Measuring Project Management Performance: Case of Construction Industry

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Abstract: This study develops construction-specific determinants and indicators of project management performance based on the fourteen knowledge areas of the project management body of knowledge (PMBoK) Guide. Interrelations among the knowledge areas and influence of these factors on performance are investigated. Data collected from 121 construction projects are analysed using structural equation modeling. Research findings suggest that project integration, communications, safety, risk, human resources, financial, and cost management have a direct impact; whereas scope and time management have indirect effect on performance. The findings reported in this study are expected to help construction project managers devise and implement strategies and develop actions to improve project success. An engineering manager might use the framework developed in this research to conceive the underlying factors of efficient project management practices.

Keywords: Project management; engineering management; modeling; performance; construction.

Introduction

Project management continues to be challenging for many industries. Hence, project managers seek more efficient project management tools and techniques. A need exists for developing efficient plans and systems to increase an organization's efficiency in executing projects.

Hence, organizations perform better with the better integration of engineering methods, principles, and technologies into projects, products, and processes. To scrutinize the need for more efficient engineering management tools, strategies, and methods, a considerable portion of studies focus on management models and different approaches for measuring performance in a wide spectrum of industries (Cooke-Davies & Arzymanov, 2003; Eastham, Tucker, Varma, & Sutton, 2014; Nassar & AbouRizk, 2014; Mizell & Malone, 2007; Zanoni & Audy, 2004).

Considering the global economic impact of the construction industry, performance measurement in construction is critical as well. Therefore, effective project management is crucial for higher performance levels in construction. Performance measurement has been reported to be critical in several research studies (Jin, Deng, & Skitmore, 2013; Kagioglou, Cooper, & Aouad, 2001; Robinson, Carrillo, Anumba, & A-Ghassani, 2005).

Existing studies regarding performance measurement focus on key performance indicators (Lin, Shen, Sun, & Kelly, 2011; Ngacho & Das, 2014; Skibniewski & Ghosh, 2009); balanced scorecard (Halman & Voordijk, 2012; Wang, Lin, & Huang, 2010); maturity models (Goh & Rowlinson, 2013; Meng, Sun, & Jones, 2011), and critical success factors (Kog & Loh, 2012; Pinto & Slevin, 1988; Toor & Ogunlana, 2008).

A portion of the studies focused on project success for the assessment of performance. For example, measuring success in construction was investigated by Hughes, Tippett, and Thomas (2004); this study involved a survey to evaluate construction project success. However, there has not been an agreed way of assessing performance in construction.

This study aims to develop a complete performance measurement model. In this respect, project management knowledge areas of PMBoK Guide of Project Management Institute (PMI, 2013) and its Construction Extension (PMI, 2005) are adopted as the main determinants of performance in construction project management: (1) project integration management; (2) project scope management; (3) project time management; (4) project cost management; (5) project quality management; (6) project human resources management; (7) project communications management; (8) project risk management; (9) project procurement management; (10) project stakeholder management; (11) project safety management; (12) project environmental management; (13) project financial management; and (14) project claim management. Additionally, performance is measured in terms of project success. An extensive literature review was conducted to identify the components relevant to determinants and indicators of performance.

The study develops hypotheses regarding the interrelations among determinants and their influence on performance. To test the hypotheses, data was collected through a questionnaire survey. Structural Equation Modeling was used for the data analysis.

The main contribution of this study is that it enables engineering managers to develop practices, acquire solid project management strategies, and benefit from the tools proposed in the context of this research. Additionally, engineering managers may benefit from the framework developed in this research to relate their projects to project management knowledge areas and the components associated. The research extends the project management body of knowledge by encouraging project managers to utilize the concepts and areas of the Project Management Body of Knowledge Guide so as to enable them to devise better project management solutions through the use of a project management framework. Within this perspective, the model developed contributes to the body of knowledge by bringing up new components to evaluate when managing practices in knowledge areas. It also introduces the several relationships encompassing all knowledge areas, which have not been investigated in previous studies.

This study first introduces previous literature in modeling project management performance. Then, it presents indicators and determinants of performance, and indicates the hypotheses constructed accordingly. It then follows the research methodology and presents data analysis. Finally, it presents the findings of the study along with discussion and concludes with the results.

Modeling the Project Management Performance

Various studies have been conducted on measuring and managing performance in construction (Berssaneti & Carvalho, 2015; Chou, Irawan, & Pham, 2013; Doloi, Iyer, & Sawhney, 2011; Egan, 1998; Jin et al., 2013; Kagioglou et al., 2001; Nudurupati, Arshad, & Turner, 2007). Performance measurement in the construction industry has been investigated through the adoption of key performance indicators, balanced scorecard, critical success factors, and maturity models (Alzahrani & Emsley, 2013; Beatham, Anumba, Thorpe, & Hedges, 2004; Chan, 2001; Chan, Scott & Chan, 2004).

To best manage projects, the PMBoK Guide (PMI, 2013) proposed ten knowledge areas for project management and its Construction Extension (PMI, 2005) proposed four additional ones. Most of the studies focused on individual knowledge areas such as safety management (Cheng, Ryan, & Kelly, 2012), risk management (Zhao, Hwang, & Low, 2013), and communications management (Albert, Hallowell, & Kleiner 2014). The effects of project scope, time, quality, human resources, communication, risk, and procurement management on project success using structural equation modeling was investigated in a recent study. The study concluded that communication management is critical for promoting project success (Chou et al., 2013).

In a recent study, project management competencies of building construction firms were evaluated on a structural model. The results of the study indicated that project cost, risk, and quality management skills are the most important factors affecting project success (Attakora-Amaniampong, 2016). Moreover, contractors' performance on project success was assessed by a structural equation model. The results of the study prove that overall success mostly relies on contractors' technical ability in planning and controlling the project (Doloi et al., 2011). A portion of the studies concentrated on the role of the project manager and top management support in achieving higher project success (Ahmed & Mohamad, 2016; Anantatmula, 2010).

Nine knowledge areas of PMBoK Guide were adopted to predict project performance in the construction industry. The proposed model was proven to estimate project outcomes with a level of accuracy (Ling, Low, Wang, & Egbelakin, 2008). The effects of project characteristics on project performance in construction projects were also assessed based on a structural equation model. The results of the study prove that project characteristics positively influence cost management practices, where cost is a strong indicator of performance (Cho, Hong, & Hyun, 2009).

However, these studies lack a complete analysis of the fourteen knowledge areas available for construction. Therefore, this study attempts to fill this gap by first identifying proper metrics for construction then investigating relationships between these, and quantifying their influence on performance.

Indicators of Project Management Performance

Project management performance is measured by means of project success as suggested previously in other studies (Lim & Mohamed, 1999; Mir & Pinnington, 2014; Wang & Huang, 2006). In terms of project success, a majority of the research studies focus on timely completion (Chan, Scott, & Lam, 2002; Cooke-Davies, 2002; Egan, 1998; Lim & Mohamed, 1999; Rad, 2003), under budget completion (Berssaneti & Carvalho, 2015; Nudurupati et al. 2007; Papke-Shields, Beise & Quan, 2010), meeting quality criteria (Chou et al., 2013; Rad, 2003; Tam, Shen, & Kong, 2011), safely completed work (Almahmoud, Doloi, & Panuwatwanich, 2012; Lim & Mohamed, 1999), and client satisfaction (Gayatri & Saurabh, 2013; Lim & Mohamed, 1999; Nassar & Abourizk, 2014). In the light of previous studies, this study also utilizes those mostly cited indicators to measure construction project success.

Determinants of Project Management Performance

The framework proposed in this study involves fourteen knowledge areas of the PMBoK Guide. In the initial step, a total of 76 components are derived regarding the knowledge areas. After conducting pilot studies with three university professors and two industry practitioners, some of the components were either combined or removed to best reflect their corresponding knowledge areas. In the final step, a total of 58 components under 14 knowledge areas are obtained. The underlying components of each knowledge area are identified (Exhibit 1).

Exhibit 1. Components of Project Management Knowledge Areas

Knowledge Area	Component	Key references
Project Integration Management (F1)	Development of Project Charter	Larson and Gray (2011); Mustaro and Rossi (2013); PMI (2013).
	Knowledge Integration	Carlile and Rebentisch (2003); Enberg (2012); Heising (2012); Mitropoulos and Tatum (2000); Song and Song (2010).
	Process Integration	Birkinshaw, Bresman and Håkanson (2000); Mitropoulos and Tatum (2000).
	Staff Integration	Jonas (2010); Enberg (2012); Tiller (2012).
	Supply Chain Integration	Ernst, Hoyer and Rübsaamen (2010); Enberg (2012); Gemunden et al. (1996); Henard and Szymanski (2001).
	Integration of Changes	Hornstein (2015); PMI (2013); Turner and Muller (2005).
Project Scope Management (F2)	Scope Planning	Gumus, Ertas, Tate and Cicek, (2008); Nevo and Chan (2007); PMI (2013).
	Scope Definition	Abrantes and Figueiredo (2014); Hamilton and Jr (1996); Song and Abourizk (2005).
	Scope Changes	Abrantes and Figueiredo (2014); Ibbsand Nguyen (2007).
Project Time Management (F3)	Activity Definition	Love et al. (2002); Mustaro and Rossi (2013), PMI (2013).
	Activity Sequencing	Liberatore and Pollack-Johnson (2006); PMI (2013).
	Time Estimation	Berssaneti and Carvalho (2015); Brown, Adams and Amjad (2007); Cooke-Davies (2002); Guerrero, Villacampa and Montoyo (2014).
	Development of Project Schedule	Berssaneti and Carvalho (2015); Khamooshi and Golafshani, (2013).
	Schedule Monitoring, Control and Revision	Guerrero et al. (2014); Ibbs and Nguyen (2007); Meng, (2012).
Project Cost Management (F4)	Cost Estimation	Aibinu and Pasco (2008); Doloi (2011); PMI (2013); Yildiz, Dikmen, Birgonul, Ercoskun and Alten (2014).
	Determination of Budget	Ahsan and Gunawan (2010); Atkinson (1999); Doloi (2011); Kim, Kang and Hwang (2012); PMI (2013).
	Cost Control	Atkinson, (1999); Jung and Gibson (1999); Jung and Woo (2004); Doloi (2011); Kim et al. (2012); PMI (2013).
Project Quality Management (F5)	Quality Definition	Qureshi, Warraich and Hijazi (2009); Marques, Gourc and Lauras (2011); Wanberg, Harper, Hallowell and Rajendran (2013).
	Quality Standardization	Qureshi et al. (2009); Marques et al. (2011).
	Quality Assurance and Control	Aliverdi, Naeni and Salehipour (2013); Flyvbjerg (2014); PMI (2013); Wanberg et al. (2013).

