0.892	0.935	0.954	0.953	0.916	0.875	0.822
X^2/df	< 5.0	1.834	1.345	1.472	1.778	1.158	1.482	1.746	1.557	1.782	3.662	2.016	1.989	1.543	1.391	4.607
RFI	> 0.90	0.932	0.978	0.964	0.98	0.988	0.959	0.956	0.981	0.97	0.954	0.972	0.985	0.977	0.971	0.841
CFI	> 0.90	0.987	0.998	0.995	0.997	0.999	0.996	0.994	0.999	0.998	0.989	0.996	0.998	0.999	0.997	0.949
TLI	> 0.90	0.968	0.994	0.988	0.991	0.998	0.986	0.981	0.993	0.987	0.966	0.986	0.993	0.992	0.992	0.871
RMSEA	< 0.10	0.084	0.054	0.063	0.081	0.036	0.064	0.079	0.068	0.081	0.15	0.092	0.091	0.068	0.057	0.174

Note: The reliability of all constructs meet Nunnally's (1978) recommendation, as the Cronbach's alpha values exceed 0.7 for all of them. Fit indices are also within acceptable ranges. All in all, the measurement model shows a good fit to the data.

Table 4.20 shows the reliability values and fit indices for the initial and modified model. The X^2 to df ratios were smaller than 5 as suggested by Marsh and Hocevar (1985). The TLI, IFI, and CFI values of around 0.9 demonstrate a slightly good fit of the model to the data. Moreover, the RMSEA values were found to be below the recommended value of 0.10 (Kline, 1998). The correlation matrices (See Appendix C) calculated for all constructs show that all intercorrelations are below 0.90, suggesting that there is no multicollineraity (Hair *et al.*, 1998).These values provide evidence that the fit between the final model and the data is quite satisfactory.

Table 4.20. Reliability Values and Fit Indices for the Initial and Final Model.

Index	Recommended Value	Initial Model	Final Model
Cronbach's Alpha	>0.7	0.98	0.98
X^2/df	< 5.0	1.682	1.566
TLI	0 (no fit) to 1 (perfect fit)	0.847	0.901
IFI	0 (no fit) to 1 (perfect fit)	0.859	0.911
CFI	0 (no fit) to 1 (perfect fit)	0.857	0.909
RMSEA	< 0.10	0.072	0.058

5. SUMMARY AND DISCUSSION

The major objective of this research was to propose appropriate performance metrics. In this context, time, cost, quality, safety, and client satisfaction were proposed as the valid indicators of project management performance. The proposed model also involved fourteen constructs as the determinants of project management performance. In the measurement model, all constructs were validated and they were all found to be significant, so there was no need to delete any of those indicators from the model. Moreover, reliability values and fit indexes were found quite satisfactory. Finally, the hypothesized relationships between determinants and the project management performance and the relationships among the determinants by themselves were tested and insignificant paths were eliminated from the model.

5.1. Project Integration Management

As one of the most important components of project management, project integration management has a significant influence on project management performance. Considering the high factor loadings of the variables of project integration management (Table **??**), one should recommend that for enhanced project management performance, firms must achieve process integration (factor loading: 0.836), knowledge integration (0.834), supply chain integration (0.710), and staff integration (0.663). It must be also noted that timely development of project charter (0.761), and integration of changes (0.759) in the project are critical for enhanced project management performance. Heising (2012) also underlined the critical role of integration in project portfolio management. Mitropoulos and Tatum (2000) indicated that the degree of integration affects project performance. The analysis of the proposed project management performance model also revealed that project integration management has a direct influence on the project management performance. In addition, the model revealed that there is a strong link between project integration management and project scope management. In this respect, Crawford (2005) states that project directors, who use the high level of integration and scope practices, are more likely to be the top performers. Therefore, one must note that for enhanced project management performance, the association of project integration and scope management should not be discarded.

5.2. Project Scope Management

According to Fageha and Aibinu (2014), project scope management has a direct impact on the project outcome. Especially, considering high factor loadings for scope planning (factor loading: 0.831), scope definition (0.810), and scope changes (0.732), one must recommend that effective planning of project scope, appropriate definition of scope, and timely handling of scope changes are critical for the effective project scope management. However, it is interesting that the data analysis results showed no significant correlation between project scope management and project management performance. This may be because firms do not indicate clear specifications, roles and responsibilities of the project parties in defining the project scope. This may result in lack of clear benefits, which in turn leads to poor scope management.

To emphasize the importance of project scope management, one might recommend that firms may expand the number of scope documents and clearly indicate their project objectives in those documents, and set effective strategies for the appropriate understating of project deliverables. On the other hand, the model proposed (Figure 4.31) indicates that project scope management has an indirect effect on project management performance through project risk management. In Chou *et al.*, study (2013), it was also implied that project scope management has a direct association with the project risk management. In addition, it was indicated that uncertainties need careful addressing since management of uncertainties is necessary for effective project management. The uncertainties in the projects differ. For example, lack of clear specifications in the project scope or perceptions of roles and responsibilities are among the uncertainties (Atkinson *et al.*, 2006). It was stated that necessary focus should be given on uncertainty to enhance risk management (Ward and Chapman, 2003). This proves that effective management of risks is needed to enhance project management performance.

5.3. Project Time Management

Project Time Management is one of the most critical components of project management. The high factor loading for schedule monitoring, control, and revision (factor loading: 0.865), development of project schedule (0.844), activity definition (0.835), activity sequencing (0.800), and time estimation (0.763) indicate that project time management is achieved when addressing all those indicators in a proper manner. Although researchers have previously indicated that effective project time management contributes to the enhanced project performance (Gayatri and Saurabh, 2013; Ngacho and Das, 2014), no direct association was found between project time management and project management performance. This may be because construction firms in Turkey are more sensitive to under budget completion rather than on time completion. Since owners' expectations mostly focus on the use of monetary resources, it is not surprising that many of the firms put more focus on cost management. In the light of this view, the data analysis results indicated that project time management has an indirect influence on project management performance through project cost management. Although the direct impact of time management on performance was found insignificant, this does not imply that time management is not important for the improved performance. This may be interpreted that time management is still critical for the improved performance despite the fact that relative importance of time management is lower compared to the other knowledge areas.

5.4. Project Cost Management

Several research studies indicated that effective cost is one of the most important factors of project management success (De Wit, 1988; Pinto and Slevin, 1988; Wateridge, 1998; Atkinson, 1999; Lim and Mohamed, 1999). This hypothesis was supported by the analysis results, which provided that project cost management has a moderate effect on project management performance. It appears that enhanced project management performance is achieved through cost estimation (factor loading: 0.954), determination of budget (0.890), and cost control (0.740). In this context, Alshawi and Ingirige (2003) indicated that clients are in greater demand of quality at the lowest price in the projects. Therefore, cost, quality, and schedule objectives should be achieved for successful project management. Indeed, efficient cost management brings the high quality at the lowest price. Based on this information, it is undeniable that efficiency in project cost management facilitates the achievement of quality objectives in the project. However, it is interesting that the data analysis results provided no significant effect of project cost management on project quality management. The reason behind the insignificant association between cost and quality management may stem from the changes contractors and owners' expectations. Since owners and contractors are more focused on time and under budget delivery of projects, quality objectives might fall in the secondary place. Therefore, there might not be a direct association between cost and quality management. However, quality management is critical itself but its relative importance might be low when considering other knowledge areas. To improve quality management practices, firms may develop the quality excellence models or systems and standardize quality documentation in a more proper manner for efficiency in the quality management.

5.5. Project Quality Management

Efficiency in quality management prevents the duplicated efforts and waste in the project. Especially, standardization of quality documents allows project personnel having common understanding of the project objectives. High factor loadings for "quality standardization" (factor loading: 0.944), "quality assurance and control" (0.895), and "quality definition" (0.861) indicate that efficiency in quality management might be achieved through the careful consideration of those components. On the other hand, the data analysis results indicated that project quality does not have a significant influence on the project management performance despite the fact that researchers have previously stated that quality is one of the most important factors of project management success (Atkinson, 1999; Chua *et al.*, 1999; Westerveld, 2003). The reason that lies behind might be that the firms evaluate quality as one of the secondary objectives that must be achieved in the project compared to time and cost objectives. As evidenced by Koskela and Howell (2002), it is stated that quality is one of the external goals in relation with the customer needs. Therefore, firms must shift quality objectives while they are engaged in achieving cost and schedule objectives. Since the client satisfaction has the priority over the other project objectives, firms may better perform in other areas to acquire enhanced performance. However, setting a common language for the project personnel is still very important in project quality management. Hence, firms may also perform better in project quality management by the development of well-set quality systems.

The analysis of the research also proposed that project quality management has a moderate influence on the project procurement management as it was hypothesized. A similar result was obtained by Chou *et al.*, (2013) indicating that project quality management has a direct association with the project quality management.

5.6. Project Human Resource Management

The analysis results provided that project human resource management has both direct and indirect influences on the project management performance. High factor loadings for performance development (factor loading: 0.901), staff training (0.824), performance evaluation (0.817), workforce planning (0.651), and project team composition (0.610) proves that effective human resource management is possible through the careful consideration of those components. Research studies investigated the effect of human resource management on project performance or project success (Huselid, 1995; Guest, 1997). For example, Popaitoon and Siengthai (2014) indicated that knowledge absorption capacity and project performance are highly affected by human resource management practices. Moreover, Belout and Gauvreau (2004) also researched the effect of personnel factor on project success. According to their study, it was shown that personnel factor has a moderating effect on project success. The hypothesized relationship between project human resource management and project management performance was also supported by the analyses results.

The analysis results also provided that project human resource management has a positive effect on project safety management (Figure 4.31). This result is supported by Lai *et al.*, (2011) study indicating that human resource practices are strongly related to the effective safety management where workers are provided with feedback about the unsafe behavior or where the age criteria is taken into consideration in the selection process. Moreover, the relationship between project human resource management and project cost management was also hypothesized and the hypothesis was validated. In this respect, Huselid (1995) indicated that effective human resource management practices have both economic and significant effect on firm's financial performance, turnover, and productivity. In addition, it was indicated that those practices might contribute to the reduction in shirking and increase in the performance of quality employees. This might also encourage the non-performers leave the firms, which has a significant impact on the productivity. Effective management of human resource practices might therefore improve firms' cost management practices in that increased productivity brings the advantages in the cost management practices. The analysis results also indicated that human resource management practices have a considerable impact on the project cost management. This might be interpreted as the firms performing well in project team composition; performance evaluation and staff training are more likely to effectively manage project costs.

5.7. Project Communication Management

The high factor loadings for coordination and collaboration (factor loading: 0.892), knowledge sharing (0.838), communication strategies (0.816), communication technology (0.778), and multi-cultural communication (0.718) indicate that firms employing well-coordinated and collaborated teams, having good coordination strategies and knowledge sharing channels are more likely to have improved performance. The analysis results indicated that project communications management has a considerable influence on project management performance. This is also supported by Badir *et al.*, (2012) study where it is clearly implied that communication is one of the key components of improved performance. In addition, it might be also stated that the use of communication technology and effectiveness in multi-cultural communication might also lead to the improved performance through effectively managing project communication.

It was hypothesized that project communications management has a high influence on the project stakeholder management (Figure 4.31). As evidenced by Pinto and Slevin (1987), communication with stakeholders is stated among the most important project success factors. In addition, Welch and Jackson (2007) also defined the strong interaction between internal communication, which they define as the strategic management of relationships and the stakeholders. The analysis results also revealed that project communications management is positively associated with the project stakeholder management. Therefore, it might be concluded that firms are very much sensitive about the communication with stakeholders in order to achieve higher project success.

5.8. Project Risk Management

By the accurate risk analysis (factor loading: 0.925), risk allocation (0.913), risk control (0.900), and risk identification (0.883), project risk management, firms are more likely to achieve enhanced project management performance. Hwang *et al.*, (2014) implied that effective risk management result in improved performance. This supports the hypothesized relationship that project risk management has a direct effect on the project management performance (Figure 4.31).

The data analysis also revealed that project risk management is strongly associated with project environmental management (Figure 4.31). In this issue, Moore *et al.*, (2004) demonstrated that environmental impacts have harmful consequences. Therefore, effective management of environmental risks is essential (Zhi, 1995). Al-Bahar and Crandall (1990) also implied that environmental risks are among the risk categories for the construction projects. This brings the need for effective environmental management schemes. Therefore, firms developing appropriate risk management schemes are more likely to handle environmental risks, which in turn results in effective environmental management.

It was also hypothesized that project risk management has a direct effect on project financial management. The data analysis results indicated that project risk management has a considerable impact on the project financial management (Figure 4.31). In this respect, Froot *et al.*, (1993) implied that firms' risk management policies strongly rely on the coordination of investment and financing policies. The data collected prove that firms succeeding in handling project risks are more likely to handle financial risks and manage financial operations.

5.9. Project Procurement Management

Project Procurement Management is among the most important constructs of project management. High factor loadings for supplier selection (factor loading: 0.901), type of contract (0.875), supply of resources (0.879), and risk management in the supply process (0.760) indicated that firms are much more effective in the project procurement management through achievement of these components. Previous research also indicated that collaborative practices in project procurement management results in improved performance (Eriksson and Westerberg, 2011). Moreover, it was indicated that project procurement management has a strong influence on project performance in Ling *et al.*, (2009) study. However, the data analysis results found no evidence on the effect of project procurement management on the project management performance. This may be because the importance of the effect of procurement on performance might be relatively than the effect of other knowledge areas on performance. One other reason might be that firms manage supply chain relations through the subcontractors and they do not set up any project procurement management department. Nonetheless, project procurement is critical for performing better in the construction projects. Therefore, firms might need to put more emphasis on project procurement departments and make the best selection among the suppliers.

5.10. Project Stakeholder Management

High factor loadings for stakeholder engagement (0.929), stakeholder needs, interests, and influences (0.913), identification of stakeholders (0.872), and stakeholder conflicts (0.860) indicate that effective stakeholder management is possible through the consideration of these factors. Researchers have previously indicated that project stakeholder management has a strong association with the project management performance or project success. For example, Wateridge (1998) indicated that IS/IT projects' success not only depends on delivery of the projects on time and to budget cost but also the incorporation of the views of stakeholders. Atkinson *et al.*, (2006) also indicated that consideration of the characteristics of project parties is important for effective project management. On the other hand, data analysis results provided no evidence on the significant relationship between project stakeholder management and project management performance. In this respect, some researchers indicated that project stakeholders management is not as important as the other project management constructs such as cost management and time management (Rayner and Reiss, 2001; Thiry, 2002). This may stem from that construction projects involve several stakeholders, which might create conflict in some phases of the projects. Therefore, firms might fail in managing in all those stakeholders. To improve project stakeholder management, firms need to put more focus on the benefits of stakeholder satisfaction and understand the metrics behind the stakeholder.

5.11. Project Safety Management

High factor loadings for safety implementation (factor loading: 0.934), safety planning (0.928), safety inspection and monitoring (0.912), safety awareness and culture (0.910), and safety training (0.894) prove that effective safety management is possible through the careful consideration of these components. Project Safety Management is critical for the effective management of construction projects. Inefficiency in safety practices may lead to serious problems in the projects. Therefore, effective project safety management practices are listed among the key parameters of the project success and improved performance (Shenhar *et al.*, 2001; Alzahrani and Emsley, 2013; Kerzner, 2013). A similar result was obtained by the data analysis indicating that the effectiveness of project safety management leads to improved project management performance. As evidenced by Demirkesen and Arditi (2015), ensuring safety learning in safety training, developing trust in the organizations and teach workers about the safety practices result in improved safety performance. Therefore, firms need to promote their safety management practices in that they organize regular safety meetings, train workers about safety, monitor and control safety practices for achieving improved project management performance.

5.12. Project Environmental Management

High factor loadings for environmental impact (factor loading: 0.959), environmental policies and regulations (0.954), and environmental implementation and control measures(0.913) shows a considerable consistency among the components of project environmental management. Construction projects require the development successful environmental management strategies, environmental implementation and control measures for the effective project management and improved performance (Yang *et al.*, 2012). Montabon *et al.*, (2007) indicated that there is a strong link between the effectiveness of project environmental management and business performance. Chan and Chan (2004) also listed environmental management as one of the key performance indicators of construction project success. However, the data analysis results provided no evidence on the significant relationship between project environmental management and project management performance. This may be because firms are more focused on short term profiting since environmental activities might induce extra costs (Abdalla *et al.*, 2009). Moreover, the relative importance of environmental management might be perceived as low when compared to the importance of other knowledge areas on performance. Therefore, the reason behind low performance in project environmental management may also stem from the lack of awareness for environmental control measures and lack of knowledge in environmental policies and regulations.

Previous research indicated that there is a link between project environmental management and project stakeholder management. It was stated that environmental performance influences a firm's reputation and relationships with the stakeholders (Miles and Covin, 2000; Leach *et al.*, 2002; Reed, 2008). The data analysis also revealed a considerable impact of project environmental management on project stakeholder management. It appears that firms that perform better in environmental activities are more likely to gain a good reputation among stakeholders resulting in the achievement of good relations.

5.13. Project Financial Management

High factor loadings provided that consideration of cash flow analysis (factor loading: 0.917), cash flow planning (0.904), cash flow monitoring and control (0.871), and foreign exchange risk (0.789) are crucial for a successful financial management scheme. Previously conducted research studies have already underlined the importance of project financial management for the project management performance (Sanvido *et al.*, 1992; Dvir *et al.*, 2002; Love *et al.*, 2002; Li *et al.*, 2005). The analysis results also indicated that project financial management has a considerable impact on the project management performance. Love *et al.*, (2002) stated that changing exchange rates, uncertainty in inflation and interest rates might affect a project by means of cash flow and cost of materials and salaries. This brings the need for effective financial management not only for the improved project performance but also efficiency in project cost management. The analysis results also indicated that project financial management has a positive impact on the project cost management. It appears that firms need to carefully consider their financial viability through the cash flow analysis, monitoring and control to perform better in project cost management.

5.14. Project Claim Management

Claims arising in the project directly affect project performance. Therefore, effective claim management is crucial for the improved performance. High factor loadings for claim notification (factor loading: 0.856), claim identification (0.822), claim resolution (0.806), and claim prevention (0.773) indicated that effective claim management is possible through the careful consideration of those factors. Previous research studies mentioned that project claim management has a considerable impact on the project management performance. For example, Li and Wang (2013) indicated that project claim management is very important in improved economic efficiency. Demkin (2001) stated that higher construction costs might occur due to the frequently arising claims in the construction projects, which results in poor project performance.

Tochaiwat and Chovichien (2004) reported that ineffective claim management might have higher impacts on construction costs and time. Semple *et al.*, (1994) stated that claims have significant effect on construction time, resulting in delays, original contract duration was exceeded by 100%. Khanchitvorakul (2000) reported that claims have impact on costs. However, data analysis results prove no evidence that project claim management has a considerable impact on project management performance. This might be interpreted as claim management does not load as much importance as the other knowledge areas load on performance. Firms perform poor in the active notification, analysis and defense of the claims. Similar results were obtained in Tochaiwat and Chovichien's (2004) indicating that a stratified sample of contractors selected performed poor in managing construction claims. The reason behind the poor performance in claim management was found as the necessity for active notification of the change, active negotiation of the claim, and defensive recognition of the change. It appears that the firms need to accelerate the right identification of the claims and notify the interested party on time. Therefore, qualified employees might be hired for the effective management of the claims.