Project Human Resource Management (F6)	Project Team Composition	Belout and Gauvreau (2004); Buller and McEvoy (2012); Jiang, Klein and Discenza (2002); Khan and Rasheed (2015); Tabassi and Bakar (2009).
	Workforce Planning	Belout and Gauvreau (2004); Buller and McEvoy (2012); Jiang et al. (2002); Khan and Rasheed (2015); Tabassi and Bakar (2009).
	Staff Training	Belout and Gauvreau (2004); Huselid, Jackson and Schuler (1997); Jiang et al. (2002);
	Performance Development	Birasnav (2014); Buller and McEvoy (2012); Tabassi and Bakar, (2009).
	Performance Evaluation	Huselid et al. (1997); Youndt, Snell, Dean and Lepak (1996).
Project Communications Management (F7)	Communication Strategies	Badir, Büchel and Tucci (2012); Ochieng and Price (2010); Meng (2012); Senescu, Aranda-Mena and Haymaker (2013); PMI (2013).
	Communication Technology	Arriagada and Alarcon (2014); Meng (2012); Zhang and Ng (2013).
	Coordination and Collaboration	Arriagada and Alarcon (2014); Badir et al. (2012); Ochieng and Price (2010); Senescu et al. (2013); Zhang and Ng (2013).
	Knowledge Sharing	Arriagada and Alarcon (2014); Badir et al. (2012); Meng (2012); Senescu et al. (2013); Zhang and Ng (2013).
	Multi-Cultural Communication	Ochieng and Price (2010); Pheng and Leong (2000).
Project Risk Management (F8)	Risk Identification	Liu, Zhang, Keil and Chen (2009); Sousa et al. (2014); Zou, Chen and Chan (2010); Zhao et al. (2013); Hwang, Zhao and Toh (2014).
	Risk Analysis	Bakker, Boonstra and Wortmann (2010); Eybpoosh, Dikmen and Birgonul (2011); Liu et al. (2009); Zhi (1995); Zou et al. (2010).
	Risk Allocation	Hwang et al. (2014); Sousa et al. (2014); Zhao et al. (2013); Zou et al. (2010).
	Risk Control	Hwang et al. (2014); Liu et al. (2009); Sousa et al. (2014); Zhao et al. (2013); Zou et al. (2010).
Project Procurement Management (F9)	Supplier Selection	Chen, Li and Hong (2004); Eriksson and Westerberg (2011); Ruparathna and Hewage (2014); Meng et al. (2011).
	Type of Contract	Eriksson and Westerberg (2011); Meng et al. (2011); Ruparathna and Hewage (2014); Wardani et al. (2006);
	Supply of Resources	Chen et al. (2004); Eriksson and Westerberg (2011); Meng et al. (2011); Ruparathna and Hewage (2014).
	Risk Management in the Supply Process	Chopra and Sodhi (2004); Zsidisin, Panelli and Upton (2000).
Project Stakeholder Management (F10)	Identification of Stakeholders	Achterkamp and Vos (2008); Elias, Cavana and Jackson (2002); Jepsen and Eskerod (2009); Yang, Huang and Wu (2011); PMI (2013); Walker, Bourne and Shelley (2008).
	Stakeholder Needs, Interests, and Influences	Jepsen and Eskerod (2009); Missonier and Loufrani-Fedida (2014); Mok, Shen and Yang (2015); Yang et al. (2011).
	Stakeholder Engagement	Jepsen and Eskerod (2009); PMI (2013); Missonier and Loufrani-Fedida (2014); Mok et al. (2015); Yang et al. (2011);
	Stakeholder Conflicts	Missonier and Loufrani-Fedida (2014); Yang et al. (2011).

Project Safety Management (F11)	Safety Awareness and Culture	Cheng et al. (2012); Choudhry (2014); Hinze (1997); Mitropoulos, Cupido and Namboodiri, (2009); Molenaar, Park and Washington (2009); Sousa et al. (2014); Tappura, Sievänen, Heikkilä, Jussila and Nenonen (2015).
	Safety Planning	Cheng et al. (2012); Choudhry (2014); Hinze (1997); PMI (2005); Mitropoulos et al. (2009); Molenaar et al. (2009); Tappura et al. (2015).
	Safety Training	Cheng et al. (2012); Choudhry (2014); Sousa et al. (2014); Demirkesen and Arditi (2015); Mitropoulos et al. (2009); Molenaar et al. (2009); Tappura et al. (2015).
	Safety Implementation	Cheng et al. (2012); Choudhry (2014); Mitropoulos et al. (2009); Sousa et al. (2014); Tappura et al. (2015).
	Safety Inspection and Monitoring	Cheng et al. (2012); Choudhry (2014); Mitropoulos et al. (2009); Molenaar et al. (2009); Tappura et al. (2015).
Project Environmental Management (F12)	Environmental Implementation and Control Measures	Chen et al. (2004); Fuertes et al. (2013); Shen, Wu and Zhang, (2011); Testa, Iraldo and Frey (2011).
	Environmental Impact	Fuertes et al. (2013); Goh and Rowlinson (2013); Shen et al. (2011); Testa et al. (2011).
	Environmental Policies and Regulations	Chen et al. (2004); Fuertes et al. (2013); Goh and Rowlinson (2013); PMI (2005); Shen et al. (2011); Testa et al. (2011).
Project Financial Management (F13)	Cash Flow Planning	Boussabaine and Kaka (1998); Kaka and Price (1993); Pate-Cornell et al. (1990).
	Cash Flow Analysis	PMI, (2005); Maravas and Pantouvakis (2012).
	Foreign Exchange Risk	He and Ng (1998); Kapila and Handrickson (2001).
	Cash Flow Monitoring and Control	Bradley and Tomasides (1991); Gardiner and Stewart (2000); Kao, Pan and Lin (2009).
Project Claim Management (F14)	Claim Identification	Abdul-Malak, El-Saadi and Abou-Zeid, (2002); PMI (2005); Vidogah and Ndekugri (1997); Zaneldin (2006).
	Claim Notification	Kartam (1999); Kululanga, Kuotcha, Mccaffer and Edum-Fotwe (2001); PMI (2005).
	Claim Resolution	Abdul-Malak et al. (2002); PMI (2005); Vidogah and Ndekugri (1997).
	Claim Prevention	Kartam (1999); Kululanga et al. (2001); PMI (2005).

Considering the relations between knowledge areas and project management performance, and interrelations among knowledge areas, a total of 30 hypotheses are developed. Among these, 14 hypotheses represent the relations between knowledge areas and project management performance; whereas 16 of them represent the interrelations among the knowledge areas. To best represent the model developed, a visual diagram for the initial model is provided along with the hypotheses numbered (Exhibit 2). Following sections provide evidence from previous research to indicate how each hypothesis was developed.

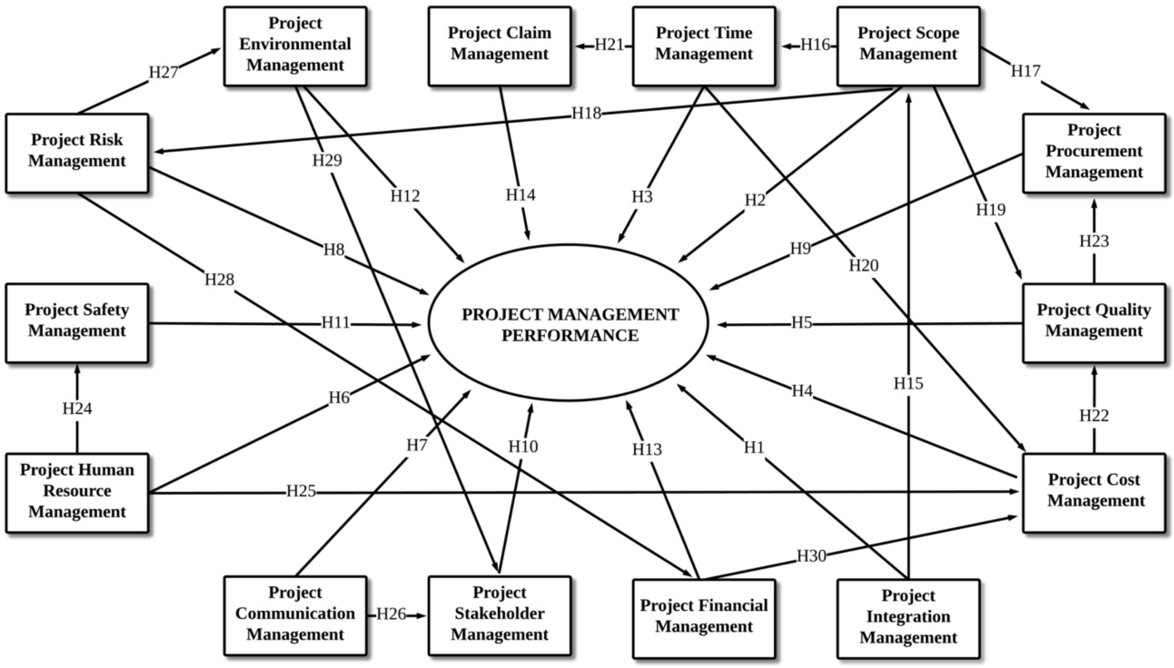

Exhibit 2. Project Management Performance Model with Hypotheses

Hypotheses for the Relationship between the Determinants and Performance Construct

PMBoK Guide lists project integration, scope, cost, time, quality, human resource, communications, risk, procurement, and stakeholder management as the critical areas in effective project management (PMI, 2013). The engineering management body of knowledge (EMBoK) also defines competency areas that professionals should possess. EMBoK Guide mentions eleven domains: introduction to engineering management, leadership and organization management, strategic planning, financial resource management, project management, operations and supply chain management, marketing and sales management in engineering organizations, management of technology, research, and development, systems engineering, legal issues in engineering management, and professional codes of conduct and ethics (Shah, 2012).

One might relate EMBoK Guide to PMBoK Guide in that most of the areas mentioned in PMBoK coincide with the areas in EMBoK Guide. EMBoK Guide also highlights that the areas mentioned are crucial for better project management. Apart from those, previous research also indicated the essential elements of project management.

For example, the critical role of integration in terms of project portfolio management was highlighted (Heising, 2012). In addition, it was stated that degree of project integration affects project performance (Mitropoulos & Tatum, 2000).

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

It was reported that effective scope management has a direct impact on the project outcome (Fageha & Aibinu, 2013).

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

As previously conducted studies prove, effective time management provides enhanced project management performance (Gayatri & Saurabh, 2013; Ngacho & Das, 2014).

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

Cost was also indicated among the most important attributes of a project management model developed by Salazar-Aramayo, da-Silveira, de-Almeida, & de Castro-Dantas (2013).

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

It was emphasized that quality of work done is among the most important attributes of project performance measurement (Ali, Al-Sulaihi, & Al-Gahtani, 2013).

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

Project performance and knowledge absorptive capacity of project teams are highly affected by project human resource management practices (Popaitoon & Siengthai, 2014).

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

Communication is one of the key components of improved performance (Badir, Buchel, & Tucci, 2012).

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

It was demonstrated that effective risk management leads to enhanced project performance (Hwang, Zhao, & Toh, 2014).

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

It was shown that collaborative procurement practices have a positive influence on construction project performance (Eriksson & Westerberg, 2011).

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

Stakeholder satisfaction is directly associated with the performance management in construction (Kagioglu et al., 2001). Stakeholder attributes are among the success factors for measuring performance (Takim & Akintoye, 2002, Rad, 2003, Bassioni, Price, & Hassan 2004). Project stakeholder management has a direct influence on project success (Freeman

Harrison, Wicks, Parmar, & De Colle, 2010).

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 safety, environmental, financial, and claim management are among the most important attributes of project management.

Successful safety management practices have a positive contribution to improved project performance (Cheng et al., 2012).

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

The strong link between the effectiveness of project environmental management and business performance was provided (Montabon, Sroufe, & Narasimhan, 2007).

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

Financial attributes are highly effective on project performance (Akanni, Oke, & Akpomiemie, 2015).

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

Effectiveness of claim management is essential in terms of successful completion of project, which in turn leads to enhanced project performance (Vidogah & Ndekugri, 1997). It was indicated that successful handling of claims is one of the most important components of enhanced performance (Jastaniah, 1997).

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

Hypotheses for the Interrelations among the Determinants of Project Management Performance

Early studies show that ***integration management*** has a direct influence on ***scope management***. For instance, program or project directors, who use high levels of integration and scope practices are more likely to be top performers (Crawford, 2005). Scope was listed as one of the main functions of integration (Grant, 1996).

H15: Effectiveness of "integration management" has a direct and positive effect on "scope management".

It was indicated that ***scope management*** has a direct impact on the ***time, procurement, risk,*** and ***quality management*** (Chou et al., 2013). Strong correlation was found between scope and time management (Chou & Yang, 2012). The essential function of broadly defined scope on procurement for achieving better procurement practices was emphasized (Schapper, Veiga, Malta, & Gilbert, 2006). The critical importance of scope in risk management activities was implied (Haimes, 2004). The clarity of scope is one of the most important elements of total quality management (Arditi & Gunaydin, 1997).

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

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

H18: Effectiveness of "scope management" has a direct and positive effect on "risk management".

H19: Effectiveness of "scope management" has a direct and positive effect on "quality management".

The impact of ***time management*** on ***cost management*** was implied in different studies. Time-cost trade off problems become a challenge for successful project management since crashing an activity ensures time saving but increases the cost (Babu & Suresh, 1996). Early completion of projects might be achieved through cost activities (Hu, Cui, Demeulemeester, &Bie, 2016; Kerzner, 2009). Studies also emphasized the link between ***time*** and ***claim management*** as well. It was provided that untimely notification of claims leads to difficulty in handling construction claims (Sibanyama, Muya, & Kaliba, 2012).

H20: Effectiveness of "time management" has a direct and positive effect on "cost management".

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

The relationship between ***cost management*** and ***quality management*** was demonstrated in different studies (Alshawi & Ingirige, 2003; Bowen, Cattel, Hall, Edwards & Pearl, 2012), which reported that clients demand high quality and low cost at the same time.

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

The effect of ***quality management*** on ***procurement management*** was emphasized in several studies. It was indicated that quality management is strongly associated with procurement management (Chou et al., 2013). Systems and processes for quality control are listed as the key elements of a procurement management model to relate quality with procurement (Yeo & Ning, 2002).

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

The link between ***human resource management*** and ***safety management*** practices was implied in several studies. Human resource management department plays a critical role in providing construction workers with feedback about unsafe behaviour and being sensitive towards contract employment relationships for workplace safety (Kochan et al., 2003; Lai, Liu,

& Ling, 2011). The strong association between ***human resource management*** and ***cost management*** was also indicated in several studies (Dess & Shaw, 2001; Singh, 2003) since recruiting costs, cost of human capital, and training costs of employees are strongly linked to the cost management processes.

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

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

Communications management is strongly related with ***project stakeholder management***. Liaising with stakeholders is critical in terms of effective communications management (Baccarini, Salm, & Love, 2004). Stakeholder information, response and involvement are very important for corporate social responsibility communication (Morsing & Schultz, 2006). Communication is the key point for managing crises arising among stakeholders and for achieving success (Ulmer, 2001). Improved communication leads to higher project performance (Chang & Shen, 2009). There is a positive relationship between communication among top management and project success (Ahmed & Mohamad, 2016).

H26: Effectiveness of "communications management" has a direct and positive impact on "stakeholder management".

Previous studies emphasized that ***risk management*** has a direct association with the ***environmental management***. Effective management of environmental risks is essential for the successful execution of projects (Zhi, 1995). Environmental risks are among the most important risk categories for construction projects (Al-Bahar & Crandall, 1990). The impact of ***risk management*** on ***financial management*** was demonstrated in Odeyinka, Lowe and Kaka's (2008) study, which determined that risk factors have direct impact on cash flow forecasts.

H27: Effectiveness of "risk management" has a direct and positive impact on "environmental management".

H28: Effectiveness of "risk management" has a direct and positive impact on "financial management".

The relationship between ***environmental management*** and ***stakeholder management*** was reported in previous studies. For example, it was indicated that stakeholder participation should be institutionalized in terms of having a more comprehensive and systematic approach for the solution to technical and environmental problems (Reed, 2008). It was implied that stakeholders have a strong influence on conservation projects, where environmental factors are evaluated (De Lopez, 2001).

H29: Effectiveness of **"**environmental management" has a direct and positive impact on "stakeholder management".

The link between ***financial management*** and ***cost management*** was also sought. For example, it was mentioned that disclosure costs are important in the choice of financial resources (Yosha, 1995). Financial objectives were defined in terms of total life cycle cost (Jaafari, 2001).

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

Research Methodology

Based on the proposed model, an online questionnaire was designed and administered to project management professionals in Turkish construction firms. The questionnaires were sent to key large-scale engineering, construction, and architecture firms. The firms are selected based on their age, annual turnover and number of employees, which are the indicators of a large firm. Exhibit 3 reflects the characteristic of responding firms. The targeted respondents are among members of Turkish Contractors Association, Association of Turkish Consulting

Engineers and Architects, The Turkish Employers' Association of Construction Industries, and Architectural Archive of Turkey. A total of 99 online questionnaires were returned out of 508 sent out. To increase the response rate, face-to-face interviews were conducted with 22 professionals, where the same questionnaire items are verbally provided. Face-to-face interviews are selected among the respondents who did not return the questionnaire in the first hand and the return rate for face-to-face invitations was 100%. The total responses collected resulted in 121 responses with a response rate of 24%. The respondents were asked to fill in the questionnaires based on the project management performance of their completed projects.

The collected data represent 121 different construction projects that were undertaken by 82 different firms, where some of the firms provided multiple data. The survey includes two main parts: (i) general information about the company, respondent and the project; and (ii) variables for project management performance. The respondents were asked to evaluate their project management performance based on the effectiveness of the listed variables using a 1-5 point Likert scale (1: very low, 2: low, 3: medium, 4: high, 5: very high). Additionally, they evaluated the level of project management performance based on the specified project success criteria. Exhibit 3 summarizes the characteristics of the respondents.

Exhibit 3. Characteristics of the Respondents

Respondent Firm	Mean	Median	Minimum	Maximum
Age of firm (years)	33	29	2	70
Total turnover (million dollars)	612	1.15	0.250	6500
Number of Employees	4563	100	8	22,000

The questionnaire also gathered information regarding project characteristics. Exhibit 4 summarizes project characteristics. According to Exhibit 4, most of the projects are building projects, and contractors are the most numerous respondents in the survey. The average project duration, based on the information provided, is 2.9 years. The average contracted duration is

2.4 years, indicating delays were common. The most common type of contract is unit price contract. Finally, most of the projects’ budget lies between 400-600 million US dollars.