5.15. Project Management Performance

Project Management Performance is very important in terms of determining project success. As previously explained, there are several success criteria for evaluating project success. However, in this study, time, cost, quality, safety, and client satisfaction are determined as the indicators of project success. High factor loadings for client satisfaction and safety indicate that firms are more sensitive about satisfying client (factor loading: 0.656) and performing well in safety (0.634) management for achieving higher success in the projects. On the other hand, quality (0.591), cost (0.500), and time (0.499) have also been shown as the important indicators of project success. The results of the data analysis prove that firms perform well in project management by the careful consideration of project success indicators.

6. CONCLUSIONS

This study proposes a project management performance model for construction firms. In this respect, project management knowledge areas were adopted as the key determinants of performance. The model comprises a total of 63 components related to project management performance. Data was collected from 121 through a questionnaire survey. SEM was used to validate the model and test the hypotheses.

Findings of the study reveal that project integration, human resource, financial, and risk management contribute both directly and indirectly to the improved performance. Project communications, safety, and cost management are found to have direct impact on performance. On the other hand, indirect effects of project scope and time management over risk and cost management are observed. However, the effects of project claim, procurement, quality, stakeholder, and environmental management on performance were not found significant. Apart from the association between the determinants and performance, strong links were observed among the determinants.

Based on the research findings, following recommendationsare provided to improve project management performance:

- Based on the high influence of integration management on performance, it is recommended that firms prioritize key integration initiatives, develop sound feasibility reports and tracking mechanisms, consider issue and change management, make accurate status reporting, and use Lean Project Delivery (LPD) for the efficient integration management. Firms are also encouraged to use the latest technological tools such as Building Information Modeling (BIM), Radio Frequency Identification (RFID), and Enterprise Resource Planning (ERP) for improved performance through integration activities. Firms are also expected to use project based knowledge management systems since construction projects are unique in nature. For the efficiency in the integration management processes, another critical issue is that firms take corrective action in the cases where integrated change control is required.

- Based on the indirect effect of scope management on performance, firms are suggested to set clear objectives at the beginning of the construction projects. As another strategy, it is highly recommended that firms adopt lean management, which aims to minimize waste while maximizing value to the customer. In addition, Just-in-Time (JIT) delivery, a related concept to lean production, is recommended due to its wide variety of advantages such as waste reduction, process simplification, batch size reduction, quicker response to customer, and throughput time reduction. Moreover, firms are suggested to develop team for integrated scope changes so that no claims arise in the further phases of the project. Finally, it is advised that scope changes are carefully addressed and evaluated for the well-being of the project.
- Based on the indirect effect of time management on performance, firms are strongly recommended to clearly define project activities and benefit from concurrent engineering, which is long term business strategy in terms of gaining competitive advantage in time, enhancing productivity, and decreasing design and development time. Furthermore, firms are advised with giving special importance to accurate activity duration estimation and determination of milestones in a correct manner so that efficient time management is put in place. The use of information technology, automation, and innovative products may also enhance project performance. From the perspective of time management, firms are recommend to use latest technological tools and software such as last planner system, which provides several advantages in predictable work flow and rapid learning in programming, design, construction and commissioning of projects and Primavera, which is a scheduling software offering easy tracking and progress monitoring curves for the project performance. It is proposed that firms make use of lean management, JIT, and multi-task construction tools for achieving time reductions. Finally, firms are suggested to benefit from BIM software for the easy follow-up of the processes.
- Based on the direct influence of cost management on performance, firms are advised to develop different bidding models and cost estimation tools at the very early stages of construction projects. Firms are suggested to develop cost break-

down structures, progress monitoring curves and conduct earned value analysis (EVA) to evaluate the current project conditions. Lean management and JIT are also recommended due to the cost advantages. Use of BIM is strongly recommended for the easy coordination and communication for project team so that accurate knowledge sharing is achieved at the maximum level. This may provide cost advantages in terms of accurate estimation of costs and project information. Finally, firms must be sensitive about cost control and monitoring to ensure that the project is delivered within the cost expectations.

- Despite the insignificant influence of quality management on performance, there is still need for effective strategies for achieving quality objectives in construction projects since quality management is interacted with almost all project management knowledge areas. Within this respect, firms need to set up a well-set quality management frame in which quality objectives are clearly defined. Moreover, firms are recommended to benefit from the quality by design aiming to prevent quality problems in the planning processes. Built in Quality (BiQ) is also recommended for the faster, cheaper, and effective products. Another major concern in the construction industry is that majority of the firms do not have standardized quality documents. Therefore, firms are advised with standardizing quality documents for the better follow-up of the quality processes and easy information flow. To enhance quality, firms may organize quality trainings where project teams are provided with the quality functions and stimulated with the quality awareness. In addition, internal quality audits might be organized and check sheets/lists are set for the elimination of faulty applications. Finally, firms are advised to ensure quality of the service and control the quality to check whether the results match with the expectations.
- Based on the direct effect of human resource management on performance, firms must be sensitive about the determination of workforce and team building that best address the project needs. Therefore, the selection of skillful project personnel is at utmost importance. To improve the performance of project personnel, which in turn affects the project performance, firms are recommended to establish reward mechanisms and performance development systems where higher performance is rewarded. Besides, leadership must be taken into account in the context

of human resource practices so that project personnel gain knowledge and skills for determining top priorities in the project. Moreover, building trust and commitment among project personnel is strongly advised to achieve success in future projects.

- Based on the high influence of communications management on performance, it is suggested that firms develop communication strategies for the effective usage of communication channels, tools, and applications. Firms are recommended to standardize project documents such as change orders, request for changes, and request for information for the fact that project personnel easily communicate through those documents. Moreover, firms are proposed to use project-based knowledge management systems, web-based communication, information communication technologies (ICT), and RFID for the time advantages, accurate knowledge transfer, and workforce and inventory management in terms of facilitating communication.
- Based on the positive impact of risk management on performance, firms are recommended to develop sound risk management plans and risk mitigation procedures. Especially, identification, prioritization, screening, analysis and assessment of risks are strongly suggested for the success of risk management processes. Moreover, it is proposed that risk response plans are developed and risk management knowledge is reinforced within the companies. Firms are suggested to improve internal communication for timely handling of risks. In addition, it is encouraged that firms consider uncertainty management, which defines project complexity to enable project success. Finally, risk monitoring and control should be put in place to keep the track of the identified risks, monitor residual risks and identify new risks.
- Despite the low relative importance of procurement management on performance, the procurement practices are still worth mentioning since construction projects' success heavily relies on the good practices in procurement management. Therefore, firms are recommended to develop procurement management plans and procedures at the early stages of construction projects. It is suggested that firms define a selection criteria for the suppliers so that all goods are supplied in better conditions. Along with the selection criteria, firms must select the best type of

contract to be signed with the suppliers where all procurement procedures are clearly stated. This may prevent the claims from arising in the construction processes. Firms are suggested to organize coordination and collaboration by the supply chain integration where all tasks and roles of project teams are implicitly identified. This may bring time savings and communication facilities for the successful execution of projects. A competitive procurement scheme is also proposed to ensure the value for money, which is the optimum combination of whole life costs and quality. Finally, RFID, which is one the major technologies in procurement management is recommended for the just-in-time purchasing and inventory control.

- Despite the insignificant influence of stakeholder management on performance, the management stakeholders is essential in construction projects due to their high influence in decision making processes. Within this respect, it is suggested that firms develop stakeholder management plans at the beginning of construction projects so that stakeholder needs, influences, and interests are considered in the further phases. Lean construction techniques are also greater importance since they are used to deliver maximum value to the customer. It is proposed that agile methods, which rely on the continuous collaboration of stakeholders throughout the project lifecycle by the development of iterative techniques at regular review points, are adopted in construction projects. Furthermore, key stakeholders must be identified and engagement of stakeholders in the processes should be satisfied to best address project needs. Especially, early engagement of stakeholders in the processes might prevent conflicts from arising. To engage stakeholders in the most successful manner, firms must consider the relationship management as the business strategy for the fact that well-set relations are set for enhancing the project teams' contribution to the project. Finally, client satisfaction, which is one of the most important indicators of project success must be taken into account.
- Based on the strong influence of safety management on performance, firms are suggested to develop well-set safety management plans for defining safety procedures. To achieve safety objectives, firms are recommended to build awareness for safety mainly among the workers on site. To prevent workers from poten-

tially being injured or died, safety by design must be adopted as the project policy for providing the workers with the best safety equipment. Similarly, lean construction methods must be adopted since lean methods may support safety infrastructure. As another important strategy for safety, firms must adopt zero accident policy for the prevention of potential hazards or injuries. Frequent safety trainings are essential for reinforcing workers with a work safe culture and prevent accidents from occurring. Incentives mechanisms for safety may be proposed for rewarding workers, who care about the safety concerns. In this way, workers are more motivated and committed to follow safety rules. Use of RFID is suggested for reducing the number of workplace accidents and injuries.

- Despite the insignificant influence of environmental management on performance, environmental issues are the source of major concerns in the project management practices. Therefore, development of environmental management plans at the early stages of construction projects is critical. Furthermore, adoption of lean principles is proposed for the success of environmental management. Another important strategy is suggested as the ensuring sustainability by design, which aims to minimize negative impacts to the environment. Firms are strongly recommended to develop environmental policies, which comply with the governmental institutions for the fact that environmental permits are gained in the easiest manner. Firms are also encouraged to consider environmental implementation, and quantification and measurement of the environmental impacts for the purpose of achieving the best evaluation of environmental concerns. Finally, improvement in the corporate social responsibility practices is advised for the successful handling of environmental concerns.
- Based on the positive influence of financial management on performance, firms are recommended to determine their financial viability before investing in a project. Within this context, they are expected evaluate their financial resources and review their financial state of capital. Moreover, the exchange risk has its critical importance in the financial management in that firms may face with the unexpected exchange rates due to the fluctuations in the market. Besides, financial feasibility planning constitutes an important place before making investment decisions. Therefore, firms are suggested to conduct sound financial feasibilities for

the evaluation of the alternatives. During the construction phases of projects, cash flow calculations are of great importance since materials and resources are extensively provided in this stage. Towards the operation and maintenance phase, an analysis of financial situation and cash flow monitoring is crucial. A well-set financial frame might prevent construction claims from occurring. Finally, financial reporting must be conducted to evaluate the financial effectiveness.

- Despite the insignificant influence of claim management on performance, construction claims need careful assessment. Thus, strategies are of great importance for the prevention of claims or timely resolution of those. For the successful handling of claims, firms are strongly recommended to develop a claim management approach for the effective consideration of claims. The estimation of claims that might arise during the project is essential since potential claims might be prevented this way. Another important strategy in claim management is to have a shared risk contract for having less number of claims. Hiring experienced personnel may also reduce the number of claims arising. Firms, which standardize claim documents, are more likely to handle claims in a more successful manner. In addition to the prevention of claims, resolution of claims occurred is critical. Hence, firms may establish claim resolutions mechanisms for the quick resolution of claims. Owner practices also play an important role in the timely resolution claims. Therefore, owners' expertise in claim management should not be discarded.

Table 6.1 is proposed to guide construction firms for taking the necessary action in terms of construction stages. It includes the summarized tools/strategies and activities above based on those phases. The table provides those tools and strategies needed to increase project management performance depending on the project objectives in each phase.

Table 6.1. Strategies/Tools for Construction Phases.

Construction Phases	Conception		Planning & Design		Construction		Operation & Maintenance		Close-out	
Knowledge Area	Activity	Strategy/ Tool	Activity	Strategy/ Tool	Activity	Strategy/ Tool	Activity	Strategy/ Tool	Activity	Strategy/ Tool
Integration Management	Prioritization of Key Integration Initiatives Development of Feasibility Reports	Change Management Issue Management	Development of Tracking Mechanisms Composition of Integration Teams Status Reporting	Lean Project Delivery Enterprise Resource Planning (ERP)	Development of Tracking Mechanisms Status Reporting	Building Information Modeling (BIM) Project Based Knowledge Management Systems Agile Management	Status Reporting	BIM Use of Project Based Knowledge Management Systems	Status Reporting	Integrated Change Control
Scope Management	Setting Clear Expectations Setting Clear Scope Statement	Lean Management	Development of Scope Management Plans Prioritization of Stakeholders' Expectations	Lean Management	Setting Teams for Scope Changes' Integration Impact Assessment	Lean Management Just-in-Time Delivery	Conducting Integrated Change Control Processes	Lean Management	Evaluating Scope Changes	Post Project Evaluation
Time Management	Clear Definition of Project Activities	Concurrent Engineering	Prioritization of Activities Accurate Activity Duration Estimation Accurate Determination of Milestones	Concurrent Engineering Last Planner System Primavera	Development of Progress Monitoring Curves	Use of BIM and Multi-Task Construction Tools Lean Management Just-in-Time Delivery	Development of Time Recording and Control Tools	Concurrent Engineering Last Planner System Primavera	Project Schedule Control	Post Project Evaluation

Table 6.1. Strategies/Tools for Construction Phases.

Construction Phases	Conception		Planning & Design		Construction		Operation & Maintenance		Close-out	
Knowledge Area	Activity	Strategy/ Tool	Activity	Strategy/ Tool	Activity	Strategy/ Tool	Activity	Strategy/ Tool	Activity	Strategy/ Tool
Cost Management	Composing Different Bidding Models Development of Cost Estimation Tools	Adoption of Lean Thinking in Construction	Determination of Cost Breakdown Structures	Lean Management	Earned Value Analysis (EVA)	Use of BIM Lean Management Just-in-Time Delivery	EVA	Use of BIM	Cost Control and Reporting	Post Project Evaluation
Quality Management	Defining a Well-Set Quality Frame	Adopting Quality by Design	Development of Quality Standardization Documents Development of Built in Quality Incoming Inspection Plan	Involvement of People	Enhancing Quality Awareness Quality Trainings	Internal Quality Audits Check Sheets/ Lists	Enhancing Quality Awareness Quality Trainings	Check Sheets /Lists	Quality Assurance and Control	Post Project Evaluation
Human Resource Management	Determination of Workforce Needed Performance Development	Team Building	Composition of Skilled Project Teams	Team Building	Evaluation of Project Teams' Performance Organizing Regular Staff Training Sessions	Leadership	Performance Evaluation Establishing Reward Mechanisms	Leadership	Acquiring Feedback from Project Personnel	Leadership Building Trust and Commitment Post Project Evaluation

Table 6.1. Strategies/Tools for Construction Phases.

Construction Phases	Conception		Planning & Design		Construction		Operation & Maintenance		Close-out	
Knowledge Area	Activity	Strategy/ Tool	Activity	Strategy/ Tool	Activity	Strategy/ Tool	Activity	Strategy/ Tool	Activity	Strategy/ Tool
Communications Management	Awareness for the Usage of Communication Skills	Setting Communication Strategies	Document Standardization Risk Screening Risk	Setting Communication Strategies	Organizing meetings for enhanced communication Improving Internal Communication Risk	Use of Information Communication Technologies (ICT) Use of RFID Web-Based Communication	Organizing meetings for enhanced communication Conducting Collaborative Practices Encouraging	Web-Based Communication Use of ICT Use of RFID	Evaluation of Communication Activities	Post Project Evaluation
Risk Management	Developing a Risk Management Plan	Adoption of Risk Mitigation Procedures	Prioritization Risk Assessment	Risk Response Planning	Transfer Collaborative Practices Encouraging Risk Management Knowledge	Uncertainty Management	Risk Management Knowledge	Uncertainty Management	Risk Monitoring and Control	Post Project Evaluation
Procurement Management	Developing a Procurement Management Plan	Adoption of Procurement Procedures	Development of Selection Criteria for the Suppliers Selecting the Best Type of Contract with the Suppliers	Supply Chain Integration	Use of Effective Communication Channels for Timely Supply of Resources	Achieving Value for Money	Ensuring the requirements of procurement contracts	Use of RFID	Closing contracts	Post Project Evaluation

Table 6.1. Strategies/Tools for Construction Phases.

Construction Phases	Conception		Planning & Design		Construction		Operation & Maintenance		Close-out	
Knowledge Area	Activity	Strategy/ Tool	Activity	Strategy/ Tool	Activity	Strategy/ Tool	Activity	Strategy/ Tool	Activity	Strategy/ Tool
Stakeholder Management	Developing a Stakeholder Management Plan	Adopting Lean Construction Principles Adoption of Agile Methods	Determination of Key Stakeholders Evaluation of Stakeholders Needs, Interests and Influences Engaging Mechanisms of or Stakeholders Development of Early Conflict Mechanism	Relationship Management	Engaging Stakeholders	Conflict Management	Engaging Stakeholders	Conflict Management	Ensuring Client Satisfaction	Post Project Evaluation
Safety Management	Developing a Safety Management Plan	Building Safety Awareness Safety-by-Design	Lean Management for Safety	Adoption of Zero Accident Policy	Organizing Frequent Safety Trainings and Meetings Composing Monitoring Systems Establishing Incentive Mechanisms for Safety Enhancing Commitment for Safety	Lean Management for Safety	Enhancing Commitment for Safety	Use of RFID Establishing Incentive Mechanisms for Safety	Rewarding Personnel for Safely Completed Work	Post Project Evaluation

Table 6.1. Strategies/Tools for Construction Phases.

Construction Phases	Conception		Planning & Design		Construction		Operation & Maintenance		Close-out	
Knowledge Area	Activity	Strategy/ Tool	Activity	Strategy/ Tool	Activity	Strategy/ Tool	Activity	Strategy/ Tool	Activity	Strategy/ Tool
Environmental Management	Developing an Environmental Management Plan	Adoption of Lean Thinking in Construction Sustainability by Design	Development of Environmental Policies Improving Relationships with Stakeholders, Governmental Agencies and Institutions Development of Environmental Management Systems	Lean Management	Accurate Documentation of Environmental Implementation Quantification and Measurement of Environmental Impact Enhancing Corporate Social Responsibility (CSR)	Lean Management	Measuring Effectiveness of Environmental Management Systems Enhancing CSR	Lean Management	Enhancing CSR	Post Project Evaluation
Financial Management	Determination of Financial Viability Evaluation of Financial Resources	Review of Financial State of Capital	Evaluation of Exchange Risk	Financial Feasibility Planning	Cash Flow Calculations, Analysis, and Monitoring	Reducing Construction Claims	Cash Flow Monitoring	Reducing Construction Claims	Financial Reporting	Post Project Evaluation
Claim Management	Development of a Claim Management Approach Estimating Possible Claims That Might Arise	Shared Risk Contracts	Employing Personnel Having Industry Expertise Standardization of Claim Documents for Timely Handling Establishment of Claim Resolution Mechanisms	Documents for Timely Claim Notifications	Use of Standardized Claim Documents Establishment of Claim Resolution Mechanisms	Dispute Resolution	Use of Standardized Claim Documents Establishment of Claim Resolution Mechanisms	Dispute Resolution	Owner Practices	Post Project Evaluation

Contractors are encouraged to use the proposed model and its components to measure their project management performance and benefit from its findings to improve the low performing areas. Findings show the importance of technology and therefore, firms should invest more on learning advanced tools and concepts to enhance their performance. Although the model is based on completed project information, the study provides strategies that could be used both at pre-project phase and for on-going projects.

One of the limitations of this study is that the data was collected from Turkish contractors and therefore it reflects their experiences and opinions. Data from different projects undertaken by different companies might result in varying findings. However, the main contribution of the study to the literature is that it provides construction specific measures for project management performance. The proposed model could easily be used in other studies and the findings may be used for comparison. This model may set the basis to develop an entirely construction-specific model for measuring project management performance. As a future work, a new set of knowledge areas might be composed along with tools and strategies to support those areas.