Exhibit 4. Characteristics of the Projects

Project Type (Numbers)	Role in the Project (Numbers)	Project Completion Time (Average Years)	Contract Duration (Average Years)	Contract Type (Numbers)	Contractual Budget (Million dollars)
Building (55)	Contractor (57)	Contractor (3.5)	Contractor (2.6)	Unit Price (70)	0-200 (13)
Transportation (21)	Structural Designer (8)	Structural Designer (2.7)	Structural Designer (2.2)	Turnkey (27)	200-400 (24)
Industrial (17)	Architectural Designer (6)	Architectural Designer (2.5)	Architectural Designer (1.8)	Lump Sum (16)	400-600 (37)
Infrastructure (12)	Subcontractor (4)	Subcontractor (3.3)	Subcontractor (3.2)	Cost Plus Fee (6)	600-800 (25)
Water Structures (11)	Client (4)	Client (2.6)	Client (2.2)	Build-Operate-Transfer (2)	800-1000 (15)
Other (5)	Other (3)	Other (2.8)	Other (2.5)	-	+1000 (7)

Data Analysis

The data were analyzed using a software package called Analysis of Moment Structures, a structural equation modeling tool. Structural equation modeling is a multivariate statistical methodology that is used to analyze structural relationships, and it takes confirmatory approach into account and tests hypothesis among observed and latent variables (Bollen & Long, 1993; Byrne, 2012; Hoyle, 1995; Kline, 1998).

A typical structural equation model consists of two parts: the measurement model and the structural model (Kline, 1998). The measurement model defines how the hypothetical constructs are measured by means of the observed variables where the structural model specifies the causal relationships among the latent variables (Byrne, 2012). In structural equation modeling, the validity of the hypothesized constructs also needs to be tested. There are two types of validity, namely the content and construct validity, which must be achieved in a structural equation model.

In this study, research judgment and insight is applied for content validity since there is no formal statistical test (Garver & Mentzer, 1999). The indicators of each proposed construct were selected after an in-depth literature review and they were 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 constructs.

Convergent validity, discriminant validity, and reliability are the main elements of the construct validity. Examination of factor loadings and goodness of fit indices is a method of assessing convergent validity. Evaluation of inter-correlations between the measures of a construct is a way of assessing discriminant validity (Byrne, 2012). Factor loadings are important in confirmatory factor analysis since indicators which are not statistically significant are deleted from the model. This operation helps improve the internal reliability and fit indices as well.

Exhibit 5 represents the factor loadings corresponding to the latent and constituent variables of the model. “F” label in Exhibit 5 represents factor and “V” label represents variable. It is observed that all factor loadings are statistically significant at α=0.05. Hence, there is no variable that need to be removed from the initial model.

Exhibit 5. Latent and Constituent Variables of the Model

Label	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	0.710
V6	Integration of Changes	0.759
F2	**Project Scope Management**	
V7	Scope Planning	0.831
V8	Scope Definition	0.810
V9	Scope Changes	0.732
F3	**Project Time Management**	
V10	Activity Definition	0.835
V11	Activity Sequencing	0.800
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	0.890
V17	Cost Control	0.740
F5	**Project Quality Management**	
V18	Quality Definition	0.861
V19	Quality Standardization	0.944
V20	Quality Assurance and Control	0.895
F6	**Project Human Resource Management**	
V21	Project Team Composition	0.610
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	0.900
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	0.760
F10	**Project Stakeholder Management**	
V39	Identification of Stakeholders	0.872
V40	Stakeholder Needs, Interests and Influences	0.913
V41	Stakeholder Engagement	0.929
V42	Stakeholder Conflicts	0.860
F11	**Project Safety Management**	
V43	Safety Awareness and Culture	0.910
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	0.500
V61	Quality	0.591
V62	Safety	0.634
V63	Client Satisfaction	0.656

Exhibit 6 presents the reliability values and fit indices for the constructs of the model. The reliability of the all constructs is satisfied when Cronbach's 'α' coefficient is over 0.7 for all the constructs (Nunnally, 1978). For testing goodness of fit, Chi-square ($\chi 2$) test was assessed. The smaller the Chi-square value, the better fit is observed. In analysis of moment structures, a ratio of Chi-square over degree of freedom is proposed as a fit measure. Although there is no agreed consensus on Chi-square over degree of freedom value, a ratio lower than 5.0 is an acceptable range (Marsh & Hocevar, 1985). Relative fit index (Bollen, 1986), Comparative fit index (Bentler, 1990), and Tucker-Lewis index (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 (Steiger & Lind, 1980) is a parsimony-adjusted index, which includes a built-in correction for model complexity. A threshold value of root mean square error of approximation was previously proposed indicating that values less than 0.1 shows acceptable fit (Kline, 1998). Exhibit 6 shows that the reliability of all constructs and fit indices are in the acceptable ranges with a few exceptions in some of the indices. However, the values of fit indices and root mean square error of approximation values are close to the cut-off value of 0.9 for the fit indices and 0.1 for the recommended root mean square error of approximation threshold.

Nonetheless, research studies have previously implied that these cut-off points are subjective measures depending on the substantial amount of experience of the researchers (Browne & Cudeck, 1993; Steiger, 1989). Moreover, a group of studies demonstrated that the use of precise numerical cut-off values for root mean square error of approximation should not be considered too seriously (Hayduk & Glaser 2000; Steiger 2000).

Exhibit 6. 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
Chi Square/Degree of freedom	< 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
Relative Fit Index	> 0.9	0.932	0.978	0.964	0.980	0.988	0.959	0.956	0.981	0.970	0.954	0.972	0.985	0.977	0.971	0.841
Comparative Fit Index	> 0.9	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
Tucker-Lewis Index	> 0.9	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
Root Mean Square Error of Approximation	< 0.1	0.084	0.054	0.063	0.081	0.036	0.064	0.079	0.068	0.081	0.150	0.092	0.091	0.068	0.057	0.174

Structural equation modeling tests the hypotheses between the validated constructs. In the first step, the relationships among the determinants of project management performance are assessed. Exhibit 7 presents the hypothesized relationships for project management performance. The arrows represent the direction of influences between the parameters of the model where the numbers on the arrows show the path coefficients. Path coefficients are the equivalents of regression weights except that there is no intercept term in structural equation modeling. An interpretation guideline adopted from Murari (2015) is used for evaluating the strength of association between variables, where the path coefficient ranging from 0.1 to 0.3 shows weak; 0.3 to 0.5 moderate, and 0.5 to 1.0 strong association.

In the second step, the influences of each determinant on overall management performance are assessed. A significant and moderate effect of "integration management" with a path coefficient of 0.435 on "project management performance" is found. "Communications management" (0.352) and "safety management" (0.323) are found to have a positive and moderate effect on "performance". "Human resource management" (0.275), "cost management" (0.235), "risk management" (0. 234), and "financial management" (0.222) were all found to have a positive and weak effect on "performance". Unlike the above knowledge areas, the influences of "environmental management" (0.015), "quality management" (0.062), "stakeholder management" (0.084), "scope management" (0.113), "time management" (0.128), "claim management" (0.142), and "procurement management" (0.141) on "performance" are not found to be statistically significant.

The paths that are not statistically significant, represented by the dashed lines, are eliminated from the initial model. The final path coefficients are shown in Exhibit 7.

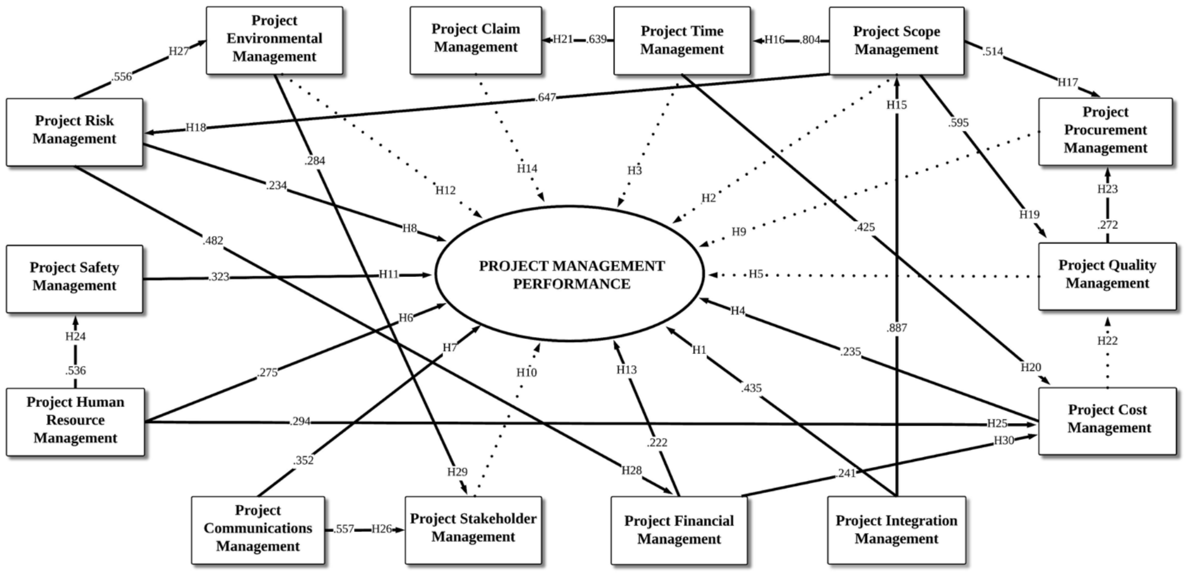

Exhibit 7. Project Management Model

In some cases, both direct and indirect or only indirect effects are observed. For example, scope management has an indirect effect on performance through risk management; time management through cost management; risk management through financial management in addition to its direct effect on performance; human resource management through cost management in addition to its direct effect; and financial management through cost management as well as its direct effect.

Exhibit 8 presents the reliability values and fit indices for the initial and modified model. Cronbach's Alpha values were found higher than 0.7 as recommended by Nunnally (1978). Relative fit index, Confirmatory fit index and Tucker-Lewis index values were also found around 0.9, which indicates good fit of the model to the data. Furthermore, root mean square error of approximation values were found to be below the threshold value as recommended by (Kline, 1998). Finally, the correlation matrices were calculated for all constructs and the intercorrelations were all found below 0.90, which indicated that there is no multicollinearity (Hair, Anderson, Tatham & Black, 1998). Exhibit 8 shows that the fit indices are slightly better in the final model. According to Exhibit 8, it is clear that model fit is ensured.

Exhibit 8. Reliability and Fit Indices

Index	Recommended Value	Initial Model	Final Model
Cronbach's Alpha	> 0.7	0.980	0.980
Chi square/Degree of Freedom	< 5.0	1.682	1.566
Tucker-Lewis Index	0 (no fit) to 1 (perfect fit)	0.847	0.901
Incremental Fit Index	0 (no fit) to 1 (perfect fit)	0.859	0.911
Comparative Fit Index	0 (no fit) to 1 (perfect fit)	0.857	0.909
Root Mean Square Error of Approximation	< 0.10	0.072	0.058

Discussion of Findings

Among the 16 hypotheses developed in this study regarding the interrelations among the knowledge areas, 15 were validated as suggested in the literature. However, the hypothesis regarding the influence of cost management on quality management was rejected despite several studies that found the link between cost and quality management (Alshawi & Ingirige, 2003; Bowen et al., 2012). This may be because contractors in Turkey are much more sensitive about achieving under budget completion rather than ensuring the specified quality requirements.

Among the 14 hypotheses related with project performance, seven were validated whereas seven were rejected. This is mainly because the model involves a high number of determinants and the magnitudes of influence of those determinants on performance are found to be low compared to a model that involves a fewer number of constructs. The expected positive effect of integration, cost, human resource, communications, safety, risk, and financial management on performance was validated by the analysis as also provided in the literature. It is also essential to note that the positive effects of these areas on performance are supported with well-set practices such as incentive and reward mechanisms that intend to increase employee performance on the project. These reward mechanisms might have a considerable impact on project success in that employees get motivated or work towards improving their skills.

It is interesting to note that the positive influence of scope management on performance was not validated despite the previous studies supporting the direct association between project scope management and performance (Koskela & Howell, 2002). On the other hand, it is found that scope management has indirect effects through risk and environmental management, which proves its relative importance. The reason behind the low direct impact of scope management on performance might be that firms do not indicate clear specifications, roles and responsibilities of the project parties in defining the project scope, which in turn leads to poor scope management.

Although researchers have previously indicated that effective project time management contributes to enhanced project performance (Gayatri & Saurabh, 2013; Ngacho & Das, 2014), positive effect of time management on performance was not validated by the analysis. However, indirect effect of time management on performance through project cost management was observed. This may be because construction firms in Turkey are more sensitive to under budget completion rather than on time completion. Since owner expectations mostly focus on the use of monetary resources, it is not surprising that many of the firms put more focus on cost management. Moreover, it is worth noting the impact of ease of measurement of cost on performance than time. Schedule is less clear in terms of considering the exact project start and completion due to the subjectivity in deciding when the tasks are 100% done.

The expected effect of quality management on performance was rejected despite several studies indicating the relationship between quality and performance (Atkinson, 1999; Chua, Kog, & Loh, 1999; Westerveld, 2003). As indicated by Koskela & Howell (2002), the reason might be that the firms evaluate cost minimization as one of the priorities whereas quality is regarded as one of the secondary objectives that must be achieved in the project.

Effect of procurement management on performance was found insignificant unlike the previous research, which indicated strong effect of procurement management on project performance (Eriksson & Westerberg, 2011; Ling, Low, Wang, & Lim, 2009). This may be because some firms manage supply chain relations through subcontractors, and they do not set up any project procurement management department.

Effect of stakeholder management on performance was also found insignificant despite the studies supporting evidence of the relationship between stakeholder management and performance (Atkinson, Crawford, &Ward, 2006; Rowlinson & Cheung, 2008). This may be as attributed to the fact that stakeholder management is not as important as the other project management areas such as cost and time management as mentioned in past studies (Rayner & Reiss, 2001; Thiry, 2002).

Environmental management was not found to affect performance unlike previous research (Chan & Chan, 2004; Montabon, Sroufe, & Narasimhan, 2007; Yang, Chen, & Wang, 2012). This may be because firms are more focused on short term profiting due to the fact that environmental activities may bring extra costs.

Finally, the hypothesis regarding the influence of claim management on performance was rejected even though several research studies indicated that claim management has a considerable impact on performance (Nitithamyong & Skibniewski, 2006). The reason behind this finding might be the higher influence levels of the other knowledge areas such as integration, communications, safety, cost, and human resource management.

The impact of project characteristics on project success was also sought. The findings indicate that water structures are completed with higher success rates compared to the other project types such as infrastructure, building, and transportation. Small size projects are found to be more successful; longer durations lead to lower success rates; projects involving consortiums are more likely to succeed; and cost-plus fee contracts are more advantageous over other contract types.

Implications for Engineering Managers

Engineering managers are in charge of integrating engineering principles into business practices. Hence, they need to work in close coordination with all members of the project. To better manage projects, engineering managers are expected to be familiar with the concepts of performance management. This study proposes a unique set of variables for project management performance where core components of project management are presented in a conceptual model. Moreover, the relations among the aspects of project management are quantified. With the adoption of the model developed, engineering managers might better coordinate projects by analyzing the metrics developed for aspects of project management and integrate these into the projects so as to better coordinate and collaborate throughout the project. This will also help engineering managers experience improved project performance, which in turn results in trust for future projects. This study enables engineering managers to benefit from increased awareness of the low performing areas, enabling them to adopt appropriate strategies for improved performance. Based on the dominant impacts of project integration, human resources, financial, and risk management, engineering managers can become aware that innovative and integrative solutions are required to better perform in project management. The model proposed in the study is also expected to encourage engineering managers for successful project evaluation in the light of upper level executives' perceptions and devise strategies to motivate project members for improved performance.

Conclusions

This study has proposed a project management performance model for construction firms. In this respect, project management knowledge areas have been adopted as the key determinants of performance. The model comprises a total of 63 components related to project management performance, where 58 belong to knowledge areas and 5 belong to performance construct. Data was collected from 121 projects through a questionnaire survey. Structural equation modeling 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 improved performance. Project communications, safety, and cost management are found to have direct impact on performance. Project scope and time management are observed to affect performance indirectly over risk and cost management. However, the effects of project claim, procurement, quality, stakeholder, and environmental management on performance were not found to be significant. Apart from the association between the determinants and performance, strong links were observed among the determinants as well.

The following recommendations are provided to improve project management performance within construction firms:

- ***Based on the high influence of integration, human resource, financial, and risk management on performance***, firms are expected to focus on these areas. For more effective integration management, they should prioritize key integration initiatives, develop sound feasibility reports and tracking mechanisms, consider issue and change management, and make accurate status reporting. In this respect, Integrated Project Delivery Systems, Building Information Modeling, Radio Frequency Identification, and Enterprise Resource Planning may be adopted as tools supporting integration in construction.

  Regarding human resources, the following factors are considered to be critical: determination of workforce, establishment of reward mechanisms for project personnel, and performance development and evaluation. It is advised that firms evaluate their financial viability and resources at the beginning of the projects, and establish financial monitoring and controlling systems for improved performance in financial management. Firms are encouraged to prioritize project risks, set up risk management procedures where risks are identified, categorized, and allocated in an appropriate manner.

- ***Based on the positive effect of communications, safety, and cost management on performance,*** it is suggested that firms try to improve their capabilities in these areas. In terms of communications, firms may benefit from project-based knowledge management systems, web-based communication, and information communication technologies. They are encouraged to organize frequent safety training sessions, establish incentive mechanisms for safety personnel, enhance awareness for safety, set work safe procedures, and adopt zero accident policies. They are also advised to enhance cost performance through determining critical milestones and cost breakdown structures, developing progress monitoring curves, conducting earned value analysis, and adopting lean construction techniques for maximization of value whilst minimizing waste.
- ***Based on the indirect impacts of scope and time management on performance,*** these areas should not be ignored. Firms should pay attention to the existence of clear objectives, expectations, definition of project scope and activities, and prioritization of stakeholders' expectations. Additionally, they should focus extensively on prioritization of project activities, accurate activity duration estimation, and accurate determination of milestones.

Contractors are encouraged to use the proposed model and its components to measure their project management performance and benefit from its findings to improve 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 the 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 serve as the basis for developing 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.

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References

Abdul-Malak, M. A., El-Saadi, M. M., & Abou-Zeid, M. G. (2002). Process Model for Administrating Construction Claims. *Journal of Management in Engineering, 18*(2), 84-94. doi:10.1061/(asce)0742-597x(2002)18:2(84).

Abrantes, R., & Figueiredo, J. (2014). Feature based process framework to manage scope in dynamic NPD portfolios. *International Journal of Project Management, 32*(5), 874-884. doi:10.1016/j.ijproman.2013.10.014.

Achterkamp, M. C., & Vos, J. F. (2008). Investigating the use of the stakeholder notion in project management literature, a meta-analysis. *International Journal of Project Management, 26*(7), 749-757. doi:10.1016/j.ijproman.2007.10.001.

Ahmed, R. & Mohamad, A.N., (2016). Exploring the Relationship Between Multi-Dimensional Top Management Support and Project Success: An International Study, *Engineering Management Journal, 28* (1), 54-67, doi: 10.1080/10429247.2015.1136525.

Ahsan, K., & Gunawan, I. (2010). Analysis of cost and schedule performance of international development projects. *International Journal of Project Management, 28*(1), 68-78. doi:10.1016/j.ijproman.2009.03.005.