APPENDIX A: DESCRIPTIVE STATISTICS

Questionnaire Survey can also be found on this link: *https : //docs.google.com/forms /d/1UmKvL3HrgI6W6Os5Kk − NzSeM1WFKbwCoS6J6*$_8$*9M*$_C$*0/viewform*

A.1. General Information sbout The Company

1) Field of operation

☐ Engineering ☐ Architecture ☐ Construction

2) Number of years that your company has been operating in the construction industry

☐ 0-10 years ☐ 10-20 years ☐ 20-30 years ☐ 30-40 years ☐ >50 years

3) Areas of expertise of your company

☐ Infrastructure ☐ Transportation ☐ Building ☐ Industrial ☐ Water Structures ☐ Other

4) Annual turnover of your company ....

5) Number of total employees in your company ....

6) Your position at the company

☐ Owner ☐ Board Member ☐ Director ☐ Manager ☐ Engineer ☐ Other.

7) Your experience in the construction industry

☐ 0-5 years ☐ 5-10 years ☐ 10-15 years ☐ 15-20 years ☐ >20 years

8) Type of the project

☐ Infrastructure ☐ Transportation ☐ Building ☐ Industrial ☐ Water Structures ☐ Other

9) Project Ownership

☐ Sole ☐ Joint Venture ☐ Consortium ☐ Other.......

10) Role in the project

☐ Contractor ☐ Designer ☐ Client ☐ Sub-Contractor ☐ Other

11) Start Date of Project..

12) Finish Date of Project..

13) Start Date in the Contract..

14) Finish Date in the Contract..

15) Contractual Budget of the Project..

16) Contract type

☐ Unit Price ☐ Lump Sum ☐ Turnkey ☐ Cost Plus Fee ☐ Other

Figure A.1. Respondent and the Project.

A.2. Project Management Performance Framework

Table A.1. Project Integration Management.

SUCCESS CRITERIA		EXTENT IT IS REALIZED BY THE COMPANY				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
PROJECT INTEGRATION MANAGEMENT	Timely Development of Project Charter					
	Effectiveness of Knowledge Integration					
	Efficiency of Process Integration					
	Effectiveness of Staff Integration					
	Effectiveness of Supply Chain Integration					
	Effectiveness of Incorporation of Changes					

Table A.2. Project Scope Management.

SUCCESS CRITERIA		EXTENT IT IS REALIZED BY THE COMPANY				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
PROJECT SCOPE MANAGEMENT	Accuracy of Scope Planning					
	Completeness of Scope Planning					
	Effective Handling of Scope Changes					

Table A.3. Project Time Management.

SUCCESS CRITERIA		EXTENT IT IS REALIZED BY THE COMPANY				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
PROJECT TIME MANAGEMENT	Completeness of Activity Definition					
	Accuracy of Activity Sequencing					
	Accuracy of Time Estimation					
	Appropriateness of Project Schedule					
	Effectiveness of Schedule Monitoring and Control					

Table A.4. Project Cost Management.

SUCCESS CRITERIA		EXTENT IT IS REALIZED BY THE COMPANY				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
PROJECT COST MANAGEMENT	Accuracy of Cost Estimation					
	Accuracy of Budget Determination					
	Effectiveness of Cost Control					

Table A.5. Project Quality Management.

SUCCESS CRITERIA		EXTENT IT IS REALIZED BY THE COMPANY				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
PROJECT QUALITY MANAGEMENT	Appropriateness Quality Definition					
	Effectiveness of Quality Test Procedures					
	Effectiveness of Quality Control and Assurance					

Table A.6. Project Human Resource Management.

SUCCESS CRITERIA		EXTENT IT IS REALIZED BY THE COMPANY				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
PROJECT HUMAN RESOURCE MANAGEMENT	Effectiveness of Team Composition					
	Efficiency of Workforce Planning					
	Frequency of Staff Training					
	Effectiveness of Performance Development					
	Effectiveness of Project Staff Evaluation					

Table A.7. Project Communications Management.

SUCCESS CRITERIA		EXTENT IT IS REALIZED BY THE COMPANY				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
PROJECT COMMUNICATIONS MANAGEMENT	Development of Sound Communication Strategies					
	Effective Use of Communication Technology					
	Effectiveness of Coordination and Collaboration					
	Effectiveness of Knowledge Sharing					
	Effectiveness of Inter-Cultural Communication					

Table A.8. Project Risk Management.

SUCCESS CRITERIA		EXTENT IT IS REALIZED BY THE COMPANY				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
PROJECT RISK MANAGEMENT	Accuracy of Risk Identification					
	Effectiveness of Risk Analysis					
	Appropriateness of Risk Allocation					
	Effectiveness of Risk Control					

Table A.9. Project Procurement Management.

SUCCESS CRITERIA		EXTENT IT IS REALIZED BY THE COMPANY				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
PROJECT PROCUREMENT MANAGEMENT	Effectiveness of Supplier Selection					
	Accuracy of Type of Contract					
	Timely Supply of Resources					
	Effectiveness of Risk Management in the Supply Process					

Table A.10. Project Safety Management.

SUCCESS CRITERIA		EXTENT IT IS REALIZED BY THE COMPANY				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
PROJECT SAFETY MANAGEMENT	Enhancement of Safety Awareness and Culture					
	Effectiveness of Safety Planning					
	Frequency of Safety Training					
	Effectiveness of Safety Implementation					
	Effectiveness of Safety Inspection and Monitoring					

Table A.11. Project Environmental Management.

SUCCESS CRITERIA		EXTENT IT IS REALIZED BY THE COMPANY				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
PROJECT ENVIRONMENTAL MANAGEMENT	Accurate Identification of Environmental Quality Procedures					
	Accurate Determination of Environmental Impact					
	Commitment to Environmental Policies and Regulations					

Table A.12. Project Financial Management.

SUCCESS CRITERIA		EXTENT IT IS REALIZED BY THE COMPANY				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
PROJECT FINANCIAL MANAGEMENT	Effectiveness of Cash Flow Planning					
	Effectiveness of Cash Flow Evaluation					
	Effectiveness of Currency Risk Evaluation					
	Effectiveness of Cash Flow Monitoring and Reporting					

Table A.13. Project Claim Management.

SUCCESS CRITERIA		EXTENT IT IS REALIZED BY THE COMPANY				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
PROJECT CLAIM MANAGEMENT	Accuracy of Claim Identification					
	Timely Handling of Claim Notification					
	Timely Handling of Claim Resolution					
	Effectiveness of Claim Prevention					

Table A.14. Project Stakeholder Management.

SUCCESS CRITERIA		EXTENT IT IS REALIZED BY THE COMPANY				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
PROJECT STAKEHOLDER MANAGEMENT	Complete Identification of Stakeholders					
	Accurate Determination of Stakeholder					
	Needs, Interests and Influences					
	Effectiveness of Stakeholder Engagement					
	Timely Handling of Stakeholder Conflicts					

A.3. Performance Indicators of Turkish Construction Companies

Table A.15. Project Management Performance.

OBJECTIVES		EXTENT IT IS REALIZED BY THE COMPANY				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
PROJECT MANAGEMENT PERFORMANCE	Complete the Project within Schedule					
	Complete the Project within Budget					
	Achieve Required Quality					
	Achieve Required Safety					
	Satisfy the Client					

APPENDIX B: DESCRIPTIVE STATISTICS

Table B.1. Descriptive Statistics of General Information on Respondent Companies.

Statistics	Age	Company Turnover ($M)	Project Value ($M)
Mean	33	612	267.4
Sum	3913	54702.9	26055.5
Median	25	553	11.520
Standard Deviation	24.57	238.49	828.421
Kurtosis	-1.184	-0.87	0.71
Skewness	0.325	0.91	0.786
Range	68	258	799
Minimum	2	0.25	0.004
Maximum	70	6500	8000

Table B.2. Descriptive Statistics of “Project Integration Management”.

Statistics	V1	V2	V3	V4	V5	V6
Mean	3.37	3.43	3.42	3.56	3.45	3.54
Median	3	4	4	4	4	4
Std. Deviation	0.914	0.965	0.864	0.893	0.903	0.958
Variance	0.836	0.93	0.746	0.798	0.816	0.917
Skewness	-0.145	-0.562	-0.7	-0.225	-0.32	-0.513
Std. Error of Skewness	0.22	0.22	0.22	0.22	0.22	0.22
Kurtosis	-0.329	0.086	0.223	-0.009	-0.209	-0.093
Std. Error of Kurtosis	0.437	0.437	0.437	0.437	0.437	0.437
Range	4	4	4	4	4	4
Minimum	1	1	1	1	1	1
Maximum	5	5	5	5	5	5
Sum	408	415	414	431	417	428

Table B.3. Descriptive Statistics of “Project Scope Management”.

Statistics	V7	V8	V9
Mean	3.47	3.57	3.6
Median	4	4	4
Std. Deviation	0.949	0.864	0.908
Variance	0.901	0.747	0.825
Skewness	-0.48	-0.299	-0.619
Std. Error of Skewness	0.22	0.22	0.22
Kurtosis	-0.181	-0.545	0.412
Std. Error of Kurtosis	0.437	0.437	0.437
Range	4	3	4
Minimum	1	2	1
Maximum	5	5	5
Sum	420	432	436

Table B.4. Descriptive Statistics of “Project Time Management”.

Statistics	V10	V11	V12	V13	V14
Mean	3.74	3.56	3.68	3.83	3.68
Median	4	4	4	4	4
Std. Deviation	0.945	0.974	0.915	0.901	1.058
Variance	0.892	0.948	0.837	0.811	1.120
Skewness	-0.852	-0.893	-0.839	-0.831	-0.864
Std. Error of Skewness	0.22	0.22	0.22	0.22	0.22
Kurtosis	0.859	0.656	0.967	1.043	0.455
Std. Error of Kurtosis	0.437	0.437	0.437	0.437	0.437
Range	4	4	4	4	4
Minimum	1	1	1	1	1
Maximum	5	5	5	5	5
Sum	453	431	445	463	445

Table B.5. Descriptive Statistics of “Project Cost Management”.

Statistics	V15	V16	V17
Mean	3.68	3.75	3,71
Median	4	4	4
Std. Deviation	0.887	0.888	0.961
Variance	0.787	0.788	0.924
Skewness	-0.481	-0.579	-0.705
Std. Error of Skewness	0.22	0.22	0.22
Kurtosis	-0.081	0.073	0.279
Std. Error of Kurtosis	0.437	0.437	0.437
Range	4	4	4
Minimum	1	1	1
Maximum	5	5	5
Sum	445	454	449

Table B.6. Descriptive Statistics of “Project Quality Management”.

Statistics	V18	V19	V20
Mean	3.79	3.83	3.82
Median	4	4	4
Std. Deviation	0.856	0.891	0.904
Variance	0.732	0.795	0.817
Skewness	-0.643	-0.583	-0.457
Std. Error of Skewness	0.22	0.22	0.22
Kurtosis	0.374	0.085	-0.483
Std. Error of Kurtosis	0.437	0.437	0.437
Range	4	4	3
Minimum	1	1	2
Maximum	5	5	5
Sum	459	463	462

Table B.7. Descriptive Statistics of "Project Human Resource Management".

Statistics	V21	V22	V23	V24	V25
Mean	3.48	3.46	3.02	2.98	3.06
Median	3	4	3	3	3
Std. Deviation	0.932	0.94	1.000	1.072	1.082
Variance	0.868	0.884	1.000	1.150	1.172
Skewness	-0.284	-0.625	-0.186	-0.008	-0.076
Std. Error of Skewness	0.22	0.22	0.22	0.22	0.22
Kurtosis	-0.032	0.102	-0.436	-0.653	-0.723
Std. Error of Kurtosis	0.437	0.437	0.437	0.437	0.437
Range	4	4	4	4	4
Minimum	1	1	1	1	1
Maximum	5	5	5	5	5
Sum	421	419	365	361	370

Table B.8. Descriptive Statistics of "Project Communications Management".

Statistics	V26	V27	V28	V29	V30
Mean	3.21	3.46	3.59	3.57	3.17
Median	3	4	4	4	3
Std. Deviation	0.965	0.949	0.91	1.023	1.054
Variance	0.932	0.901	0.828	1.047	1.111
Skewness	-0.145	-0.219	-0.701	-0.62	-0.528
Std. Error of Skewness	0.22	0.22	0.22	0.22	0.22
Kurtosis	-0.728	-0.675	0.09	-0.185	-0.384
Std. Error of Kurtosis	0.437	0.437	0.437	0.437	0.437
Range	4	4	4	4	4
Minimum	1	1	1	1	1
Maximum	5	5	5	5	5
Sum	388	419	434	432	384

Table B.9. Descriptive Statistics of "Project Risk Management".

Statistics	V31	V32	V33	V34
Mean	3.26	3.19	3.16	3.19
Median	3	3	3	3
Std. Deviation	0.971	1.075	1.080	1.098
Variance	0.942	1.155	1.167	1.205
Skewness	-0.37	-0.511	-0.44	-0.309
Std. Error of Skewness	0.22	0.22	0.22	0.22
Kurtosis	-0.383	-0.623	-0.558	-0.554
Std. Error of Kurtosis	0.437	0.437	0.437	0.437
Range	4	4	4	4
Minimum	1	1	1	1
Maximum	5	5	5	5
Sum	394	386	382	386

Table B.10. Descriptive Statistics of "Project Procurement Management".

Statistics	V35	V36	V37	V38
Mean	3.73	3.79	3.56	3.43
Median	4	4	4	4
Std. Deviation	0.983	1.018	1.016	1.079
Variance	0.967	1.037	1.032	1.164
Skewness	-0.87	-0.759	-0.729	-0.605
Std. Error of Skewness	0.22	0.22	0.22	0.22
Kurtosis	0.543	0.069	0.069	-0.197
Std. Error of Kurtosis	0.437	0.437	0.437	0.437
Range	4	4	4	4
Minimum	1	1	1	1
Maximum	5	5	5	5
Sum	451	458	431	415

Table B.11. Descriptive Statistics of “Project Stakeholder Management”.

Statistics	V39	V40	V41	V42
Mean	3.38	3.4	3.5	3.33
Median	3	3	4	3
Std. Deviation	0.915	0.926	0.932	1.028
Variance	0.838	0.858	0.869	1.056
Skewness	-0.103	-0.171	-0.396	-0.282
Std. Error of Skewness	0.22	0.22	0.22	0.22
Kurtosis	-0.299	-0.086	-0.013	-0.289
Std. Error of Kurtosis	0.437	0.437	0.437	0.437
Range	4	4	4	4
Minimum	1	1	1	1
Maximum	5	5	5	5
Sum	409	411	423	403

Table B.12. Descriptive Statistics of “Project Safety Management”.

Statistics	V43	V44	V45	V46	V47
Mean	3.62	3.64	3.56	3.67	3.65
Median	4	4	4	4	4
Std. Deviation	1.105	1.110	1.095	1.044	1.093
Variance	1.221	1.231	1.198	1.090	1.195
Skewness	-0.441	-0.559	-0.374	-0.372	-0.477
Std. Error of Skewness	0.22	0.22	0.22	0.22	0.22
Kurtosis	-0.611	-0.411	-0.345	-0.489	-0.511
Std. Error of Kurtosis	0.437	0.437	0.437	0.437	0.437
Range	4	4	4	4	4
Minimum	1	1	1	1	1
Maximum	5	5	5	5	5
Sum	438	441	431	444	442

Table B.13. Descriptive Statistics of “Project Environmental Management”.

Statistics	V48	V49	V50
Mean	3.34	3.36	3.33
Median	3	4	3
Std. Deviation	1.053	1.049	1.106
Variance	1.109	1.100	1.223
Skewness	-0.239	-0.513	-0.426
Std. Error of Skewness	0.22	0.22	0.22
Kurtosis	-0.581	-0.306	-0.429
Std. Error of Kurtosis	0.437	0.437	0.437
Range	4	4	4
Minimum	1	1	1
Maximum	5	5	5
Sum	404	407	403

Table B.14. Descriptive Statistics of “Project Financial Management”.

Statistics	V51	V52	V53	V54
Mean	3.6	3.6	3.45	3.67
Median	4	4	4	4
Std. Deviation	0.944	1.020	1.016	1.068
Variance	0.891	1.041	1.033	1.140
Skewness	-0.576	-0.62	-0.409	-0.64
Std. Error of Skewness	0.22	0.22	0.22	0.22
Kurtosis	0.136	0.088	-0.401	-0.101
Std. Error of Kurtosis	0.437	0.437	0.437	0.437
Range	4	4	4	4
Minimum	1	1	1	1
Maximum	5	5	5	5
Sum	436	436	417	444

Table B.15. Descriptive Statistics of “Project Claim Management”.

Statistics	V55	V56	V57	V58
Mean	3.54	3.41	3.19	3.36
Median	4	3	3	3
Std. Deviation	0.913	0.955	1.027	0.973
Variance	0.834	0.911	1.055	0.948
Skewness	-0.145	-0.04	-0.25	-0.217
Std. Error of Skewness	0.22	0.22	0.22	0.22
Kurtosis	-0.461	-0.7	-0.466	-0.476
Std. Error of Kurtosis	0.437	0.437	0.437	0.437
Range	4	4	4	4
Minimum	1	1	1	1
Maximum	5	5	5	5
Sum	428	413	386	406

Table B.16. Descriptive Statistics of “Project Management Performance”.

Statistics	V59	V60	V61	V62	V63
Mean	3.43	3.23	3.67	3.45	3.28
Median	3	3	4	4	3
Std. Deviation	0.874	0.824	0.889	0.922	0.829
Variance	0.764	0.679	0.79	0.85	0.687
Skewness	-0.429	-0.183	-0.527	-0.254	-0.3
Std. Error of Skewness	0.22	0.22	0.22	0.22	0.22
Kurtosis	0.623	-0.558	-0.061	-0.287	0.317
Std. Error of Kurtosis	0.437	0.437	0.437	0.437	0.437
Range	4	4	4	4	4
Minimum	1	1	1	1	1
Maximum	5	5	5	5	5
Sum	415	391	444	418	397

APPENDIX C: CORRELATION MATRICES

Table C.1. Intercorrelations for the Variables of “Project Integration Management”.

F1	V1	V2	V3	V4	V5	V6
V1	1.000	0.677	0.613	0.466	0.463	0.531
V2	0.677	1.000	0.741	0.452	0.553	0.578
V3	0.613	0.741	1.000	0.533	0.558	0.671
V4	0.466	0.452	0.533	1.000	0.637	0.599
V5	0.463	0.553	0.558	0.637	1.000	0.607
V6	0.531	0.578	0.671	0.599	0.607	1.000

Table C.2. Intercorrelations for the Variables of “Project Scope Management”.

F2	V7	V8	V9
V7	1.000	0.787	0.567
V8	0.787	1.000	0.652
V9	0.567	0.652	1.000

Table C.3. Intercorrelations for the Variables of “Project Time Management”.

F3	V10	V11	V12	V13	V14
V10	1.000	0.711	0.685	0.653	0.692
V11	0.711	1.000	0.589	0.682	0.703
V12	0.685	0.589	1.000	0.69	0.632
V13	0.653	0.682	0.69	1.000	0.771
V14	0.692	0.703	0.632	0.771	1.000

Table C.4. Intercorrelations for the Variables of “Project Cost Management”.