Aibinu, A. A., & Pasco, T. (2008). The accuracy of pre-tender building cost estimates in Australia. *Construction Management and Economics, 26*(12), 1257-1269. doi:10.1080/01446190802527514.

Akanni, P.O., Oke, A.E., & Akpomiemie, A.O. (2015). Impact of Environmental Factors on Building Project Performance in Delta State Nigeria. *HBRC Journal,* 11(1), 91-97. http://dx.doi.org/10.1016/j.hbrcj.2014.02.010.

Al-Bahar, J. F., & Crandall, K. C. (1990). Systematic Risk Management Approach for Construction Projects. *Journal of Construction Engineering and Management, 116*(3), 533-546. doi:10.1061/(asce)0733-9364(1990)116:3(533).

Ali, M.A.E.H, Al-Sulaihi, A.I., & Al-Gahtani, S.K. (2013). Indicators for Measuring Performance of Building Construction Companies in Kingdom of Saudi Arabia. *Journal of King Saud University - Engineering Sciences*, 25 (2), 125-134. http://dx.doi.org/10.1016/j.jksues.2012.03.002.

Albert, A., Hallowell, M. R., & Kleiner, B. M. (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, 140*(2), 04013042. doi:10.1061/(asce)co.1943-7862.0000790.

Aliverdi, R., Naeni, L. M., & Salehipour, A. (2013). Monitoring project duration and cost in a construction project by applying statistical quality control charts. *International Journal of Project Management, 31*(3), 411-423. doi:10.1016/j.ijproman.2012.08.005.

Almahmoud, E. S., Doloi, H. K., & Panuwatwanich, K. (2012). Linking project health to project performance indicators: Multiple case studies of construction projects in Saudi Arabia. *International Journal of Project Management, 30*(3), 296-307. doi:10.1016/j.ijproman.2011.07.001.

Alshawi, M., & Ingirige, B. (2003). Web-enabled project management: An emerging paradigm in construction. *Automation in Construction, 12*(4), 349-364. doi:10.1016/s0926-5805(03)00003-7.

Alzahrani, J. I., & Emsley, M. W. (2013). The impact of contractors' attributes on construction project success: A post construction evaluation. *International Journal of Project Management, 31*(2), 313-322. doi:10.1016/j.ijproman.2012.06.006.

Anantatmula, V.S., (2010). Project Manager Leadership Role in Improving Project Performance, *Engineering Management Journal, 22*(1), 13-22, doi: 10.1080/10429247.2010.11431849.

Arditi, D., & Gunaydin, H. M. (1997). Total quality management in the construction process. *International Journal of Project Management, 15*(4), 235-243. doi:10.1016/s0263-7863(96)00076-2.

Arriagada, D.R., & Alarcon C.L., (2014). Knowledge management and maturation model in construction companies. *Journal of Construction Engineering and Management*, 140(4), B4013006.

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, 17*(6), 337-342. doi:10.1016/s0263-7863(98)00069-6.

Atkinson, R., Crawford, L., & Ward, S. (2006). Fundamental uncertainties in projects and the scope of project management. *International Journal of Project Management, 24*(8), 687-698. doi:10.1016/j.ijproman.2006.09.011.

Attakora-Amaniampong, E. (2016). Project management competencies of building construction firms: A structural equation model approach. *Architecture Research,* 6(3), 68-79. doi: 10.5923/j.arch.20160603.03.

Babu, A., & Suresh, N. (1996). Project management with time, cost, and quality considerations. *European Journal of Operational Research, 88*(2), 320-327. doi:10.1016/0377-2217(94)00202-9.

Baccarini, D., Salm, G., & Love, P.E.D., (2004). Management of risk in information technology projects. *Industrial Management and Data Systems*, 104 (4), 286-295.

Badir, Y. F., Büchel, B., & Tucci, C. L. (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, 30*(8), 914-926. doi:10.1016/j.ijproman.2012.01.013.

Bakker, K. D., Boonstra, A., & Wortmann, H. (2010). Does risk management contribute to IT project success? A meta-analysis of empirical evidence. *International Journal of Project Management, 28*(5), 493-503. doi:10.1016/j.ijproman.2009.07.002.

Bassioni, H.A., Price, A.D.F., & Hassan, T.M. (2004). Performance Measurement in Construction. *Journal of Management in Engineering,* 20(2), 42-50. 10.1061/(ASCE)0742-597X(2004)20:2(42).

Beatham, S., Anumba, C., Thorpe, T., & Hedges, I. (2004). KPIs: A critical appraisal of their use in construction. *Benchmarking: An International Journal Benchmarking, 11*(1), 93-117. doi:10.1108/14635770410520320.

Belout, A., & Gauvreau, C. (2004). Factors influencing project success: The impact of human resource management. *International Journal of Project Management, 22*(1), 1-11. doi:10.1016/s0263-7863(03)00003-6.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107*(2), 238-246. doi:10.1037/0033-2909.107.2.238.

Berssaneti, F. T., & Carvalho, M. M. (2015). Identification of variables that impact project success in Brazilian companies. *International Journal of Project Management, 33*(3), 638-649. doi:10.1016/j.ijproman.2014.07.002.

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, 67*(8), 1622-1629. doi:10.1016/j.jbusres.2013.09.006.

Birkinshaw, J., Bresman, H., & Håkanson, L. (2000). Managing the Post-acquisition Integration Process: How the Human Iintegration and Task Integration Processes Interact to

Foster Value Creation. *Journal of Management Studies, 37*(3), 395-425. doi:10.1111/1467-6486.00186.

Bollen, K. A. (1986). Sample size and Bentler and Bonett's nonnormed fit index. *Psychometrika, 51*(3), 375-377. doi:10.1007/bf02294061.

Bollen, K. A., & Long, J. S. (1993). *Testing structural equation models*. Newbury Park: Sage Publications.

Boussabaine, A., & Kaka, A. (1998). A neural networks approach for cost flow forecasting. *Construction Management and Economics, 16*(4), 471-479. doi:10.1080/014461998372240.

Bowen, P., Cattel, K., Hall, K., Edwards, P., & Pearl, R. (2012). Perceptions of Time, Cost and Quality Management on Building Projects. *Australasian Journal of Construction Economics and Building, 2*(2), 48. doi:10.5130/ajceb.v2i2.2900.

Bradley, R. M., & Tomasides, C. H. (1991). Financial Management as Tool for Management Development of Engineers. *Journal of Management in Engineering, 7*(2), 223-236. doi:10.1061/(asce)9742-597x(1991)7:2(223).

Browne, M.W., & Cudeck, R. (1993). *Alternative Ways of Assessing Model Fit.* In: Bollen, K.; Long, J., editors. Testing Structural Equation Models. Sage; Newbury Park, CA: 1993. p. 136-162.

Brown, A., Adams, J., & Amjad, A. (2007). The relationship between human capital and time performance in project management: A path analysis. *International Journal of Project Management, 25*(1), 77-89. doi:10.1016/j.ijproman.2006.07.011.

Buller, P. F., & Mcevoy, G. M. (2012). Strategy, human resource management and performance: Sharpening line of sight. *Human Resource Management Review, 22*(1), 43-56. doi:10.1016/j.hrmr.2011.11.002.

Byrne, B.M., (2012). *Structural Equation Modeling with Mplus: Basic Concepts, Applications, and Programming*. Taylor and Francis Group, New York, USA.

Carlile, P., & Rebentisch, E. (2003). Into the black box: The knowledge transformation cycle. *IEEE Engineering Management Review IEEE, 31*(4), 67-67. doi:10.1109/emr.2003.24940.

Chan, A. P. (2001). Time–cost relationship of public sector projects in Malaysia. *International Journal of Project Management, 19*(4), 223-229. doi:10.1016/s0263-7863(99)00072-1.

Chan, A. P., Scott, D., & Lam, E. W. (2002). Framework of Success Criteria for Design/Build Projects. *Journal of Management in Engineering, 18*(3), 120-128. doi:10.1061/(asce)0742-597x(2002)18:3(120).

Chan, A. P., Scott, D., & Chan, A. P. (2004). Factors Affecting the Success of a Construction Project. *Journal of Construction Engineering and Management J. Constr. Eng. Manage., 130*(1), 153-155. doi:10.1061/(asce)0733-9364(2004)130:1(153).

Chan, A. P., & Chan, A. P. (2004). Key performance indicators for measuring construction success. *Benchmarking: An International Journal Benchmarking, 11*(2), 203-221. doi:10.1108/14635770410532624.

Chang, A. S., & Shen, F. (2009). Coordination Needs and Supply of Construction Projects. *Engineering Management Journal,* 21(4), 44-57, doi:10.1080/10429247.2009.11431844.

Chen, Z., Li, H., & Hong, J. (2004). An integrative methodology for environmental management in construction. *Automation in Construction, 13*(5), 621-628. doi:10.1016/j.autcon.2004.04.006.

Cheng, E. W., Ryan, N., & Kelly, S. (2012). Exploring the perceived influence of safety management practices on project performance in the construction industry. *Safety Science, 50*(2), 363-369. doi:10.1016/j.ssci.2011.09.016.

Cho, K., Hong, T., & Hyun, C. (2009). Effect of project characteristics on project performance in construction projects based on structural equation model. *Expert Systems with Applications,* 36, 10461-10470. doi:10.1016/j.eswa.2009.01.032.

Chopra, S., & Sodhi, M.S., (2004). Managing risk to avoid supply-chain breakdown. *MIT Sloan Management Review,* 46 (1), 53-62.

Chou, J., & Yang, J. (2012). Project Management Knowledge and Effects on Construction Project Outcomes: An Empirical Study. *Project Management Journal, 43*(5), 47-67. doi:10.1002/pmj.21293.

Chou, J., Irawan, N., & Pham, A. (2013). Project Management Knowledge of Construction Professionals: Cross-Country Study of Effects on Project Success. *Journal of Construction Engineering and Management, 139*(11), 04013015. doi:10.1061/(asce)co.1943-7862.0000766.