F4	V15	V16	V17
V15	1.000	0.871	0.73
V16	0.871	1.000	0.687
V17	0.73	0.687	1.000

Table C.5. Intercorrelations for the Variables of “Project Quality Management”.

F5	V18	V19	V20
V18	1.000	0.816	0.759
V19	0.816	1.000	0.85
V20	0.759	0.85	1.000

Table C.6. Intercorrelations for the Variables of “Project Human Resource Management”.

F6	V21	V22	V23	V24	V25
V21	1.000	0.715	0.394	0.475	0.542
V22	0.715	1.000	0.462	0.545	0.547
V23	0.394	0.462	1.000	0.801	0.646
V24	0.475	0.545	0.801	1.000	0.726
V25	0.542	0.547	0.646	0.726	1.000

Table C.7. Intercorrelations for the Variables of “Project Communications Management”.

F7	V26	V27	V28	V29	V30
V26	1.000	0.704	0.715	0.605	0.669
V27	0.704	1.000	0.696	0.618	0.569
V28	0.715	0.696	1.000	0.792	0.553
V29	0.605	0.618	0.792	1.000	0.603
V30	0.669	0.569	0.553	0.603	1.000

Table C.8. Intercorrelations for the Variables of “Project Risk Management”.

F8	V31	V32	V33	V34
V31	1.000	0.848	0.772	0.775
V32	0.848	1.000	0.843	0.817
V33	0.772	0.843	1.000	0.846
V34	0.775	0.817	0.846	1.000

Table C.9. Intercorrelations for the Variables of "Project Procurement Management".

F9	V35	V36	V37	V38
V35	1.000	0.823	0.764	0.606
V36	0.823	1.000	0.714	0.646
V37	0.764	0.714	1.000	0.766
V38	0.606	0.646	0.766	1.000

Table C.10. Intercorrelations for the Variables of "Project Stakeholder Management".

F10	V39	V40	V41	V42
V39	1.000	0.843	0.813	0.76
V40	0.843	1.000	0.861	0.78
V41	0.813	0.861	1.000	0.836
V42	0.76	0.78	0.836	1.000

Table C.11. Intercorrelations for the Variables of "Project Safety Management".

F11	V43	V44	V45	V46	V47
V43	1.000	0.888	0.812	0.815	0.807
V44	0.888	1.000	0.825	0.84	0.825
V45	0.812	0.825	1.000	0.857	0.791
V46	0.815	0.84	0.857	1.000	0.899
V47	0.807	0.825	0.791	0.899	1.000

Table C.12. Intercorrelations for the Variables of "Project Environmental Management".

F12	V48	V49	V50
V48	1.000	0.876	0.862
V49	0.876	1.000	0.916
V50	0.862	0.916	1.000

Table C.13. Intercorrelations for the Variables of “Project Financial Management”.

F13	V51	V52	V53	V54
V51	1.000	0.847	0.681	0.753
V52	0.847	1.000	0.687	0.797
V53	0.681	0.687	1.000	0.767
V54	0.753	0.797	0.767	1.000

Table C.14. Intercorrelations for the Variables of “Project Claim Management”.

F14	V55	V56	V57	V58
V55	1.000	0.776	0.61	0.59
V56	0.776	1.000	0.65	0.621
V57	0.61	0.65	1.000	0.732
V58	0.59	0.621	0.732	1.000

Table C.15. Intercorrelations for the Variables of “Project Management Performance”.

F15	V59	V60	V61	V62	V63
V59	1.000	0.497	0.453	0.366	0.741
V60	0.497	1.000	0.435	0.464	0.502
V61	0.453	0.435	1.000	0.602	0.693
V62	0.366	0.464	0.602	1.000	0.584
V63	0.741	0.502	0.693	0.584	1.000

REFERENCES

Aaltonen, K., J. Kujala, 2010, “A Project Lifecycle Perspective on Stakeholder Influence Strategies in Global Projects”, *Scandinavian Journal of Management*, Vol. 26, No. 4, pp. 381-397.

Abdalla, G., G. Maas, J. Huyghe, 2009, “Barriers to Zero Energy Construction Technically Possible Why Not Succeed Yet”, *Proceedings, 26th International Passive and Low Energy Architecture Conference*, Quebec, Canada.

Abdul-Malak M.A., M.M. El-Saadi, M.G. Abou-Zeid, 2002, “Process Model for Administrating Construction Claims”, *Journal of Management in Engineering*, Vol. 18, No. 2, pp. 84-94.

Abdul-Malak, M. and M. El-Saadi, 2000, “Claim-Avoidance Administrative Procedures for Construction Projects”, *Construction Congress VI*, Vol. 1, pp. 584-592.

Abrantes, R. and J. Figueiredo, 2014, “Feature Based Process Framework to Manage Scope in Dynamic NPD Portfolios”, *International Journal of Project Management*, Vol. 32, No. 5, pp. 874-884.

Abeyasinghe, M.C.L., D.J. Greenwood, D.E. Johansen, 2001, “An Efficient Method for Scheduling Construction Projects with Resource Constraints”, *International Journal of Project Management*, Vol. 19, No. 1, pp. 29-45.

Achterkamp, M.C., J.F.J. Vos, 2008, “Investigating the use of the Stakeholder Notion in Project Management Literature”, *A Meta-Analysis. International Journal Project Management*, Vol. 26, pp. 749-757.

Ahsan, K., I. Gunawan, 2010, “Analysis of Cost and Schedule Performance of International Development Projects”, *International Journal Project Management*, Vol. 28, No. 1, pp. 68-78.

Ahuja, V., J. Yang, M. Skitmore, R. Shankar, 2010, “An Empirical Test of Causal Relationships of Factors Affecting ICT Adoption for Building Project Management: An Indian SME Case Study”, *Construction Innovation Influence Proceeding Management*, Vol. 10, No. 2, pp. 164-180.

Aibinu, A.A., T. Pasco, 2008, “The Accuracy of Pre-Tender Building Cost Estimates in Australia”, *Construction Management and Economics*, Vol. 26, pp. 1257-1269.

Akanni, P.O., A.E. Oke, *et al.*, 2015, “Impact of Environmental Factors on Building Project Performance in Delta State Nigeria”, *Housing and Building National Research Center Journal*, Vol. 11, No. 1, pp. 91-97.

Akintoye, A., E. Fitzgerald, 2000, “A Survey of Current Cost Estimating Practices in the United Kingdom”, *Construction Management and Economics*, Vol. 18, pp. 161-172.

Alarcon, L.F., S. Diethelm and O. Rojo, 2002, “Collaborative Implementation of Lean Planning Systems in Chilean Construction Companies”, *Proceedings of the IGLC-10 Conference Gramado* , Brazil.

Al-Bahar, J.F, K.C. Crandall, 1990, “Systematic Risk Management Approach for Construction Projects”, *Journal Construction Engineering Management*, Vol. 116, No. 3, pp. 533-546.

Albert, A., R.M. Hallowell, M.B. Kleiner, 2014, “Enhancing Construction Hazard Recognition and Communication with Energy-Based Cognitive Mnemonics and Safety Meeting Maturity Model: Multiple Baseline Study”, *Journal of Construction Engineering and Management*, Vol. 10, pp. 1943-7862.

Ali, M.A.E.H, A.I. Al-Sulaihi, S.K. Al-Gahtani, 2013, “Indicators for Measuring Performance of Building Construction Companies in Kingdom of Saudi Arabia”, *Journal of King Saud University - Engineering Sciences*, Vol. 25, pp. 125-134.

Aliverdi, R., *et al.*, 2013, "Monitoring Project Duration and Cost in A Construction Project by Applying Statistical Quality Control Charts", *International Journal of Project Management*, Vol, 31, No. 3, pp. 411-423.

Almahmoud, E.S., H.K. Doloi, K. Panuwatwanich, 2012, "Linking Project Health to Project Performance Indicators: Multiple Case Studies of Construction Projects in Saudi Arabia", *International Journal of Project Management*, Vol. 30, No. 3, pp. 296-307.

Aloini, D., R. Dulmin, V. Mininno, 2012, "Modelling and Assessing ERP Project Risks: A Petri Net Approach", *European Journal Operation Resistance*, Vol. 220, No. 2, pp. 484-495.

Alshawi, M., and B. Ingirige, 2003, "Web-Enabled Project Management: An Emerging Paradigm in Construction", *Automation Construction*, Vol. 12, No. 4, pp. 349-364.

Alzahrani, J.I. and M.W. Emsley, 2013, "The Impact of Contractors Attributes on Construction Project Success: A Post Construction Evaluation", *International Journal of Project Management*, Vol. 31, No. 2, pp. 313-322.

Andersen, E.S., S.A. Jessen, 2003, "Project Maturity in Organizations", *International Journal of Project Management*, Vol. 21, No. 6, pp. 457-461.

Anderson, J.C., D.W. Gerbing, 1988, "Structural Equation Modeling in Practice: A Review and Recommended", *Two-Step Approaches Psychological Bulletin*, Vol. 103, No. 3, pp. 41-423.

April, A., A. Abran, 2009, "A Software Maintenance Maturity Model (S3M): Measurement Practices at Maturity Levels 3 and 4", *Electronic Notes in Theoretical Computer Science*, Vol. 233, No. 27, pp. 73-G.

Ardichvili, A., V. Page, and T. Wentling, 2003, "Motivation and Barriers to Participation in Virtual Knowledge-Sharing Communities of Practice", *Journal Knowledge Management*, Vol. 7, No. 1, pp. 64-77.

Arditi, D. and H.M. Günaydın, 1997, "Total Quality Management in the Construction Process", *International Journal of Project Management*, Vol. 15, No. 4, pp. 235-243.

Arriagada, D.R. and C.L. Alarcón, 2014, "Knowledge Management and Maturation Model in Construction Companies", Journal Construction Engineering Management, Vol. 140, No. 4, pp. B4013006.

Artto, K.A., J.M. Lehtonen, J. Saranen, 2001, "Managing Projects Front-End: Incorporating a Strategic Early View to Project Management with Simulation", *International Journal of Project Management*, Vol. 19, pp. 255-264.

Atkinson, R. 1999, Project Management: Cost, Time and Quality, Two Best Guesses and a Phenomenon, its time to Accept Other Success Criteria. International Journal of Project Management, Vol. 17, No. 6, pp. 337-342.

Atkinson, R., L. Crawford, *et al.*, 2006, "Fundamental Uncertainties in Projects and the Scope of Project Management", *International Journal of Project Management*, Vol. 24, No. 8, pp. 687-698.

Badir, Y.F., B. Büchel, *et al.*, 2012, "A Conceptual Framework of the Impact of NPD Project Team and Leader Empowerment on Communication and Performance: An Alliance Case Context", *International Journal of Project Management*, Vol. 30, No. 8, pp. 914-926.

Bagozzi, R.P., Y. Yi, 2012, "Specification, Evaluation and Interpretation of Structural Equation Models", *Journal of the Academy of Marketing Science*, Vol. 40, pp. 8-34.

Bakker, K., *et al.*, 2010, "Does Risk Management Contribute to IT Project Success?

A Meta-Analysis of Empirical Evidence", *International Journal of Project Management*, Vol. 28, No. 5, pp. 493-503.

Bassioni, H.A., A.D.F. Price, and T.M. Hassan, 2004, "Performance Measurement in Construction", *Journal of Management in Engineering, American Society of Civil Engineers*, Vol. 20, pp. 42-50.

Baxendale, T., and O. Jones, 2000, "Construction Design and Construction Management Safety Regulations in Practice-Progress and Implementation", *International Journal Project Management*, Vol. 18, No. 1, pp. 33-40.

Bayless, R. 1986, "Contractor's Quality Control and Owner's Guidelines", *Journal Professor Issues in Engineering*, Vol. 112, No. 4, pp. 230-235.

Beard, J., M.C. Loukakis and E.C. Wundram, 2001, "Design-build: Planning Through Development", *McGraw-Hill*, New York.

Becker, J., R. Knackstedt and J. Pöppelbuβ, 2009, "Developing Maturity Models for IT Management", *Business Information System Engineering*, Vol. 1, No. 3, pp. 213-222.

Belout, A., 1998, "Effects of Human Resource Management on Project Effectiveness and Success: Towards a New Conceptual Framework", *International Journal Projects Management*, Vol. 16, No. 1, pp. 21-26.

Belout, A., C. Gauvreau, 2004, "Factors Influencing Project Success: the Impact of Human Resource Management", *International Journal of Project Management*, Vol. 22, No. 1, pp. 1-11.

Bentler, P.M., 1989, "EQS Structural Equations Program Manual", *Statistical Software*, Los Angeles.

Bentler, P.M., 1990, "Comparative Fit Indexes in Structural Models", *Psychological Bulletin*, Vol. 107, pp. 238-246.

Berg, E., D. Knudsen, A. Norrman, 2008, "Assessing Performance of Supply Chain Risk Management Programmes: a Tentative Approach", *International Journal of Risk Assessment and Management*, Vol. 9, pp. 288-310.

Beringer, C., D. Jonas, *et al.*, 2013, "Behavior of Internal Stakeholders in Project Portfolio Management and its Impact on Success", *International Journal of Project Management*, Vol. 31, No. 6, pp. 830-846.

Berssaneti, F.T., M.M. Carvalho, 2015, "Identification of Variables that Impact Project Success in Brazilian Companies", *International Journal of Project Management*, Vol. 33, No. 3, pp. 638-649.

Beset, A., 2007, *A Model For Assessing Project Management Maturity Level of Architectural Design Offices (Arch-Pmm)*, PhD Thesis, Izmir Institute of Technology.

Bhagwat, R. and M.K. Sharma, 2007, "Performance Measurement of Supply Chain Management: A Balanced Scorecard Approach", *Computers & Industrial Engineering*, Vol. 53, No. 1, 43-62.

Birasnav, M., 2014, "Knowledge Management and Organizational Performance in the Service Industry: The Role of Transformational Leadership Beyond the Effects of Transactional Leadership", *Journal of Business Research*, Vol. 67, No. 8, pp. 1622-1629.

Birkinshaw, J., H. Bresman and L. Hakanson, 2000, "Managing the Post-Acquisition Integration Process: How the Human Integration and Task Integration Processes Interact to Foster Value Creation", *Journal of Management Studies*, Vol. 37, No. 3, pp. 395-425.

Bollen, K.A. 1986, "Sample Size and Bentler and Bonett's no Normed Fit Index", *Psychometrika*, Vol. 51, pp. 375-377.

Bollen, K.A., S.L. Long, 1993, "Testing Structural Equation Modeling", *Sage Publica-*

tion, Newbury, United Kingdom.

Boussabaine, A.H. and A.P. Kaka, 1998, "A Neural Networks Approach for Cost Flow Forecasting", *Construction Management and Economics*, Vol. 16, pp. 471-479.

Bowen, P.A., K.A. Hall, *et al.*, 2002, "Perceptions of Time, Cost and Quality Management on Building Projects", *The Australian Journal of Construction and Economics*, Vol. 2, No. 2, pp. 48-56.

Bower, D., G. Ashby, K. Gerald and W. Smyk, 2002, "Incentive Mechanisms for Project Success", *Journal Management Engineering*, Vol. 18, No. 1, pp. 37-43.

Bradley, R. and C. Tomasides, 1991, "Financial Management as Tool for Management Development of Engineers", *Journal Management Engineering*, Vol. 7, No. 2, pp. 223-236.

Brettel, M., F. Heinemann, A. Engelen, S. Neubauer, 2011, "Cross-Functional Integration of R&D, Marketing and Manufacturing in Radical and Incremental Product Innovations and its Effects on Project Effectiveness and Efficiency", *Journal of Product Innovation Management*, Vol. 28, No. 2, pp. 251-269.

Brown, A.W., J.D. Adams, 2000, "Measuring the Effect of Project Management on Construction Outputs: A New Approach", *International Journal Project Management*, Vol. 18, pp. 327-35.

Browne, M.W., R. Cudeck, 1993, "Alternative Ways of Assessing Model Filtration Testing Structural Equation Models", *Sage; Newbury Park*, Vol. 1, pp. 136-162.

Brown, A.W., *et al.*, 2007, "The Relationship Between Human Capital and Time Performance in Project Management: A Path Analysis", *International Journal of Project Management*, Vol. 25, No. 1, pp. 77-89.

Buller, P.F. and G.M. McEvoy, 2012, "Strategy, Human Resource Management and Performance: Sharpening Line of Sight", *Human Resource Management Review*, Vol. 22, No. 1, pp. 43-56.

Byrne, B.M., 2006, "Structural Equation Modeling with EQS: Basic Concepts, Applications, and Programming, 2nd Ed., *Lawrence Erlbaum Associates*, London.

Byrne, B.M. 2001, "Structural Equation Modeling with AMOS, EQS, and LISREL: Comparative Approaches to Testing for the Factorial Validity of a Measuring Instrument", *International Journal of Testing*, Vol. 11, pp. 55-86.

Carlile, P.R., E.S. Rebentisch, 2003, "Into the Black Box: the Knowledge Transformation Cycle", *Management Science*, Vol. 49, No. 9, pp. 1180-1195.

Carmeli, A., HaleviMeyrav, Y. 2009, "How top Management Team Behavioral Integration and Behavioral Complexity Enable Organizational Ambidexterity: the Moderating Role of Contextual Ambidexterity", *Leadership Quarterly*, Vol. 20. No. 2, pp. 207-218.

Carmeli, A., J. Schaubroeck, 2006, "Top Management Team Behavioral Integration, Decision Quality, and Organizational Declineé, *Leadership Quarterly*, Vol. 17, No. 5, pp. 441-453.

Caron, F., G. Marchet, 1998, "Project Logistics: Integrating the Procurement and Construction Processes", *International Journal of Project Management*, Vol. 165, pp. 311-319.

Carr, R.I., 1993, "Cost, Schedule and Time Variances and Integration", *Journal of Construction Engineering and Management*, Vol. 1, pp. 245-265.

Chan, A., D. Scott and A. Chan, 2004, "Factors Affecting the Success of a Construction Project", *Journal Construction Engineering Management*, Vol. 1301, pp. 153-155.

Chan, A., D. Scott and E. Lam, 2002, "Framework of Success Criteria for Design/Build Projects", *Journal Management Engineering*, Vol. 183, pp. 120-128.

Chan, A.P.C., A.P.L. Chan, 2004, “Key Performance Indicators for Measuring Construction Success”, *International Journal of Benchmarking*, Vo. 112, pp. 203-221.

Chang, A., Y.Y. Chih, *et al.*, 2013, “Reconceptualising Mega Project Success in Australian Defence: Recognising the Importance of Value Co-Creation”, *International Journal of Project Management*, Vol. 318, pp. 1139-1153.

Cheng, E.W.L., N. Ryan, *et al.*, 2012, “Exploring the Perceived Influence of Safety Management Practices on Project Performance in the Construction Industry”, *Safety Science*, Vol. 502, pp. 363-369.

Cheng, M.Y., H.C. Tsai, *et al.*, 2009, “Construction Management Process Reengineering Performance Measurements”, *Automation in Construction*, Vol. 182, pp. 183-193.

Chimnowsky, P., K. Molenaar, A. Realph, 2007, “Learning Organizations in Construction”, *Journal Management Engineering*, Vol. 23, pp. 27-34.

Cho, S., R.H. Woods, *et al.*, 2006. “Measuring the Impact of Human Resource Management Practices on Hospitality Firms’ Performances”, *International Journal of Hospitality Management*, Vol. 252, pp. 262-277.

Chopra, S., M.S. Sodhi, 2004, “Managing Risk to Avoid Supply-Chain Breakdown”, *MIT Sloan Management Review*, Vol. 46, pp. 53-62.

Chou, C.P., P.M. Bentler and A. Satorra, 1991, “Scaled Test Statistics and Robuststandard Errors for Non-Normal Data in Covariance Structure Analysis: A Montecarlo Study”, *British Journal of Mathematical and Statistical Psychology*, Vol. 442, pp. 347-357.

Chou, J., N. Irawan, and A. Pham, 2013, “Project Management Knowledge of Construction Professionals: Cross-Country Study of Effects on Project Success”, *Journal Construction Engineering Management*, Vol. 13, No. 911, pp. 401-3015.

Chou, J.S., M. Peng, K.R. Persad, J.T. O'Connor, 2006, "Quantity-Based Approach to Preliminary Cost Estimates for Highway Projects", *Transportation Research Record*, Vol. 1, pp. 22-30.

Choudhry, R.M. 2014, "Behavior-Based Safety on Construction Sites: A Case Study", *Activation Analysis Predation*, Vol. 70, pp. 14-23.

Chovichien, V., T.A. Nguyen, 2013, "List of Indicators and Criteria for Evaluating Construction Project Success and Their Weight Assignment", *Proceedings of the 4th International Conference on Engineering*, Project and Production Management.

Chua, D.K.H., Y.C. Kog and P.K. Loh, 1999, "Critical Success Factors for Different Project Objectives", *Journal of Construction Engineering and Management*, Vol. 125, pp. 142-150.

Chua, D.K.H., Y.C. Kog, P.K. Loh, 1999, "Critical Success Factors for Different Project Objectives", *Journal of Construction Engineering and Management*, Vol. 125, No. 3, pp. 142-150.

Clark, I., T. Colling, 2005, "The Management of Human Resources in Project Management Led Organizations", *Presentation Revelation*, Vol. 34, pp. 178-191.

Clark, I., T. Colling, 2005, "The Management of Human Resources in Project Management Led Organizations", *Presentation Revelation*, Vol. 34, pp. 178-191.

Cookie-Davies, T., 2002, "The Real Success Factors on Projects", *International Journal of Project Management*, Vol. 20, No. 3, pp. 185-190.

Cookie-Davies, T., 2002, "The Real Success Factors on Projects", *International Journal of Project Management*, Vol. 20, No. 3, pp. 185-190.

Cooper, R.G., S.J. Edgett, E.J. Kleinschmidt, 2004, "Benchmarking Best NPD Practices-III. Research", *Technology Management*, Vol. 47, No. 6, pp. 43-55.

Cox, A., 1996, "Relational Competence and Strategic Procurement Management", *European Journal of Purchasing and Supply Management*, Vol. 2, No. 1, pp. 57-70.

Cox, A., P. Ireland and M. Townsend, 2006, "Managing in Construction Supply Chains and Markets: Reactive and Proactive Options for Improving Performance and Relationship Management", *Thomas Telford Publishing*, London.

Cox, R., R. Issa and D. Ahrens, 2003, "Management's Perception of Key Performance Indicators for Construction", *Journal of Construction Engineering and Management*, Vol. 1292, pp. 142-151.

Crawford, C.B., 2005, "Effects of Transformational Leadership and Organizational Position on Knowledge Management", *Journal of Knowledge Management*, Vol. 9, pp. 6-16.

Cserháti, G., L. Szabó, 2014, "The Relationship Between Success Criteria and Success Factors in Organisational Event Projects", *International Journal of Project Management*, Vol. 324, pp. 613-624.

Cuenca, L., A. Boza, M.M.E. Alemany, J.J.M. Trienekens, 2013, "Structural Elements of Coordination Mechanisms in Collaborative Planning Processes and their Assessment Through Maturity Models: Application to a Ceramic Tile Company", *Computers in Industry*, Vol. 64, pp. 898-911.

Cummings, T., C. Worley, 2009, "Organization, Development and Change", *9th ed. South-Western Cengage Learning*, Mason, OH.

Dammer, H., 2008, "Multi Project Management, *Gruppe Württembergischer Verleger Fachverlage*, Gabler, Wiesbaden.

Davies, T.J.C., A. Arzymanow, 2003, "The Maturity of Project Management in Different Industries: An Investigation Into Variations Between Project Management

Models", *International Journal of Project Management*, Vol. 21, pp. 471-478.

De Wit, A. 1988, "Measurement of Project Management Success", *International Journal of Project Management*, Vol. 6 No. 3, pp. 164-70.

Delery, J.E., D.H. Doty, 1996, "Modes of Theorizing in Strategic Human Resource Management: Tests of Universalistic, Contingency, and Configurational Performance Predictions", *Academic Management Journal*, Vol. 39, pp. 802-835.

Delery, J.E., D.H. Doty, 1996, "Modes of Theorizing in Strategic Human Resource Management: Tests Of Universalistic, Contingency, and Configurational Performance Predictions", *Academic Management Journal*, Vol. 39, pp. 802-835.

Demir, C., I. Kocabas, 2010, "Project Management Maturity Model Project Management Maturity Model in educational organizations", *Procedia Social and Behavioral Sciences*, Vol. 9, pp. 1641-1645.

Demirkesen, S. and D. Arditi, 2015, "Construction Safety Personnel's Perceptions of Safety Training Practices", *International Journal of Project Management*, Vol. 1, pp. 1160-1169.

DETR 2000, "Key Performance Indicators Report for the Minister for Construction, Department for the Environment", *Transport and Regions*, United Kingdom.

Ding, L., W.F. Velicer, and L.L. Harlow, 1995, "Effects of Estimation Methods, Number of Indicators Per Factor and Improper Solutions on Structural Equation Modeling Fit Indices", *Structural Equation Modeling*, Vol. 2, pp. 119-143.

Ding, Z.K. and F.F. Ng, 2010, "Personal Construct-Based Factors Affecting Interpersonal Trust in a Project Design Team", *Journal of Construction Engineering and Management*, Vol. 136, No. 2, pp. 227-234.

Doloi, H.K. 2011, "Understanding Stakeholders' Perspective of Cost Estimation in Project Management", *International Journal of Project Management*, Vol. 295,

pp. 622-636.

Doloi, H., K. Iyer, and A. Sawhney, 2011, "Structural Equation Model For Assessing Impacts of Contractor's Performance on Project Success", *Introduction Journal Project Management*, Vol. 296, pp. 687-695.

Dransfield, R., 2000, "Human Resource Management", *Oxford*, United Kingdom.

Dumont, P.R., G.E. Gibson, and J.R. Fish, 1997, "Scope Management Using Project Definition Rating Index", *Journal Managemrnt Engineering, American Society of Civil Engineers*, Vol. 135, pp. 54-60.

Dunn, S.C., Seaker, R.F., and Waller, M.A. 1994, "Latent Variables in Business Logistics Research: Scale Development and Validation", *Journal Busines Logistic*, Vol. 152, pp. 145-172.

Dvir, D., S. Lipovetsky, A.J. Shenhar, A. Tishler, 2003, "What is Really Important for Project Success? A Refined, Multivariate, Comprehensive Analysis", *International Journal of Management and Decision Making*, Vol. 4, No. 4, pp. 382-404.

Eadie, R., S. Perera, G. Heaney, 2011, "Key Process Area Mapping in the Production of an E-Capability Maturity Model for United Kingdom Construction Organizations", *Journal of Financial Management of Property and Construction*, Vol. 163, pp. 197-210.

Easton, G.R., 1989, "Construction Claims", *Department of Civil Engineering Loughborough University*, United Kingdom.

Egan, J., 1998, "Rethinking Construction, the Construction Task Force, Report Prepared for the Deputy Prime Minister", *Department of Trade and Industry*, London.

Egan, J., 2002, "Accelerating Change, Department of the Environment", *Transport and the Regions*, London.

El Wardani, M., J. Messner, and M. Horman, 2006, "Comparing Procurement Methods for Design-Build Projects", *Jountry Construction Engineering Management*, Vol. 1323, pp. 230-238.

Elfving, J., I. Tommelein, G. Ballard, 2005, "Consequences of Competitive Bidding in Project-Based Production", *Journal of Purchasing and Supply Management*, Vol. 11, No. 4, pp. 173-181.

Elias, A.A., R.Y. Cavana, L.S. Jackson, 2002, "Stakeholder Analysis for R&D Project Management", *R&D Management*, Vol. 32, pp. 301-310.

Elias, A.A., R.Y. Cavana, L.S. Jackson, 2002, "Stakeholder Analysis for R&D Project Management", *R&D Management*, Vol. 32, No. 4, pp. 301-310.

Elkjaer, M., 2000, "Stochastic Budget Simulation", *International Journal of Project Management*, Vol. 18, pp. 139-147.

El-Mashaleh, M., 2003, "Firm Performance and Information Technology Utilization in the Construction Industry", *Journal of Construction Engineering and Management*, Vol. 132, No. 5, pp. 499-507.

Elonen, S., K.A. Artto, 2003, "Problems in Managing Internal Development Projects In Multi-Project Environments", *International Journal of Project Management*, Vol. 21, No. 6, pp. 395-402.

Enberg, C., 2012, "Enabling Knowledge Integration in Coopetitive R&D Projects - The Management of Conflicting Logics", *International Journal of Project Management*, Vol. 307, pp. 771-780.

Eriksson, P., and M. Westerberg, 2011, "Effects of Cooperative Procurement Procedures on Construction Project Performance: A Conceptual Framework", *International Journal Project Management*, Vol. 292, pp. 197-208.

Eriksson, P.E., M. Dickinson, M. Khalfan, 2007, "The Influence of Partnering and

Procurement on Subcontractor Involvement and Innovation", *Facilities*, Vol. 25, No. 5/6, 203-214.

Ernst, H., 2002, "Success Factors of New Product Development: A Review of the Empirical Literature", *International Journal of Management Reviews*, Vol. 4, No. 1, pp. 1-40.

Ernst, H., W.D. Hoyer, C. Rübsaamen, 2010, "Sales, Marketing, and Research and Development Cooperation Across New Product Development Stages: Implications for Success", *Journal of Marketing*, Vol. 74, No. 5, pp. 80-92.

Errasti, A., R. Beach, A. Oyarbide, J. Santos, 2007, "A process for Developing Partnerships with Subcontractors in the Construction Industry: an Empirical Study", *International Journal of Project Management*, Vol. 25, No. 3, pp. 250-256.

Espinoza, R.D., 2014, "Separating Project Risk from the Time Value of Money: A Step toward Integration of Risk Management and Valuation of Infrastructure Investments", *International Journal of Project Management*, Vol. 326, pp. 1056-1072.

Eybpoosh, M., I. Dikmen, M.T. Birgonul, 2011, "Identification of Risk Paths in International Construction Projects Using Structural Equation Modeling", *Journal of Construction Engineering and Management*, Vol. 13712, pp. 1164-1175.

Fageha, M.K. and A.A. Aibinu, 2013, "Managing Project Scope Definition to Improve Stakeholders' Participation and Enhance Project Outcome", *Procedia-Social and Behavioral Sciences*, Vol. 74, pp. 154-164.

Fageha, M.K. and A.A. Aibinu, 2013, "Managing Project Scope Definition to Improve Stakeholders' Participation and Enhance Project Outcome", *Procedia-Social and Behavioral Sciences*, Vol. 74, pp. 154-164.

Fawzy, S.A. and I.H. El-adaway, 2012, "Contract Administration Guidelines for Managing Conflicts, Claims, and Disputes under World Bank-Funded Projects", *Journal* *of Legal Affairs and Dispute Resolution in Engineering and Construction*, Vol. 44, pp. 101-110.

Feng, M., M. Terziovski and D. Samson, 2008, "Relationship of ISO 9001: 2000 Quality System Certification with Operational and Business Performance, A Survey in Australia and New Zealand-Based Manufacturing and Service Companies", *Journal of Manufacturing Technology Management*, Vol. 19, No. 1, pp. 22-37.

Flyvbjerg, B., 2014, "What you Should Know About Megaprojects and why: An Overview", *Project Management Journal*, Vol. 45, No. 2, pp. 6-19.

Flyvbjerg, B., M.S. Holm and S. Buhl, 2002, "Underestimating Costs in Public Works Projects: Error or lie?", *Journal of the American Planning Association*, Vol. 683, pp. 279-295.

Freeman, R.E., J.S. Harrison, A.C. Wicks, B.L. Parmar, S. De Colle, 2010, "Stakeholder Theory: The State of the Art", *Cambridge University Pressentation*, Cambridge.

Froot, K.A., D. Scharfstein, and J.C. Stein, 1993, "Risk Management: Coordinating Corporate Investment and Financing Policies", *Journal of Finance*, Vol. 48, pp. 1629-1658.

Froot Kenneth, A. and C. Jeremy Stein 1998, "Risk Management, Capital Budgeting, and Capital Structure Policy for Financial Institutions: An Integrated Approach", *Journal of Financial Economics*, Vol. 47, No. 1, pp. 55-82.

Fuertes, A., *et al.*, 2013, "An Environmental Impact Causal Model for Improving the Environmental Performance of Construction Processes", *Journal of Cleaner Production*, Vol. 52, pp. 425-437.

Gangolells, M., *et al.*, 2009, "A Methodology for Predicting the Severity of Environmental Impacts Related to the Construction Process of Residential Buildings", *Building and Environment*, Vol. 443, pp. 558-571.

Gao, Z., G. Smith and R. Minchin, 2002, "Budget and Schedule Success for Small Capital-Facility Projects", *Journal Management Engineering*, Vol. 184, pp. 186-193.

Gardiner, P.D. and K. Stewart, 2000, "Revisiting the Golden Triangle of Cost, Time and Quality: the Role of NPV in Project Control, Success and Failure", *International Journal of Project Management*, Vol. 18 No. 4, pp. 251-6.

Garver, M.S., and J.T. Mentzer, 1999, "Logistics Research Methods: Employing Structural Equation Modeling to Test for Construct Validity", *Journal Business Legist*, Vol. 201, pp. 33-58.

Gayatri, V., K. Saurabh, 2013, "Performance Indicators for Construction Project, International Journal of Advanced Electrical and Electronics Engineering", *International Journal of Advances in Electrical and Electronics Engineering*, Vol. 2, No. 1, pp. 61-66.

Gefen, D., D.W. Straub, M.-C. Boudreau, 2000, "Structural Equation Modeling and Regression: Guidelines for Research Practice", *Communications of the Association for Information Systems*, Vol. 4, pp. 1-79.

Gemünden, H.G., T. Ritter, P. Heydebreck, 1996, "Network Configuration and Innovation Success: an Empirical Analysis in German High-Tech Industries", *International Journal of Research in Marketing*, Vol. 13, No. 5, pp. 449-462.

Ghorbanali, A., S. Khosravi, H. Afshari, M. Borzabadi, M. Valipour, 2011, "Improving Project Management Competency by using an OPM3 Approach", I*nternational Conference on Economics, Business and Management*, Vol. 2, pp. 1-120.

Gilley, A., P. Dixon, J.W. Gilley, 2008, "Characteristics of Leadership Effectiveness: Implementing Change and Driving Innovation in Organizations", *Human Resource*

Development Quarterly, Vol. 19, No. 2, pp. 153-169.

Goggin, A.K., J.C. Willis, H.J. Rankin, 2010, "The Relationship Between the Maturity of Safety Management Practices and Performance", *Proceedings of Construction Research Congress 2010*, Banff, Alberta, Canada.

Goh, S.C., S. Rowlinson, 2013, "Conceptual Maturity Model for Sustainable Construction", *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, Vol. 5, pp. 191-195.

Gong, D. and R. Hugsted, 1993, "Time-Uncertainty Analysis in Project Networks with a new Merge-Event Time Estimation Technique", *International Journal of Project Management*, Vol. 113, pp. 165-174.

Gordon, C. and M. Azambuja, 2012, "Toward Effective Visualization of Sustainable Scope Development", *International Conference on Sustainable Design and Construction*, Vol. 1, pp. 450-456.

Grant, R.M. 1996, "Towards a Knowledge-Based Theory of the Firm", *Strategic Management Journal*, Vol. 17, pp. 109-122.

Griffin, A., J.R. Hauser, 1996, "Integrating R&D and Marketing: a Review and Analysis of the Literature", *The Journal of Product Innovation Management*, Vol. 13, No. 3, pp. 191-215.

Griffith, A.F., G.E. Gibson, 2001, "Alignment During Preproject Planning", *Journal Management Engineering*, Vol. 17, No. 2, pp. 69-76.

Gruner, K.E., C. Homburg, 2000, "Does Customer Interaction Enhance New Product Success?", *Journal of Business Research*, Vol. 49, No. 1, pp. 1-14.

Gu, V.C., J.J. Hoffman, Q. Cao, and M.J. Schniederjans, 2014, "The Effects of Organizational Culture and Environmental Pressures on IT Project Performance: A Moderation Perspective", *International Journal of Project Management*, Vol. 327,

pp. 1170-1181.

Guangshe, J., C. Li, C. Jianguo, Z. Shuisen, W. Jin, 2008, "Application of Organizational Project Management Maturity Model OPM3 to Construction in China: An Empirical Study, 2008 International Conference on Information Management", *Innovation Management and Industrial Engineering*, 19-21 December 2008, Taipei, Taiwan.

Guerrero, M. A., *et al.*, 2014, "Modeling Construction Time in Spanish Building Projects", *International Journal of Project Management*, Vol. 325 pp. 861-873.

Guest, D.E., 1997, "Human Resource Management and Performance: A Review and Research Agenda", *International Journal of Human Resource Management*, Vol. 8, pp. 263-276.

Gumus, B., A. Ertas, D. Tate, I. Cicek, 2008, "The Transdisciplinary Product Development Lifecycle Model", *Journal Engineering Design*, Vol. 19, pp. 185-200.

Hackney, J.W., 1992, "Control and Management of Capital Projects", *McGraw-Hill*, New York.

Hair, J.F., W.C. Black, B.J. Babin, R.E. Anderson, R.L. Tatham, 2006, "Multivariate Data Analysis, 6th ed. Prentice-Hall", *Upper Saddle River*, New Jersey.

Hallikas, J., I. Karvonen, U. Pulkkinen, V.M. Virolainen, M. Tuominen, 2004, "Risk Management Processes in Supplier Networks", *International Journal of Production Economics*, Vol. 90, pp. 47-58.

Halman, J. and J. Voordijk, 2012, "Balanced Framework for Measuring Performance of Supply Chains in House Building", *Journal Construction Engineering Managemet*, Vol. 13812, pp. 1444-1450.

Hamilton, M.R., G.E. Gibson, 1996, "Benchmarking Preproject Planning Effort", *Journal Management Engineering*, Vol. 12, No. 2, pp. 25-33.

Hampton, D. 1994, "Procurement Issues", *Journal Management Engineering*, Vol. 645, pp. 45-49.

Hampton, D., 1994, "Procurement Issues", *Journal Management Engineering*, Vol. 645, pp. 45-49.

Han, S.H., D.Y. Kim, H. Kim and W.S. Jang, 2008, "A Web-Based Integrated System for International Project Risk Management", *Autumn Construction*, Vol. 173, pp. 342-356.

Haponava, T., S. Al-Jibouri, 2009, "Identifying Key Performance Indicators for use in Control of Pre-Project Stage Process in Construction", *International Journal of Productivity and Performance Management*, Vol. 58 No. 2, pp. 160-173.

Harland, C., R. Brenchley, H. Walker, 2003, "Risk in Supply Networks", *Journal of Purchasing and Supply Management*, Vol. 9, pp. 51-62.