Choudhry, R. M. (2014). Behavior-based safety on construction sites: A case study. *Accident Analysis & Prevention, 70*, 14-23. doi:10.1016/j.aap.2014.03.007.

Chua, D. K., Kog, Y. C., & Loh, P. K. (1999). Critical Success Factors for Different Project Objectives. *Journal of Construction Engineering and Management, 125*(3), 142-150. doi:10.1061/(asce)0733-9364(1999)125:3(142).

Cooke-Davies, T. (2002). The "real" success factors on projects. *International Journal of Project Management, 20*(3), 185-190. doi:10.1016/s0263-7863(01)00067-9.

Crawford, C. (2005). Effects of transformational leadership and organizational position on knowledge management. *Journal of Knowledge Management, 9*(6), 6-16. doi:10.1108/13673270510629927.

De Lopez, T. T. (2001). Stakeholder Management for Conservation Projects: A Case Study of Ream National Park, Cambodia 1. *Environmental Management, 28*(1), 47-60. doi:10.1007/s002670010206.

Demirkesen, S., & Arditi, D. (2015). Construction safety personnel's perceptions of safety training practices. *International Journal of Project Management, 33*(5), 1160-1169. doi:10.1016/j.ijproman.2015.01.007.

Dess, G. G., & Shaw, J. D. (2001). Voluntary Turnover, Social Capital, And Organizational Performance. *Academy of Management Review, 26*(3), 446-456. doi:10.5465/amr.2001.4845830.

Doloi, H. K. (2011). Understanding stakeholders' perspective of cost estimation in project management. *International Journal of Project Management, 29*(5), 622-636. doi:10.1016/j.ijproman.2010.06.001.

Doloi, H., Iyer, K., & Sawhney, A. (2011). Structural equation model for assessing impacts of contractor's performance on project success. *International Journal of Project Management, 29*(6), 687-695. doi:10.1016/j.ijproman.2010.05.007.

Eastham, J., Tucker, D., Varma, S., & Sutton, S. (2014). PLM Software Selection Model for Project Management Using Hierarchical Decision Modeling With Criteria From PMBOK® Knowledge Areas, *Engineering Management Journal, 26*(3), 13-24. doi: 10.1080/10429247.2014.11432016.

Egan, J., (1998). *Rethinking construction, the construction task force,* Rep. Prepared for the Deputy Prime Minister, Department of Trade and Industry, London.

Elias, A. A., Cavana, R. Y., & Jackson, L. S. (2002). Stakeholder analysis for R&D project management. *R&D Management, 32*(4), 301-310. doi:10.1111/1467-9310.00262.

Enberg, C. (2012). Enabling knowledge integration in coopetitive R&D projects — The management of conflicting logics. *International Journal of Project Management, 30*(7), 771-780. doi:10.1016/j.ijproman.2012.01.003.

Eriksson, P. E., & Westerberg, M. (2011). Effects of cooperative procurement procedures on construction project performance: A conceptual framework. *International Journal of Project Management, 29*(2), 197-208. doi:10.1016/j.ijproman.2010.01.003.

Ernst, H., Hoyer, W. D., & Rübsaamen, C. (2010). Sales, Marketing, and Research-and-Development Cooperation Across New Product Development Stages: Implications for Success. *Journal of Marketing, 74*(5), 80-92. doi:10.1509/jmkg.74.5.80.

Eybpoosh, M., Dikmen, I., & Birgonul, M. T. (2011). Identification of Risk Paths in International Construction Projects Using Structural Equation Modeling. *Journal of Construction Engineering and Management, 137*(12), 1164-1175. doi:10.1061/(asce)co.1943-7862.0000382.

Fageha, M.K., & Aibinu, A.A. (2013). Managing Project Scope Definition to Improve Stakeholders' Participation and Enhance Project Outcome. *Procedia-Social and Behavioral Sciences,* 74, 154-164. doi:10.1016/j.sbspro.2013.03.038.

Flyvbjerg, B. (2014). What You Should Know About Megaprojects and Why: An Overview. *Project Management Journal, 45*(2), 6-19. doi:10.1002/pmj.21409.

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

Fuertes, A., Casals, M., Gangolells, M., Forcada, N., Macarulla, M., & Roca, X. (2013). An Environmental Impact Causal Model for improving the environmental performance of construction processes. *Journal of Cleaner Production, 52*, 425-437. doi:10.1016/j.jclepro.2013.02.005.

Jastaniah, Y. (1997). *Performance Evaluation and Benchmarking of Construction*

Industry Projects Using Data Envelope Analysis. Ph.D. Dissertation, Southern Methodist University.

Gardiner, P. D., & Stewart, K. (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, 18*(4), 251-256. doi:10.1016/s0263-7863(99)00022-8.

Garver, M. S., & Mentzer, J. T., (1999). Logistics research methods: Employing structural equation modeling to test for construct validity. *Journal of Business Logistics*, *20*(1), 33-58.

Gayatri, V., & Saurabh, K., (2013). Performance indicators for construction project. *International Journal of Advanced Electrical and Electronics Engineering*, *2*(1), 61-66.

Gemunden, H. G., Ritter, T., & Heydebreck, P. (1996). Network configuration and innovation success: An empirical analysis in German high-tech industries. *International Journal of Research in Marketing, 13*(5), 449-462. doi:10.1016/s0167-8116(96)00026-2.

Goh, C. S., & Rowlinson, S. (2013). Conceptual Maturity Model for Sustainable Construction. *J. Leg. Aff. Dispute Resolut. Eng. Constr. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 5*(4), 191-195. doi:10.1061/(asce)la.1943-4170.0000129.

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. *Strat. Mgmt. J. Strategic Management Journal, 17*(S2), 109-122. doi:10.1002/smj.4250171110.

Guerrero, M. A., Villacampa, Y., & Montoyo, A. (2014). Modeling construction time in Spanish building projects. *International Journal of Project Management, 32*(5), 861-873. doi:10.1016/j.ijproman.2013.09.009.

Gumus, B., Ertas, A., Tate, D., & Cicek, I. (2008). The Transdisciplinary Product Development Lifecycle model. *Journal of Engineering Design, 19*(3), 185-200. doi:10.1080/09544820701232436.

Haimes, Y.Y., (2004). *Risk Modeling, Assessment, and Management,* Hoboken, Wiley.

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C., (1998). *Multivariate Data Analysis,* Prentice Hall International, Inc., Upper Saddle River, N.J.

Halman, J. I., & Voordijk, J. T. (2012). Balanced Framework for Measuring Performance of Supply Chains in House Building. *Journal of Construction Engineering and Management, 138*(12), 1444-1450. doi:10.1061/(asce)co.1943-7862.0000553.

Hamilton, M. R., & Jr., G. E. (1996). Benchmarking Preproject Planning Effort. *Journal of Management in Engineering, 12*(2), 25-33. doi:10.1061/(asce)0742-597x(1996)12:2(25).

Hayduk, L. A., & Glaser, D. N. (2000). Jiving the Four-Step, Waltzing Around Factor Analysis, and Other Serious Fun. *Structural Equation Modeling: A Multidisciplinary Journal, 7*(1), 1-35. doi:10.1207/s15328007sem0701_01.

He, J., & Ng, L. K. (1999). The Foreign Exchange Exposure of Japanese Multinational Corporations. *African Journal of Finance and Management, 7*(2). doi:10.4314/ajfm.v7i2.24347.

Heising, W. (2012). The integration of ideation and project portfolio management — A key factor for sustainable success. *International Journal of Project Management, 30*(5), 582-595. doi:10.1016/j.ijproman.2012.01.014.

Henard, D. H., & Szymanski, D. M. (2001). Why Some New Products Are More Successful Than Others. *Journal of Marketing Research, 38*(3), 362-375. doi:10.1509/jmkr.38.3.362.18861.

Hinze, J.W., (1997). *Construction Safety.* Prentice Hall, Columbus.

Hornstein, H. A. (2015). The integration of project management and organizational change management is now a necessity. *International Journal of Project Management, 33*(2), 291-298. doi:10.1016/j.ijproman.2014.08.005.

Hoyle, R.H., (1995). *The structural equation modeling approach.* In R.H. Hoyle (Ed.), Structural equation modeling: Concepts, issues, and applications, Thousand Oaks, CA: Sage.

Hu, X., Cui, N., Demeulemeester, E., & Bie, L. (2016). Incorporation of activity sensitivity measures into buffer management to manage project schedule risk. *European Journal of Operational Research, 249*(2), 717-727. doi:10.1016/j.ejor.2015.08.066.

Hughes, S. W., Tippett, D. D., & Thomas, W. K. (2004). Measuring Project Success in the Construction Industry. *Engineering Management Journal,* 16(3), 31-37, doi:10.1080/10429247.2004.11415255.

Huselid, M. A., Jackson, S. E., & Schuler, R. S. (1997). Technical And Strategic Human Resources Management Effectiveness As Determinants Of Firm Performance. *Academy of Management Journal, 40*(1), 171-188. doi:10.2307/257025.

Hwang, B., Zhao, X., & Toh, L. P. (2014). Risk management in small construction projects in Singapore: Status, barriers and impact. *International Journal of Project Management, 32*(1), 116-124. doi:10.1016/j.ijproman.2013.01.007.

Ibbs, W., & Nguyen, L. D. (2007). Schedule Analysis under the Effect of Resource Allocation. *Journal of Construction Engineering and Management, 133*(2), 131-138. doi:10.1061/(asce)0733-9364(2007)133:2(131).

Jaafari, A. (2001). Management of risks, uncertainties and opportunities on projects: Time for a fundamental shift. *International Journal of Project Management, 19*(2), 89-101. doi:10.1016/s0263-7863(99)00047-2.

Jepsen, A. L., & Eskerod, P. (2009). Stakeholder analysis in projects: Challenges in using current guidelines in the real world. *International Journal of Project Management, 27*(4), 335-343. doi:10.1016/j.ijproman.2008.04.002.