Harris, L.C. E. Ogbonna, 2001, "Strategic human Resource Management, Market Orientation, and Organizational Performance", *Journal of Business Research*, Vol. 51, No. 2, pp. 157-166.

Hart, S., 1995, "A Natural-Resource-Based View of the firm", *Academy of Management Review*, Vol. 20, pp. 986-1014.

Hassner-Nahmias, A., L.H. Crawford, 2008, "Project Manager or Change Manager: who Should be Managing Organizational Change? Proceedings of the PMI Research Conference", *Warsaw Poland, Project Management Institute*, Newtown Square, Pennsylvania.

Hastak, B.M. and A. Shaked, 2000, "International Construction Risk Assessment Model-1: Model for International Construction Risk Assessment", *Journal Management Engineering*, Vol. 161, pp. 59-69.

Hayduk, L.A., D.N. Glaser, 2000, "Jiving the Four-Step, Waltzing Around Factor

Analysis and Other Serious", *Function Structural Equation Modelling*, Vol.7, pp. 1-35.

He, J., 1998, "The Foreign Exchange Exposure of Japanese Multinational Corporations", *Journal of Finance*, Vol. 53, pp. 733-753.

Heide, J.B., and G. John, 1990, "Alliances in Industrial Purchasing: The Determinants of Joint Action in Buyer-Supplier Relationships", *Journal Markers Resistance*, Vol. 271, pp. 24-36.

Heising, W. 2012, "The Integration of Ideation and Project Portfolio Management - A Key Factor for Sustainable Success", *International Journal of Project Management*, Vol. 305, pp. 582-595.

Henard, D.H., D.M. Szymanski, 2001, "Why Some New Products are More Successful than Others, *Journal of Marketing Research*, Vol. 38, No. 3, pp. 362-375.

Hoffmann, P., *et al.*, 2013, "Uncertainty, Supply Risk Management and their Impact on Performance", *Journal of Purchasing and Supply Management*, Vol. 193 pp. 199-211.

Hornstein, H.A. 2015, "The Integration of Project Management and Organizational Change Management is now a Necessity", *International Journal of Project Management*, Vol. 332 pp. 291-298.

Horta, I.M., Camanho, S.A., Da Costa, M.J. 2010, "Performance Assessment of Construction Companies Integrating Key Performance Indicators and Data Envelopment Analysis", *Journal of Construction Engineering and Management*, Vol. 136. No. 5, pp. 581-594.

Hoyle, R.H., 1995, "The Structural Equation Modelling Approach. In R.H. Hoyle Ed., Structural Equation Modelling: Concepts", *Issues, and Applications*, Vol. 1, pp. 1-15.

Hsieh, P.J., B. Lin, C. Lin, 2009, "The Construction and Application of Knowledge Navigator Model Knowledge Management Maturity: An Evaluation of Knowledge Management Maturity", *Expert Systems with Applications*, Vol. 36, pp. 4087-4100.

Hsieh, H.L., C.H. Tsai, 2013, "An Empirical Study to Explore the Adoption of Telehealth: Health Belief Model Perspective", *Journal of Engineering Science and Technology Review*, Vol. 6, No. 2, pp. 1-5.

Hsu, I.Y., T.-S. Su, *et al.*, 2012, "Analysis of Business Safety Performance by Structural Equation Models", *Safety Science*, Vol. 501, pp. 1-11.

Hu, X., N. Cui, E. Demeulemeester and L. Bie, 2015, "Incorporation of Activity Sensitivity Measures into Buffer Management to Manage Project Schedule Risk", *European Journal of Operational Research*, Vol. 10, pp. 08-066.

Huang, J.C., S. Newell, 2003, "Knowledge Integration Processes and Dynamics within the Context of Cross-Functional Projects", *International Journal of Project Management*, Vol. 21, No. 3, pp. 167-176.

Huselid, M., S. Jackson and R. Schuler, 1997, "Technical and Strategic Human Resource Management Effectiveness as Determinants of Firm Performance", *Academy of Management Journal*, Vol. 40, pp. 171-188.

Huselid, M.A., 1995, "The Impact of Human Resource Management Practices on Turnover, Productivity and Corporate Financial Performance", *Academy Management Journal*, Vol. 38, pp. 635-672.

Hwang, B.G., *et al.*, 2014, "Risk Management in Small Construction Projects in Singapore: Status, Barriers and Impact", *International Journal of Project Management*, Vol. 321, pp. 116-124.

Hwang, B.G., L.K Low, 2012, "Construction Project Change Management in Singapore: Status, Importance and Impact", *International Journal of Project Management*, Vol. 30, No. 7, pp. 817-826.

Hyväri, I., 2006, "Project Management Effectiveness in Project-Oriented Business Organizations", *International Journal Project Management*, Vol. 243, pp. 216-225.

Ibbs, C.W., and Y.H. Kwak, 1997, "The Benefits of Project Management-Financial and Organizational Rewards to Corporations", *Project Management Institute*, Upper Darby, Pennsylvania.

Ibbs, C.W., Y.H. Kwak, 2000, "Assessing Project Management Maturity", *Project Management Journal*, Vol. 4, pp. 32-43.

Ibbs, W., L.D. Nguyen, 2007, "Schedule Analysis Under the Effect of Resource Allocation", *Journal Construction Engineering Management*, Vol. 133, pp. 131-138.

Imbeah, W., S. Guikema, 2009, "Managing Construction Projects Using the Advanced Programmatic Risk Analysis and Management Model", *Journal of Construction Engineering and Management*, Vol. 135, No. 8, pp. 772-781.

Irfan, M., M.B. Khurshid, P. Anastasopoulos, S. Labi, F. Moavenzadeh, 2011, "Planning-Stage Estimation of Highway Project Duration on the Basis of Anticipated Project Cost, Project Type, and Contract Type", *Introduction Journal Projech Management*, Vol. 29, No. 1, pp. 78-92.

Isik, Z., D. Arditi, I. Dikmen and M.T. Birgonul, 2009, "Impact of Corporate Strengths /Weaknesses on Project Management Competencies", *International Journal of Project Management*, Vol. 276, pp. 629-637.

Jabbour, A.B. *et al.*, 2014, "Quality Management, Environmental Management Maturity, Green Supply Chain Practices and Green Performance of Brazilian Companies with ISO 14001 Certification: Direct and Indirect Effects", *Transportation Research Part E: Logistics and Transportation Review*, Vol. 67, pp. 39-51.

Jastaniah, Y., 1997, "Performance Evaluation and Benchmarking of Construction Industry Projects using data Envelope Analysis", Ph.D. Dissertation, Southern Methodist University.

Jepsen, A.L., Eskerod, P., 2009, "Stakeholder Analysis in Projects: Challenges in using Current Quidelines in the Real world", *International Journal Project Management*, Vol. 27, pp. 335-343.

Jia, G., X. Ni, Z. Chen, B. Hong, Y. Chen, F. Yang, C. Lin, 2013, "Measuring the Maturity of Risk Management in Large-Scale Construction Projects", *Automation in Construction*, Vol. 34, No. 1, pp. 56-66.

Jiang, J.J., G. Klein, R. Discenza, 2002, "Pre-Project Partnering Impact on an Information System Project, Project Team and Project Managerement", *European Journal Inflaence Systems*, Vol. 11, No. 2, pp. 86-97.

Jiang, J.J., G. Klein, H.G. Hwang, J. Huang, S.Y. Hung, 2004, "An Exploration of the Relationship Between Software Development Process Maturity and Project Performance", *Information & Management*, Vol. 41, pp. 279-288.

Jin, Z, F. Deng, H. Li, and M. Skitmore, 2013, "Practical Framework for Measuring Performance of International Construction Firms", *Journal of Construction Engineering and Management*, Vol. 1399, pp. 1154-1167.

Jonas, D., 2010, "Empowering Project Portfolio Managers: How Management Involvement Impacts Project Portfolio Management Performance", *International Journal of Project Management*, Vol. 288, pp. 818-831.

Jones, R.A., N.L. Jimmieson, A. Griffiths, 2005, "The Impact of Organizational Culture and Reshaping Capabilities on Change Implementation Success: the Mediating Role of Readiness for Changes", *Journal Management Studues*, Vol. 42, No. 2, pp. 361-386.

Joreskog, K.G., & D. Sorbom, 1996, "Users' Reference Guide", *Chicago: Scientific Software International.*

Jung, Y., and G.E. Gibson, 1999, "Planning for Computer Integrated Construction", *Journal Computation Civil Engineering*, Vol. 134, pp. 217-225.

Jung, Y., and S. Woo, 2004, "Flexible work Breakdown Structure for Integrated Cost and Schedule Control", *Journal Construction Engineering Management*, Vol. 130, No. 5, pp. 616-625.

Kagan, H., 1989, "Practical Quality Controlled Construction", *Journal Preformation Constriction Feculence*, Vol. 33, pp. 191-198.

Kagioglu, M., R. Cooper and G. Aoudad, 2001, "Performance Management in Construction: A Conceptual Framework", *Construction Management and Economics*, Vol. 191, pp. 85-95.

Kaka, A.P. and A.D.F. Price 1993, "Modelling Standard Cost Commitment Curves for Contractors Cash Flow", *Construction Management and Economics*, Vol. 11, pp. 271-283.

Kang, Y., W. O'Brien and J. O'Connor, 2015, "Information-Integration Maturity Model for the Capital Projects Industry", *Journal Management Engineering*, Vol. 314, pp. 401-4061.

Kao, J.J., T.C. Pan, *et al.*, 2009, "An Environmental Sustainability Based Budget Allocation System for Regional Water Quality Management", *Journal Environmental Management*, Vol. 902, pp. 699-709.

Kapila, P. and C. Hendrickson, 2001, "Exchange Rate Risk Management in International Construction Ventures", *Journal Management Engineering*, Vol. 174, pp. 186-191.

Kaplan, R.S., Norton, D.P., 1992, "The Balanced Scorecard: Measures that Drive

Performance", *Harvard Business Review.*

Kaplan, R.S., D.P. Norton, 1993, "Putting the Balanced Scorecard to Work", *Harvard Business Review.*

Karim, K., M. Marosszeky, S. Davis, 2006, "Managing Subcontractor Supply Chain for Quality in Construction, Engineering", *Construction and Architectural Management*, Vol. 13, No. 1, pp. 27-42.

Karlsen, J.T., 2002, "Project Stakeholder Management", *Engineering Management Journal*, Vol. 14 No. 4, pp. 19-25.

Kartam, S., 1999, "Generic Methodology for Analysing Delay Claims", Journal Construction Engineering and Management", *American Society of Civil Engineers*, Vol. 1256, pp. 409-419.

Kellogg, K.C., W.J. Orlikowski, J. Yates, 2006, "Life in the Trading Zone: Structuring Coordination Across Boundaries in Post Bureaucratic Organizations", *Organization Science*, Vol. 17, No. 1, pp. 22-44.

Kern, D., R. Moser, E. Hartmann, M. Moder, 2012, "Supply Risk Management: Model Development and Empirical Analysis", *International Journal of Physical Distribution and Logistics Management*, Vol. 42, pp. 60-82.

Kerzner, H., 2009, "Project Management: A Systems Approach to Planning", Scheduling and Controlling, 10th ed., *John Wiley and Sons.*

Khamooshi, H. and H. Golafshani, 2014, "EDM: Earned Duration Management, a New Approach to Schedule Performance Management and Measurement", *International Journal of Project Management*, Vol. 326, pp. 1019-1041.

Khan, A.S. and F. Rasheed, 2015, "Human Resource Management Practices and Project Success, a Moderating Role of Islamic Work Ethics in Pakistani Project-Based Organizations", *International Journal of Project Management*, Vol. 332,

pp. 435-445.

Khan, A. 2006, "Project Scope Management", *Cost Engineering*, Vol. 48, No. 6.

Khanchit, V., 2000, "Development of Construction Claim Supporting System", *Master Thesis Department of Civil Engineering*, King Mongkut University of Technology Thonburi.

Khodakarami, V. and A. Abdi, 2014, "Project Cost Risk Analysis: A Bayesian Networks Approach for Modelling Dependencies between Cost Items", *International Journal of Project Management*, Vol. 327, pp. 1233-1245.

Khosravi, S., and H. Afshari, 2011, "A Success Measurement Model for Construction Projects, Introduction Confrence on Financial Management and Economics",*International Association of Computer Science and Information Technology Press*, Vol. 11, pp.100-119.

Kim, J., *et al.*, 2012, "A Practical Approach to Project Scheduling: Considering the Potential Quality Loss Cost in the Time-Cost Trade off Problem", *International Journal of Project Management*, Vol. 302, pp. 264-272.

Klassen, R.D., D.C. Whybark, 1999, "The Impact of Environmental Technologies on Manufacturing Performance", *Academy of Management Journal*, Vol. 42, No. 6, pp. 599-615.

Kleindorfer, P.R., G.H. Saad, 2005, "Managing Disruption Risks in Supply Chains", *Production and Operations Management*, Vol. 14, pp. 53-68.

Kleinschmidt, E.J., U. Brentani, S.R. Salomo, 2007, "Performance of Global New Product Development Programs: A Resource-Based View", *Journal of Product Innovation Management*, Vol. 24, pp. 419-441.

Klemetti, A., 2006, "Risk Management in Construction Project Networks", *Helsinki University of Technology*, Helsinki.

Klimko, G. 2001, "Knowledge Management and Maturity Models: Building Common Understanding", *European Conference on Knowledge Management*, D. Remenyi, ed., Bled School of Management, Bled, Slovania, Vol. 5, pp. 269-278.

Kline, R.B., 1998, "Principles and Practices of Structural Equation Modelling", New York: Guilford.

Kline, R.B., 2005, "Principles and Practice of Structural Equation Modelling 2nd ed.", New York: Guilford Press.

Kog, Y. and P. Loh, 2012, "Critical Success Factors for Different Components of Construction Projects", *Journal Construction Engineering Management*, Vol. 1384, pp. 520-528.

Kolodny, H., 2004, "Integrating Project and Change Management", *Visiting Speaker Series John Molson School of Business*, Concordia University.

Koskela, L. and G. Howell, 2002, "The Underlying Theory of Project Management is Obsolete", *Proceedings of the PMI Research Conference*, Vol. 6. pp. 293-302.

Kraiem, Z., and J. Diekmann, 1987, "Concurrent Delays in Construction Projects", *Journal Construction Engineering and Management, American Society of Civil Engineers*, Vol. 1134, pp. 591-602.

Kululanga, G.K., W. Kuotcha, R. McCaffer, and F. Edum-Fotwe, 2001, "Construction Contractors' Claim Process Framework", *Journal Construction Engineering Management*, Vol. 10, pp. 309-314.

Kumaraswamy, M.M. and A. Thorpe, 1996, "Systematic Construction Project Evaluations", *Journal Management Engineering*, Vol. 12, pp. 34-39.

Kutsch, E., M. Hall, 2009, "The Rational Choice of Not Applying Project Risk Management in Information Technology Projects", *Project Management Journal*, Vol. 40. No. 3, pp. 72-81.

Kwak, Y. H., and C.W. Ibbs, 2002, "Project Management Process Maturity pm 2 Model", *Journal Management Engineering*, Vol. 10, pp. 150-155.

Kwak, Y.H., J. Stoddard, 2004, "Project Risk Management: Lessons Learned from Software Development Environment", *Tec Novation*, Vol. 24, No. 11, pp. 915-920.

LaBarre, P.S. and I.H. El-adaway, 2014, "Project Benchmarking: Tool for Mitigating Conflicts, Claims, and Disputes through Improved Performance", *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, Vol. 61, pp. 0451-3003.

Lai, D. N. C., M. Liu, *et al.*, 2011, "A comparative Study on Adopting Human Resource Practices for Safety Management on Construction Projects in the United States and Singapore", *International Journal of Project Management*, Vol. 298, pp. 1018-1032.

Langston, C., 2013, "Development of Generic Key Performance Indicators for Project Management Body of Knowledge using a 3D Project Integration Model", *Australasian Journal of Construction Economics and Building*, Vol. 134, pp. 78-91.

Lapina, I., *et al.*, 2014, "Human Resource Management Models: Aspects of Knowledge Management and Corporate Social Responsibility", *Procedia - Social and Behavioral Sciences*, Vol. 110, pp. 577-586.

Larson, E.W. and C.F. Gray, 2011, "Project Management: The Managerial Process, 5th ed.", *McGraw-Hill/Irwin*, New York.

Latham, M. 1994, "Constructing the Team, Her Majesty's", *Stationery Office*, London.

Leach, W.D., N.W. Pelkey, P.A. Sabatier, 2002, "Stakeholders' Partnerships as Collaborative Policymaking: Evaluation Criteria Applied to Watershed Management in California and Washington", *Journal of Policy Analysis and Management*, Vol.

21, No. 4, pp. 645-670.

Lee, J., S. Kang, D. Lee, 2010, "A Comparison of Software Product Line Scoping Approaches", *International Journal Software Engineering Knowledge Engineering*, Vo. 20, pp. 630-637.

Lee, S.K. and J.H. Yu, 2012, "Success Model of Project Management Information Systems in Construction", *Automation in Construction*, Vol. 25, pp. 82-93.

Levene, R.J., and A. Braganza, 1996, "Controlling the Work Scope in Organisational Transformation: A Programme Management Approach", *International Journal of Project Management*, Vol. 14, No. 6, pp. 331-340.

Leybourne, S.A., 2007, "The Changing Bias of Project Management Research: A Consideration of the Literatures and an Application of Extant Theory", *Project Management Journal*, Vol. 38, No. 1, pp. 61-73.

Li, S., S. Bai, R. Feng, Y. Guo, 2010, "Application of Organizational Project Management Maturity Model Based on BP Neural Network", 2010 International Conference on E-Business and E-Government, International Conference on E-Business and E-Government 2010, 7-9 May 2010, Guangzhou, China.

Li, S., S.S. Rao, T.S. Ragu-Nathan, B. Ragu-Nathan, 2005. "Development and Validation of a Measurement Instrument for Studying Supply Management Practices", *Journal of Operations Management*, Vol. 23, No. 6, pp. 618-641.

Liberatore, M.J. and B. Pollack-Johnson, 2006, "Extending Project Time-Cost Analysis by Removing Precedence Relationships and Task Streaming", *International Journal of Project Management*, Vol. 246, pp. 529-535.

Lim, C.S., M.Z. Mohamed, 1999, "Criteria of Project Success: and Exploration Re-Examination", *International Journal Project Management*, Vol. 174, pp. 243-248.

Lin, G. and Q. Shen, 2010, "Development of Performance Measurement Framework for Value Management Studies in Construction", *Construction Research Congress Vl*, Vol. 1, pp. 1000-1009.

Lin, G., G. Shen, M. Sun and J. Kelly, 2011, "Identification of Key Performance Indicators for Measuring the Performance of Value Management Studies in Construction", *Journal Construction Engineering Management*, Vol. 1379, pp. 698-706.

Ling, F.Y.Y., S.P. Low, S.Q. Wang, H.H. Lim, 2009, "Key Project Management Practices Affecting Singaporean Firms' Project Performance in China", *International Journal of Project Management*, Vol. 27, No. 1, pp. 59-71.

Liu, J., P. Love, P. Davis, J. Smith and M. Regan, 2014, "Conceptual Framework for the Performance Measurement of Public-Private Partnerships", *Journal In Frustration Systems*, 10.1061/ASCEIS.1943-555X.0000210 , 04014023.

Liu, S., J. Zhang, M. Keil, T. Chen, 2010, "Comparing Senior Executive and Project Manager Perceptions of it Project Risk: A Chinese Delphi Study", *Influence Systems Journal*, Vol. 20, No. 4, pp. 319-355.

Liu, Y., J.G. Combs, D.J. Ketchen, and R.D. Ireland, 2007, "The Value of Human Resource Management for Organizational Performance", *Business Horizons*, Vol. 506, pp 503-511.

Loehlin, J.C., 1992, "Latent Variable Models: An introduction to Factor, Path and Structural Analysis", *Techniques Rather than Mathematical Computation, 2 Ed, Hillsdale*, New Jersey.

Loosemore, M., H.S. Al Muslmani, 1999, "Construction Project Management in the Persian Gulf-Inter-Cultural Communication", *International Journal of Project Management*, Vol. 17, No. 2, pp. 95-101.

Love, P.E., G.D. Holt, L.Y. Shen, H. Li, Z. Irani, 2002, "Using Systems Dynamics to Better Understand Change and Rework in Construction Project Management

Systems", *International Journal of Project Management*, Vol. 20, No. 6, pp. 425-436.

Luu, V.T., S.Y. Kim, T.A. Huynh, 2008, "Improving Project Management Performance of Large Contractors using Benchmarking Approach", *International Journal of Project Management*, Vol. 267, pp. 758-769.

Mandal, K., G. Bandyopadhyay, K. Roy, 2011, "Quest for Different Strategic Dimensions of Channel Management", *An Empirical Study*, Vol. 3, No. 2, pp. 25-44.

Manley, K., 2008, "Implementation of Innovation by Manufacturers Subcontracting to Construction Projects", *Engineering Construction and Architectural Management*, Vol. 15 No. 3, pp. 230-245.

Mardia, K. 1970, "Measures of Multivariate Skewness and Kurtosis with Applications", *Biometrika*, Vol. 573, pp. 519-530.

Marques, G., D. Gourc, M. Lauras, 2011, "Multi-Criteria Performance Analysis for Decision Making in Project Management", *International Journal of Project Management*, Vol. 29, pp. 1057-1069.

Marsh, H.W., D. Hocevar, 1985, "Application of Confirmatory Factor Analysis to the Study of Self-Concept: First- and Higher Order Factor Models and Their Invariance Across Groups", *Psychological Bulletin*, Vol. 97, pp. 562-582.

Marshall, P.A. 2000, "Foreign Exchange Risk Management in United Kingdom, United States of America and Asia Pacific multinational companies", *Journal of Multinational Financial Management*, Vol. 10, No. 2, pp. 185-211.

Marzouk, M., T. Attia, N.E El-Bendary, 2012, "Construction Based Model for Assessing Maturity Level of Enterprises, Korea Institute of Construction Engineering and Management", *Journal of Construction Engineering and Project Management*, Vol. 21, pp. 14-19.

Masood, T., 2010, "Impact of Human Resource Management HRM Practices on Organizational Performance: A Mediating Role of Employee Performance", Doctoral dissertation Mohammad Ali Jinnah University, Karachi.

Mbabazize, M.P., *et al.*, 2014, "The Role of Foreign Exchange Risk Management on Performance Management of Exporting Firms in Developing Countries: A Case Study Of Uganda's Exporting Firms. Researchjournali's", *Journal of Economics*, Vol. 2, No. 3, pp. 2347-8233.

Melik, S., 2010, "Cash Flow Analysis of Construction Projects Using Fuzzy Set Theory", M.S. Thesis, Middle East Technical University.

Menezes, L.M., *et al.*, 2010, "The Integration of Human Resource And Operation Management Practices and its link with Performance: A Longitudinal Latent Class Study", *Journal of Operations Management*, Vol. 286, pp. 455-471.

Meng X.-H., M. Sun and M. Jones 2011, "Maturity Model for Supply Chain Relationships in Construction", *Journal of Management in Engineering*, Vol. 27, No. 2, pp. 97-105.

Meng, X., 2012, "The Effect of Relationship Management on Project Performance in Construction", *International Journal of Project Management*, Vol. 302, pp. 188-198.

Meredith, J.R., S.J. Mantel, 2000, "Project Management: A Managerial Approach", *John Wiley & Sons*, New York.

Miles, M.P., J.G. Covin, 2000, "Environmental Marketing: a Source of Reputational, Competitive, and Financial Advantage", *Journal of Business Ethics*, Vol. 23, No. 3, pp. 299-311.

Miller, R., D. Lessard, 2001, "Understanding and Managing Risks in Large Engineering Projects", *International Journal of Project Management*, Vol. 19, pp. 437-443.

Minbaeva, D.B., 2005, "Human Resource Management Practices and Multinational Corporation", *Knowledge Transfer Presentation Reverence*, Vol. 34, pp. 125-144.

Mir, F.A., A.H. Pinnington, 2014, "Exploring the Value of Project Management: Linking Project Management Performance and Project Success", *International Journal of Project Management*, Vol. 322, pp. 202-217.

Missonier, S. and S. Loufrani-Fedida 2014, "Stakeholder Analysis and Engagement in Projects: From Stakeholder Relational Perspective to Stakeholder Relational Ontology", *International Journal of Project Management*, Vol. 327, pp. 1108-1122.

Mitchell, R.K., B.R. Agle, D.J. Wood, 1997, "Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of who and what Really Counts", *Academy of Management Review*, Vol. 22, N. 4, pp. 853-886.

Mitropoulos, P. and C. Tatum, 2000, "Management-Driven Integration", *Journal Management Engineering*, Vol. 161, pp. 48-58.

Mitropoulos, P., G. Cupido, M. Namboodiri, 2009, "Cognitive Approach to Construction Safety: Task Demand-Capability Model", *Journal Construction Engineering Management*, Vol. 135, No. 9, pp. 881-889.

Mohamed, S., 2003, "Scorecard Approach to Benchmarking Organisational Safety Culture in Construction", *Journal of Construction Engineering & Management*, Vol. 129, No. 1, pp. 80-88.

Moore, M.N., M.H. Depledge, J.W. Readman P. Leonard, 2004, "An Integrated Biomarker-Based Strategy for Eco Toxicological Evaluation of risk in Environmental Management", *Mutation Resistance*, Vol. 552, pp. 247-268.

Mok, K.Y., G.Q. Shen, *et al.*, 2015, "Stakeholder Management Studies in Mega Construction Projects: A Review and Future Directions", *International Journal of*

Project Management, Vol. 332, pp. 446-457.

Molenaar, K., S. Washington, and J. Diekmann, 2000, "Structural Equation Model of Construction Contract Dispute Potential", *Journal Construction Engineering Management*, Vol. 1264, pp. 268-277.

Molenaar, K., H. Brown, S. Caile, & R. Smith, 2002, "Corporate Culture", *Professional Safety*, Vol. 47, No. 7, pp. 18.

Molenaar, K.R., J. Park, S. Washington, 2009, "Framework for Measuring Corporate Safety Culture and its Impact on Construction Safety Performance", *Journal Construction Engineering Management*, Vol. 135, pp. 488-496.

Montabon, F., R. Sroufe, R. Narasimhan, 2007, "An Examination of Corporate Reporting, Environmental Management Practices and Firm Performance", *Journal of Operations Management*, Vol. 25, No. 5, pp. 998-1014.

Moosavi, F.S. and O. Moselhi, 2014, "Review of Detailed Schedules in Building Construction", *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, Vol. 63, pp. 0501-4001.

Moran, J.W., B.K. Brightman, 2001, "Leading Organizational Change Career", *Development International*, Vol. 6, No. 2, pp. 111-118.

Morsing, M., M. Schultz, 2006, "Corporate Social Responsibility Communication: Stakeholder Information, Response and Involvement Strategies", *Business Ethics a European Review*, Vol. 15, pp. 323-338.

Mu, S. and H. Cheng, 2013, "Modelling Contractor's Risk Management Capability in Metro Projects", *International Conference on Construction and Real Estate Management*, 2013, Vol. 4, pp. 702-711.

Mullai, A., 2009, "Risk Management System: a Conceptual Model", In: G. Zsidisin, B. Ritchie, Eds., and Supply Chain Risk: A Handbook of Assessment, *Management* *and Performance. Springer, Bedford*, Vol. 4, pp. 83-101.

Mullaly, M., 2006, “Longitudinal Analysis of Project Management Maturity”, *Project Management Journal*, Vol. 363, pp. 62-73.

Munns, A.K., B.F. Bjeirmi, 1996, “The Role of Project Management in Achieving Project Success”, *International Journal of Project Management*, Vol. 14, No. 2, pp. 81-88.

Mustapha, A.A., *et al.*, 2013, “Establishment the Scope of Work for Interior Designers”, *Procedia - Social and Behavioral Sciences*, Vol. 105, pp. 875-884.

Mustaro, N.P. and R. Rossi, 2013, “Project Management Principles Applied in Academic Research Projects”, *Issues in Informing Science and Information Technology*, Vol. 10, pp. 325-340.

Nassar, N. and S. AbouRizk, 2014, “Practical Application for Integrated Performance Measurement of Construction Projects”, *Journal of Management in Engineering*, Vol. 306, pp. 0401-4027.

Nevo, D. and Y.E. Chan, 2007, “A Delphi Study of Knowledge Management Systems: Scope and Requirements”, *Information & Management*, Vol. 446, pp 583-597.

Newell, S., C. Tansley, J. Huang, 2004, “Social Capital and Knowledge Integration in an Enterprise Resource Planning Project Team: the Importance of Bridging and Bonding”, *British Journal of Management*, Vol. 1, pp. 43-57.

Ngacho, C., D. Das, 2014, “A performance Evaluation Framework of Development Projects: An Empirical Study of Constituency Development Fund Cumulative Distribution Function Construction Projects in Kenya”, *International Journal of Project Management*, Vol. 32, No. 3, pp. 492-507.

Niazi, A., J.S. Dai, S. Balabani, 2006, “Product Cost Estimation: Technique Classification and Methodology Review”, *Journal of Manufacturing Science and Engi-*

neering, Vol. 128, No. 2, pp. 563-575.

Nonaka, I., 1994, "A Dynamic Theory of Knowledge Creation", *Organization Science*, Vol. 5, No. 1, pp. 14-37.

Nudurupati, S., T. Arshad, and T. Turner, 2007, "Performance Measurement in the Construction Industry: An Action Case Investigating Manufacturing Methodologies", *Computers in Industry*, Vol. 587, pp. 667-676.

Nunnally, J.C., 1978, "Psychometric Theory", *McGraw-Hill*, New York.

O'Connor, T.J., R.L. Young, 2004, "Impact of Integration and Automation Technology on Project Success Measures, Proceedings of the Fourth Joint International Symposium on Information Technology in Civil Engineering", *Nashville*, Tennessee.

Ochieng, E., A. Price, 2010, "Managing Cross-Cultural Communication in Multicultural Construction Project Teams: the Case of Kenya and United Kingdom International", *Journal of Project Management*, Vol. 28, pp. 449-460.

Odeyinka, H.A., J. Lowe, and A. Kaka, 2008 "An Evaluation of risk Factors Impacting Construction Cash Flow Forecast", *Journal of Financial Management of Property and Construction*, Vol.131, pp. 5-17.

Oehmen, J., A. Olechowski, *et al.*, 2014, "Analysis of the Effect of Risk Management Practices on the Performance of New Product Development Programs", *Technovation*, Vol. 348, pp. 441-453.

Olander, S. 2007, "Stakeholder Impact Analysis in Construction Project Management", *Construction Management and Economics*, Vol. 253, pp. 277-287.

Oliveira, A.C., P.C. Kaminski, 2012, "A Reference Model to Determine the Degree of Maturity in the Product Development Process of Industrial SMEs", *Technovation*, Vol. 3212, pp. 671-680.

Oliver, L. and E. Palmer, 1998, "An Integrated Model for Infrastructural Implementation of Performance Measurement", *Performance Measurement-Theory and Practice Conference Proceedings Cambridge University*, Vol. 2, pp. 695-702.

Papke-Shields, E.K., C. Beise, J. Quan, 2010, "Do Project Managers Practice what they Preach, and Does it Matter to Project Success?", *International Journal of Project Management*, Vol. 28, No. 7, pp. 650-662.

Park, J.-h. and Y.-g. Ahn, 2012, "Strategic Environmental Management of Korean Construction Industry in the Context of Typology Models", *Journal of Cleaner Production*, Vol. 231, pp. 158-166.

Park, S.Y., M. Nam, & S. Cha, 2012, "University Students' Behavioral Intention to use Mobile Learning: Evaluating the Technology Acceptance Model", *British Journal of Educational Technology*, Vol. 434, pp. 592-605.

Pate-Cornel, M.E., G. Tagaras and K.M. Eisenhardt, 1990, "Dynamic Optimization of Cash Flow Management Decisions: A Stochastic Model", *Institute of Electrical and Electronics Engineers Transactions in Engineering Management*, Vol. 373, pp. 203-212.

Paulk, M.C., B. Curtis, M.B. Chrissis & C.V. Weber, 1993, "The Capability Maturity Model for Software", Technical Report, Carnegie Mellon University, *Software Engineering Institute*, Pittsburgh.

Pheng, L.S. and C.H.Y. Leong, 2000, "Cross-Cultural Project Management for International Construction in China", *International Journal of Project Management*, Vol. 18 No. 5, pp. 307-16.

Pinto, J.K. and D.P. Slevin, "Critical Factors in Successful Project Implementation" Institute of Electrical and Electronics Engineers", *Transactions on Engineering Management*, Vol. EM-34, pp. 22-27.

Pinto, J.K., Slevin, D.P. 1988, "Project Success: Definitions and Measurement Techniques", *Project Management Journal*, Vol. 191, pp. 67-72.

Pinto, J.K. and J.E. Prescott, 1988, "Variations in Critical Success Factors Over the Stages in the Project Life Cycle", *Journal of Management*, Vol. 14 No. 1, pp. 5-18.

PMI 2005, "Construction Extension to the Project Management Body of Knowledge Guide Third Edition", *Project Management Institute*, Newtown Square, Panama.

PMI 2013, "A Guide to the Project Management Body of Knowledge", Project Management Institute", *Newtown Square*, Panama.

Popaitoon, S. and S. Siengthai 2014, "The Moderating Effect of Human Resource Management Practices on the Relationship Between Knowledge Absorptive Capacity and Project Performance in Project-Oriented Companies", *International Journal of Project Management*, Vol. 326, pp. 908-920.

Qureshi, T.M., *et al.*, 2009, "Significance of Project Management Performance Assessment precision machined products industry model", *International Journal of Project Management*, Vol. 274, pp. 378-388.

Rad, P.F., 2003, "Project Success Attributes", *Cost Engineering*, Vol. 45, No. 4, pp. 23-29.

Rae, A., Alexander, R., McDermid, J., 2014, "Fixing the Cracks in the Crystalball: A Maturity Model for Quantitative Risk Assessment", *Reliability Engineering and System Safety*, Vol. 125, pp. 67-81.

Ramli, A., Z.A. Akasah, *et al.*, 2014, "Safety and Health Factors Influencing Performance of Malaysian Low-cost Housing: Structural Equation Modelling Search Engine Marketing Approach", *Procedia - Social and Behavioural Sciences*, Vol. 129, pp. 475-482.

Rankin, J., A.R. Fayek, G. Meade, C. Haas, A. Manseau, 2008, “Initial Metrics and Pilot Program Results for Measuring the Performance of the Canadian Construction Industry”, *Canadian Journal of Civil Engineering*, Vol. 35, pp. 894-907.

Rasdorf, W.J., and O.Y. Abudayyeh, 1991, “Cost and Schedule Control Integration: Issues and Needs”, *Journal of Construction Engineering and Management*, Vol. 1173, pp. 486-502.

Rasid, S.Z., W.K. Wan Ismail, *et al.*, 2014, ”Assessing Adoption of Project Management Knowledge Areas and Maturity Level: Case Study of a Public Agency in Malaysia”, *Journal of Management in Engineering*, Vol. 302, pp. 264-271.

Reed, M.S., 2008, “Stakeholder Participation for Environmental Management: A Literature Review”, *Biological Conservation*, Vol. 141, pp. 2417-2431.

Rezaei, A.R., *et al.*, 2011, “Performance Measurement in a Quality Management System”, *ScientiaIranica*, Vol. 183, pp. 742-752.

Rijke, J., V.S. Herk, C. Zevenbergen, R. Ashley, M. Hertogh, H. Heufelhoff, 2014,“Adaptive Programme Management through a Balanced Performance/Strategy Oriented Focus”, *International Journal of Project Management*, Vol. 32, No. 7, pp. 1197-1209.

Ritala, P., P. Hurmelinna-Laukkanen, 2009, “What’s in it for me? Creating and Appropriating Value in Innovation-Related Coopetition”, *Technovation*, Vol. 29, No. 12, pp. 819-828.

Roberts L., 2009, “KPIs in the UK’s Construction Industry: Using System Dynamics to Understand Underachievement”, *Revista de la Construcción*, Vol. 81, pp. 69-82.

Rodriguez, G., F. J. Alegre, *et al.*, 2011, “Evaluation of Environmental Management Resources ISO 14001 at Civil Engineering Construction Worksites: A Case Study of the Community of Madrid”, *Journal of Environmental Management*, Vol. 927,

pp. 1858-1866.

Ruparathna, R. and K. Hewage, 2015, "Review of Contemporary Construction Procurement Practices", *Journal of Management in Engineering*, Vol. 313, pp. 0401-4038.

Russo, M., P. Fouts, 1997, "Aresource-Based Perspective on Corporate Environmental Performance and Profitability", *Academy of Management*, Vol. 40, pp. 534-559.

Ruuska, I., T. Ahola, *et al.*, 2013, "Supplier Capabilities in Large Shipbuilding Projects", *International Journal of Project Management*, Vol. 314, pp. 542-553.

Rwamamara, R., 2007, "Planning the Healthy Construction Workplace through Risk Assessment and Design Methods, Ph.D. Thesis, Civil, Mining, and Environmental Engineering, Lulea University of Technology.

Salazar-Aramayo, J., R. Rodrigues-da-Silveira, M. Rodrigues-de-Almeida, and T. de Castro-Dantas, 2013, "A Conceptual Model for Project Management of Exploration and Production in the Oil and Gas Industry: The case of a Brazilian company", *International Journal of Project Management*, Vol. 10, pp. 589-601.

Sanvido, V., F. Grobler, K. Parfitt, M. Guvenis, M. Coyle, 1992, "Critical Success Factors for Construction Projects", *Journal of Construction Engineering and Management*, Vol. 118, No. 1, pp. 94-111.

Sarkar, M.B., P.S. Aulakh and S.T. Cavusgil, 1998, "The Strategic Role of Relational Bonding in Inter-Organizational Collaborations: An Empirical Study of the Global Construction Industry", *Journal International Management*, Vol. 42, pp. 415-421.

Sarshar, M., M. Finnemore, R. Haigh, J. Goulding, 1999, "Spice: Is A Capability Maturity Model Applicable In The Construction Industry? Spice: A Mature Model", Proceedings of the 8th International Conference on Durability of Building Materials and Components CIB W78, *Institute for Research in Construction*, Ottawa, Canada.

Schiele, H., 2007, “Supply-Management Maturity, Cost Savings and Purchasing Absorptive Capacity: Testing the Procurement-Performance Link”, *Journal of Purchasing and Supply Management*, Vol. 13, pp. 274-293.

Schmickl, C., A. Kieser, 2008, “How Much do Specialists have to Learn From Each Other when they Jointly Develop Radical Product Innovations?”, *Research Policy*, Vol. 37, No. 6/7, pp. 1148-1163.

Semple, C., F.T. Hartman, and G. Jergeas, 1994, “Construction Claims and Disputes: Causes and cost/time Overruns”, *Journal of Construction Engineering and Management*, Vol. 1204, pp. 785-795.

Senescu, R.R., *et al.*, 2013, “Relationships Between Project Complexity and Communication”, *Journal of Management in Engineering*, Vol. 292, pp. 183-197.

Shadish, W.R., T.D. Cook, and D.T. Campbell, 2002, “Experimental and Outsourcing in Information Systems Offshore”, *Communication of the Association for Computing Machinery*, Vol. 39, No. 7, pp. 47-54.

Shane, J.S. 2006, “A Fundamental Study of Scope Definition in Early Highway Project Development”, Ph.D. Dissertation, University of Colorado at Boulder, Boulder, Colorado.

Sharma, S., H. Vredenburg, 1998, “Proactive Corporate Environmental Strategy and the Development of Competitively Valuable Organizational Capabilities”, *Strategic Management Journal*, Vol. 19, No. 8, pp. 729-753.

Shen LY, V.W.Y. Tam, 2002, “Implementation of Environmental Management in the Hong Kong Construction Industry”, *International Journal of Project Management*, Vol. 207, pp. 535-43.

Shen, L.-Y., *et al.*, 2005, “A Computer-Based Scoring Method for Measuring the Environmental Performance of Construction Activities", *Automation in Construction*, Vol. 143, pp. 297-309.

Shen, L.Y., Y.Z. Wu, X.L. Zhang, 2011, "Key Assessment Indicators Knowledge and Information Systems for the Sustainability of Infrastructure Projects", *Journal of Construction Engineering and Management*, Vol. 137, No. 6, pp. 441-451.

Shenhar, A.J., D. Dvir, O. Levy, A.C. Maltz, 2001, "Project Success: A Multidimensional Strategic Concept", *Long Range Plan*, Vol. 34, pp. 699-725.

Shenhar, A.J., O. Levy, D. Dvir, 1997, "Mapping the Dimensions of Project Success", *Project Management Journal*, Vol. 28, pp. 5-13.

Shields, D.R., R.L. Tucker, and S.R. Thomas, 2003, "Measurement of Construction Phase Success of Projects", Construction Research Congress: Wind of Change: Integration and innovation, K R. Molenaar and P S. Chinowsky, eds., *American Society of Civil Engineers*, Reston, Virginia.

Silvo, K., M. Melanen, A. Honkasalo, S. Ruonala, M. Lindström, 2002, "Integrated Pollution Prevention and Control e the Finnish Approach Resources", *Conservation and Recycling*, Vol. 35, pp. 45-60.

Singh, S. and G. Lakanathan, 1992, "Computer-Based Cash Flow Model", Proc. 36th Annual Trans American Association of Cost Engineers, *Morgantown, West Virginia*, Vol.5.1, pp. 5-14.

Skibniewski, M. and S. Ghosh, 2009, "Determination of Key Performance Indicators with Enterprise Resource Planning Systems in Engineering Construction Firms", *Journal of Construction Engineering and Management*, Vol. 13510, pp. 965-978.

Smith, M. A., and R.L. Tucker, 1983, "An assessment of the Potential Problems Occurring in the Engineering Phase of an Industrial Project", *Representative*, Texaco, Increment University of Texas at Austin, Austin, Texas.

Smith, A., 2010, "Knowledge Management as an Indication of Organizational Maturity In Project Management: an Enhancement of the opm3© Model", Ph.D. Thesis, Capella University.

Söderlund, J., 2004, "Building Theories of Project Management, Past Research, Questions for the Future", *International Journal of Project Management*, Vol. 22, pp. 183-191.

Söderlund, J., 2010, "Pluralism in Project Management: Navigating the Crossroads of Specialization and Fragmentation", *International Journal of Management Reviews*, Vol. 13, pp. 153-176.

Son, H., Y. Park, C. Kim and J. Chou, 2000, "Toward an Understanding of Construction Professionals' Acceptance of Mobile Computing Devices in South Korea: An Extension of the Technology Acceptance Model", *Automation in Construction*, Vol. 28, pp. 82-90.

Song, L. and S. AbouRizk, 2005, "Quantifying Engineering Project Scope for Productivity Modelling", *Journal of Construction Engineering and Management*, Vol. 1313, pp. 360-367.

Song, L.Z., M. Song, 2010, "The Role of Information Technologies in Enhancing R&D-Marketing Integration: An Empirical Investigation", *The Journal of Product Innovation Management*, Vol. 27, No. 3, pp. 382-401.

Sousa, V., *et al.*, 2014, "Risk-Based Management of Occupational Safety and Health in the Construction Industry - Part 1: Background Knowledge", *Safety Science*, Vol. 66, pp. 75-86.

Steiger, J.H., & J.C. Lind, 1980, "Statistically Based Tests for the Number of Common Factors", *Paper Presented at the Annual Meeting of the Psychometric Society*, Iowa City, Iowa.

Steiger J.H., 2000, "Point Estimation, Hypothesis Testing, and Interval Estimation Using the Some Comments and a Reply to Hayduk and Glaser", *Structural Equation Modelling*, Vol. 2000, No. 7, pp. 149-62.

Storm, I., J. Harting, K. Strongks, A.J. Schuit, 2013, "Measuring Stages of health in All Policies on a Local Level: The Applicability of a Maturity Model", *Health Policy*, Vol. 114. No. 2-3, pp. 183-191.

Sutt, J., 2011, "Manual of Construction Project Management: For Owners and Clients", *Wiley*, Chichester, United Kingdom.

Tabachnick, B.G., & L.S. Fidell, 2001, "Using Multivariate Statistics", *Boston*, Allyn and Bacon.

Tabassi, A.A. and A.H.A. Bakar 2009, "Training, Motivation, and Performance: The Case of Human Resource Management in Construction Projects in Mashhad, Iran", *International Journal of Project Management*, Vol. 275, pp. 471-480.

Tabish, S.Z.S., and K.N. Jha, 2012, "Success Traits for a Construction Project", *Journal of Construction Engineering and Management*, Vol. 13810, pp. 1131-1138.

Tah, J.H.M., and V. Carr, 2000, "A Proposal for Construction Project Risk Assessment Using Fuzzy Logic", *Construction Management and Economics*, Vol. 184, pp. 491-500.

Tam, V.W.Y., L.Y. Shen, *et al.*, 2011, "Impacts of Multi-Layer Chain Subcontracting on Project Management Performance", *International Journal of Project Management*, Vol. 291, pp. 108-116.

Tappura, S., *et al.*, 2015, "A Management Accounting Perspective on Safety", *Safety Science*, Vol. 71, pp. 151-159.

Tatum, C., 1989, "Management Challenges of Integrating Construction Methods and Design Approaches", *Journal of Management in Engineering*, Vol. 52, pp. 139-

154.

Tawfek, H.S., *et al.*, 2012, “Assessment of the Expected Cost Of Quality COQ in Construction Projects in Egypt Using Artificial Neural Network Model”, *Health Behaviour Research Centre Journal*, Vol. 82, pp.132-143.

Telle, K., J. Larsson, 2007, “Do Environmental Regulations Hamper Productivity Growth? How Accounting for Improvements of Plants’ Environmental Performance Can Change the Conclusion”, *Ecological Economics*, Vol. 61, pp. 438-445.

Teller, J., A. Kock, 2013, “An Empirical Investigation on How Portfolio Risk Management Influences Project Portfolio Success International”, *Journal of Project Management*, Vol. 31, No. 6, pp. 817-829.

Testa, F., F. Iraldo, *et al.*, 2011, “”The Effect of Environmental Regulation on Firms’ Competitive Performance: the Case of the Building & Construction Sector in Some EU Regions”, *Journal of Environmental Management*, Vol. 929, pp. 2136-2144.

Tether, B., 2002, “Who Co-Operates for Innovation, and why - an Empirical Analysis”, *Research Policy*, Vol. 31, No. 6, pp. 947-967.

Thiry, M., 2002, “Combining Value and Project Management into an Effective Programme Management Model”, *International Journal of Project Management*, Vol. 20, No. 3, pp. 221-227.

Tiller, S., 2012, “Organizational Structure and Management Systems”, *Leadership Management Engineering*, Vol. 121, pp. 20-23.

Tinsley, H.E.A., D.J. Tinsley, 1987, “Uses of Factor Analysis in Counselling Psychology Research”, *Journal of Counselling Psychology*, Vol. 34 No. 4, pp. 414-424.

Too, E.G., 2012, “Capability Model to Improve Infrastructure Asset Performance”, *Journal of Construction Engineering and Management*, Vol. 1387, pp. 885-896.

Toole, M.T., P. Chinowsky and R.M. Hallowell, 2010, "A Tool for Improving Construction Organizations' Innovation Capabilities", *Construction Research Congress*, Vol. 6, pp. 727-836.

Toor, S.R., S.O. Ogunlana, 2010, "Beyond the Iron Triangle: Stakeholder Perception of Key Performance Indicators Key Performance Indicator For Large - Scale Public Sector Development Projects", *International Journal of Project Management*, Vol. 283, pp. 228-236.

Touran, A., 2003, "Probabilistic Model for Cost Contingency", *Journal of Construction Engineering Management*, Vol. 129, pp. 280-284.

Tucker, L.R., & Lewis, C., 1973, "A reliability Coefficient for Maximum Likelihood Factor Analysis", *Psychometrika*, Vol. 38, pp. 1-10.

Tukel, O.I., W.O. Rom, 2001, "An Empirical Investigation of Project Evaluation Criteria", *International Journal of Operational Product Management*, Vol. 213, pp. 400-16.

Turner, J.R., R. Müller, 2005, "The project manager's Leadership Style as a Success Factor on Projects: A Literature Review", *Project Management Journal*, Vol. 36, No. 2, pp. 49-61.

Un, C.A., A. Cuervo-Cazurra, K. Asakawa, 2010, "R&D Collaborations and Product Innovation", *The Journal of Product Innovation Management*, Vol. 27, No. 5, pp. 673-689.

Vahdat, K., N.J. Smith, *et al.*, 2014, "Fuzzy Multicriteria for Developing a Risk Management System in Seismically Prone Areas", *Socio-Economic Planning Sciences*, Vol. 484, pp. 235-248.

Van Looy, A., M.De Backer, G. Poels, & M. Snoeck, 2013, "Choosing the Right Businessprocess Maturity Model", *Information & Management*, Vol. 50, pp. 466-488.

Vidogah W, I. Ndekugri 1997, "Improving Management of Claims: Contractors' Perspective", *Journal of Management in Engineering*, Vol. 135, pp. 37-44.

Walker, D.H.T., L.M. Bourne, A. Shelley, 2008, "Influence, Stakeholder Mapping and Visualization", *Construction Management and Economics*, Vol. 26, pp. 645-658.

Wanberg, J., C. Harper, M. Hallowell and S. Rajendran, 2013, "Relationship Between Construction Safety and Quality Performance", *Journal of Construction Engineering and Management*, Vol. 13910, pp. 0401-3003.

Wang, J., W. Lin, H.Y. Huang, 2010, "A Performance-Oriented Risk Management Framework for Innovative R&D Projects", *Technovation*, Vol. 30, pp. 601-611.

Wang, S.Q., M.F. Dulaimi, and M.Y. Aguria, 2004, "Risk Management Framework for Construction Projects in Developing Countries", *Construction Management and Economics*, Vol. 223, pp. 237-252.

Wang, W.C., 2002, "Model for Project Ceiling Price Determination", *Journal of Construction Engineering Management*, Vol. 128, pp. 76-84.

Wang, X., J. Huang, 2006, "The Relationships between Key Stakeholders' Project Performance and Project Success: Perceptions of Chinese Construction Supervising Engineers", *International Journal of Project Management*, Vol. 24, pp. 253-260.

Ward, S.C., 1999, "Assessing and Managing Important Risks", *International Journal of Project Management*, Vol. 176, pp. 331-336.

Ward, S., C.B. Chapman, 2003, "Transforming Project Risk Management into Project Uncertainty Management", *International Journal of Project Managemen*t, Vol. 21, pp. 97-105.

Wardani, M., J.Messner, M. Horman, 2006, "Comparing Procurement Methods for Design Build Projects", *Journal of Construction Engineering and Management*, Vol. 132, No. 3, pp. 230-238.

Wateridge, J., 1998, "How Can IS/IT Projects be Measured for Success. International", *Journal of Project Management*, Vol. 16. No. 1, pp. 59-63.

Weinstein, M., J. Gambatese, S. Hecker, 2005, "Can Design Improve Construction Safety?: Assessing the Impact of a Collaborative Safety-in Design Process", *Journal of Construction Engineering and Management*, Vol. 131, No. 10, pp.1125-1134.

Wendler, R., 2012, "The Maturity of Maturity Model Research: A Systematic Mapping Study", *Information and Software Technology*, Vol. 54, No. 2, pp. 1317-1339.

Westerveld, E., 2003, "The Project Excellence Model: Linking Success Criteria and Critical Success Factors", *International Journal of Project Management*, Vol. 21, No. 6, pp. 411-18.

Wheelwright, S.C., K.B. Clark, 1992, "Creating Project Plans to Focus Product Development", *Harvard Business Review*, Vol. 70, pp. 70-82.

Williamson, O.E., 1991, "Comparative Economic Organization: the Analysis of Discrete Structural Alternatives", *Administrative Science Quarterly*, Vol. 36, pp. 269-296.

Winer B.J., D.R. Brown, K.M. Michels, 1991, "Statistical Principles in Experimental Design", *McGraw-Hill*, New York.

Winter, M., 2006, "Problem Structuring in Project Management: an Application of Soft Systems Methodology Soft Systems Methodology", *Journal of Operational Research Society*, Vol. 57, pp. 802-812.

Wolf, E.J., K.M. Harrington S.L., Clark, & M.W. Miller, 2013, "Sample Size Requirements for Structural Equation Models an Evaluation of Power, Bias, and Solution Propriety", *Educational and Psychological Measurement*, Vol. 736, pp. 913-934.

Xiong, B., M. Skitmore, *et al.*, 2014, "Examining the Influence of Participant Performance Factors on Contractor Satisfaction: A Structural Equation Model", I*nternational Journal of Project Management*, Vol. 323, pp. 482-491.

Xiong, B., M. Skitmore, B. Xia, 2015, "A Critical Review of Structural Equation Modelling Applications in Construction Research", *Automation in Construction*, Vol. 49, pp. 59-70.

Xu, J., *et al.*, 2012, "Discrete Time-Cost-Environment Trade-off Problem for Large-Scale Construction Systems with Multiple Modes Under Fuzzy Uncertainty and its Application to Jinping-II Hydroelectric Project1, *International Journal of Project Management*, Vol. 308, pp. 950-966.

Yang, L., C. Huang, K. Wu, 2011, "The Association Among Project Manager's Leadership Style, Teamwork and Project Success", *International Journal of Project Management*, Vol. 29, pp. 258-267.

Yang, L.R., J.H. Chen, H.W. Wang, 2012, "Assessing Impacts of Information Technology on Project Success Through Knowledge Management Practice", *Automation in Construction*, Vol. 22, pp. 182-191.

Yanwei, W., *et al.*, 2012, "Research on the Performance Evaluation of Integrated Project Management Based on PBS", *Procedia Earth and Planetary Science*, Vol. 5, pp. 249-253.

Yeung, J.F.Y., A.P.C. Chan, and D.W.M. Chan, 2009, "Developing a Performance Index for Relationship-Based Construction Projects in Australia: Delphi study", *Journal of Management in Engineering, American Society of Civil Engineers*, Vol. 252, pp. 59-68.

Yildiz, A. E., M.T. Birgonul, I. Dikmen, 2014, "A Knowledge-Based Risk-Mapping Tool for Cost Estimation of International Construction Projects", *Automation in Construction*, Vol. 43, pp. 144-155.

Yimam, A.H., 2011, "Project Management Maturity in the Construction Industry of Developing Countries the Case of Ethiopian Contractors", M.S. Thesis, The Faculty of the Graduate School, University of Maryland, Washington.

Yosha, O., 1995, "Information Disclosure Costs and the Choice of Financing Source", *Journal of Financial Intermediation*, Vol. 4, pp. 3-20.

Youndt, M.A., S.A. Snell, J.W. Dean Jr., D.P. Lepak, 1996, "Human Resource Management, Manufacturing Strategy, and Firm Performance", *Academy of Management Journal*, Vol. 39, No. 4, pp. 836-866.

Young, R., 2006, "what is the ROI for IT project governance? Establishing a Benchmark", *2006 IT Governance International Conference*, Auckland, New Zealand.

Yuan K.H., P.M. Bentler, W. Zhang 2005, "The Effect of Skewness and Kurtosis on Mean and Covariance Structure Analysis", *Sociological Methods & Research*, Vol. 342, pp. 240-258.

Yu, I., K. Kim, Y. Jung and S. Chin, 2007, "Comparable Performance Measurement System for Construction Companies", *Journal of Management in Engineering*, Vol. 23, No. 3131, pp. 131-139.

Zajac, C., 2009, "Barriers to Cultural and Organizational Integration in International Holding Groups - Nature, Scope and Remedial Measures", *Journal of Intercultural Management*, Vol. 1, No. 2, pp. 50-58.

Zaneldin, E.K., 2006, "Construction Claims in United Arab Emirates: Types, causes, and frequency", *International Journal of Project Management*, Vol. 245, pp. 453-459.

Zeng, S.X., X.H. Meng, *et al.*, 2011, "How Environmental Management Driving Forces Affect Environmental and Economic Performance of SMEs: a Study in the Northern China district", *Journal of Cleaner Production*, Vol. 1913, pp. 1426-1437.

Zhang, P. and F. Ng. 2013, “Explaining Knowledge-Sharing Intention in Construction Teams in Hong Kong”, *Journal of Construction Engineering and Management*, Vol. 1393, pp. 280-293.

Zhao, X., B.G. Hwang, and S.P. Low, 2013, “Developing Fuzzy Enterprise Risk Management Maturity Model for Construction Firms”, *Journal of Construction Engineering and Management*, Vol. 1399, pp. 1179-1189.

Zhi, H., 1995, “Risk Management for Overseas Construction Projects”, *International Journal of Project Management*, Vol. 13, No. 4, pp. 231-237.

Zou, P.X.W., Y. Chen, T. Chan, 2010, “Understanding and improving your Risk Management Capability: Assessment Model for Construction Organizations”, *Journal of Construction Engineering and Management*, Vol. 136, No. 8, pp. 854-863.

Zou, P.X.W., Y. Chen, T. Chan, 2010, “Understanding and improving your Risk Management Capability: Assessment Model for Construction Organizations”, *Journal of Construction Engineering and Management*, Vol. 136, No. 8, pp. 854-863.

Zoysa, S.D., and A.D. Russell, 2003, “Knowledge-Based Risk Identification in Infrastructure Projects”, *Canadian Journal of Civil Engineering*, Vol. 303, pp. 511-522.

Zsidisin, G.A., A. Panelli, R. Upton, 2000, “Purchasing Organization Involvement in Risk Assessments, Contingency Plans, and Risk Management: An Exploratory Study”, *Supply Chain Management*, Vol. 5, pp. 187-197.

Zwikael, O. and E. Unger-Aviram, 2010, “HRM in Project Groups: The E”, *International Journal of Project Management*, Vol. 285 pp. 413-421.