Jiang, J. J., Klein, G., & Discenza, R. (2002). Pre-project partnering impact on an information system project, project team and project manager. *European Journal of Information Systems, 11*(2), 86-97. doi:10.1057/palgrave/ejis/3000420.

Jin, Z., Deng, F., Li, H., & Skitmore, M. (2013). Practical Framework for Measuring Performance of International Construction Firms. *Journal of Construction Engineering and Management, 139*(9), 1154-1167. doi:10.1061/(asce)co.1943-7862.0000718.

Jonas, D. (2010). Empowering project portfolio managers: How management involvement impacts project portfolio management performance. *International Journal of Project Management, 28*(8), 818-831. doi:10.1016/j.ijproman.2010.07.002.

Jung, Y., & Gibson, G. E. (1999). Planning for Computer Integrated Construction. *Journal of Computing in Civil Engineering, 13*(4), 217-225. doi:10.1061/(asce)0887-3801(1999)13:4(217).

Jung, Y., & Woo, S. (2004). Flexible Work Breakdown Structure for Integrated Cost and Schedule Control. *Journal of Construction Engineering and Management, 130*(5), 616-625. doi:10.1061/(asce)0733-9364(2004)130:5(616).

Kagioglou, M., Cooper, R., & Aouad, G. (2001). Performance management in construction: A conceptual framework. *Construction Management and Economics, 19*(1), 85-95. doi:10.1080/01446190010003425.

Kaka, A. P., & Price, A. D. (1993). Modelling standard cost commitment curves for contractors' cash flow forecasting. *Construction Management and Economics, 11*(4), 271-283. doi:10.1080/01446199300000027.

Kao, J., Pan, T., & Lin, C. (2009). An environmental sustainability based budget allocation system for regional water quality management. *Journal of Environmental Management, 90*(2), 699-709. doi:10.1016/j.jenvman.2008.01.003.

Kapila, P., & Hendrickson, C. (2001). Exchange Rate Risk Management in International Construction Ventures. *Journal of Management in Engineering J. Manage. Eng., 17*(4), 186-191. doi:10.1061/(asce)0742-597x(2001)17:4(186).

Kartam, S. (1999). Generic Methodology for Analyzing Delay Claims. *Journal of Construction Engineering and Management, 125*(6), 409-419. doi:10.1061/(asce)0733-9364(1999)125:6(409).

Kerzner, H., (2009). *Project management: A systems approach to planning, scheduling and controlling*, 10th ed., John Wiley and Sons, Hooboken, New Jersey.

Khamooshi, H., & Golafshani, H. (2014). EDM: Earned Duration Management, a new approach to schedule performance management and measurement. *International Journal of Project Management, 32*(6), 1019-1041. doi:10.1016/j.ijproman.2013.11.002.

Khan, A. S., & Rasheed, F. (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, 33*(2), 435-445. doi:10.1016/j.ijproman.2014.08.006.

Kim, J., Kang, C., & Hwang, I. (2012). A practical approach to project scheduling: Considering the potential quality loss cost in the time–cost tradeoff problem. *International Journal of Project Management, 30*(2), 264-272. doi:10.1016/j.ijproman.2011.05.004.

Kline, R. B., (1998). *Principles and practices of structural equation modeling.* New York: Guilford.

Kochan, T., Bezrukova, K., Ely, R., Jackson, S., Joshi, A., Jehn, K., Leonard, J., Levine, D., Thomas, D., (2003). The effects of diversity on business performance: Report of the diversity research network. *Human Resource Management, 42*(1), 3-21. doi:10.1002/hrm.10061.

Kog, Y. C., & Loh, P. K. (2012). Critical Success Factors for Different Components of Construction Projects. *Journal of Construction Engineering and Management, 138*(4), 520-528. doi:10.1061/(asce)co.1943-7862.0000464.

Koskela, L., & Howell, G., (2002). The underlying theory of project management is obsolete, *Proceedings of PMI Research Conference,* Seattle, USA, 293–302.

Kululanga, G. K., Kuotcha, W., Mccaffer, R., & Edum-Fotwe, F. (2001). Construction Contractors' Claim Process Framework. *Journal of Construction Engineering and Management, 127*(4), 309-314. doi:10.1061/(asce)0733-9364(2001)127:4(309).

Lai, D. N., Liu, M., & Ling, F. Y. (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, 29*(8), 1018-1032. doi:10.1016/j.ijproman.2010.11.004.

Larson, E.W. and Gray, C.F. (2011). *Project Management: The Managerial Process*, 5th ed., McGraw-Hill/Irwin, New York, NY.

Liberatore, M. J., & Pollack-Johnson, B. (2006). Extending project time–cost analysis by removing precedence relationships and task streaming. *International Journal of Project Management, 24*(6), 529-535. doi:10.1016/j.ijproman.2006.04.004.

Lim, C., & Mohamed, M. (1999). Criteria of project success: An exploratory re-examination. *International Journal of Project Management, 17*(4), 243-248. doi:10.1016/s0263-7863(98)00040-4.

Lin, G., Shen, G. Q., Sun, M., & Kelly, J. (2011). Identification of Key Performance Indicators for Measuring the Performance of Value Management Studies in Construction. *Journal of Construction Engineering and Management, 137*(9), 698-706. doi:10.1061/(asce)co.1943-7862.0000348.

Ling, F. Y., Low, S. P., Wang, S., & Egbelakin, T. (2008). Models for Predicting Project Performance in China Using Project Management Practices Adopted by Foreign AEC Firms. *Journal of Construction Engineering and Management, 134*(12), 983-990. doi:10.1061/(asce)0733-9364(2008)134:12(983).

Ling, F. Y., Low, S. P., Wang, S. Q., & Lim, H. H. (2009). Key project management practices affecting Singaporean firms' project performance in China. *International Journal of Project Management, 27*(1), 59-71. doi:10.1016/j.ijproman.2007.10.004.

Liu, S., Zhang, J., Keil, M., & Chen, T. (2009). Comparing senior executive and project manager perceptions of IT project risk: A Chinese Delphi study. *Information Systems Journal, 20*(4), 319-355. doi:10.1111/j.1365-2575.2009.00333.x.

Love, P., Holt, G., Shen, L., Li, H., & Irani, Z. (2002). Using systems dynamics to better understand change and rework in construction project management systems. *International Journal of Project Management, 20*(6), 425-436. doi:10.1016/s0263-7863(01)00039-4.

Maravas, A., & Pantouvakis, J. (2012). Project cash flow analysis in the presence of uncertainty in activity duration and cost. *International Journal of Project Management, 30*(3), 374-384. doi:10.1016/j.ijproman.2011.08.005.

Marques, G., Gourc, D., & Lauras, M. (2011). Multi-criteria performance analysis for decision making in project management. *International Journal of Project Management, 29*(8), 1057-1069. doi:10.1016/j.ijproman.2010.10.002.

Marsh, H. W., & Hocevar, D. (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, 97*(3), 562-582. doi:10.1037/0033-2909.97.3.562.

Meng, X. (2012). The effect of relationship management on project performance in construction. *International Journal of Project Management, 30*(2), 188-198. doi:10.1016/j.ijproman.2011.04.002.

Meng, X., Sun, M., & Jones, M. (2011). Maturity Model for Supply Chain Relationships in Construction. *Journal of Management in Engineering, 27*(2), 97-105. doi:10.1061/(asce)me.1943-5479.0000035.

Mir, F. A., & Pinnington, A. H. (2014). Exploring the value of project management: Linking Project Management Performance and Project Success. *International Journal of Project Management, 32*(2), 202-217. doi:10.1016/j.ijproman.2013.05.012.

Missonier, S., & Loufrani-Fedida, S. (2014). Stakeholder analysis and engagement in projects: From stakeholder relational perspective to stakeholder relational ontology. *International Journal of Project Management, 32*(7), 1108-1122. doi:10.1016/j.ijproman.2014.02.010.

Mitropoulos, P., & Tatum, C., (2000). Management-Driven Integration. *Journal of Management in Engineering,* 16(1), 48–58.

Mitropoulos, P., Cupido, G., & Namboodiri, M. (2009). Cognitive Approach to Construction Safety: Task Demand-Capability Model. *Journal of Construction Engineering and Management, 135*(9), 881-889. doi:10.1061/(asce)co.1943-7862.0000060.

Mizell, C., & Malone, L., (2007). A Project Management Approach to Using Simulation for Cost Estimation on Large, Complex Software Development Projects, *Engineering Management Journal, 19*(4), 28-34, doi: 10.1080/10429247.2007.11431746.

Mok, K. Y., Shen, G. Q., & Yang, J. (2015). Stakeholder management studies in mega construction projects: A review and future directions. *International Journal of Project Management, 33*(2), 446-457. doi:10.1016/j.ijproman.2014.08.007.

Molenaar, K. R., Park, J., & Washington, S. (2009). Framework for Measuring Corporate Safety Culture and Its Impact on Construction Safety Performance. *Journal of Construction Engineering and Management, 135*(6), 488-496. doi:10.1061/(asce)0733-9364(2009)135:6(488).

Montabon, F., Sroufe, R., & Narasimhan, R. (2007). An examination of corporate reporting, environmental management practices and firm performance. *Journal of Operations Management, 25*(5), 998-1014. doi:10.1016/j.jom.2006.10.003.

Morsing, M., & Schultz, M. (2006). Corporate social responsibility communication: Stakeholder information, response and involvement strategies. *Business Ethics: A European Review Business Ethics, 15*(4), 323-338. doi:10.1111/j.1467-8608.2006.00460.x.

Murari, K., (2015). *Impact of Leadership Styles on Employee Empowerment,* Partridge, India.

Mustaro, N.P., & Rossi, R., (2013). Project management principles applied in academic research projects. *Issues in Informing Science and Information Technology,* 10, 325-340.

Nassar, N., & Abourizk, S. (2014). Practical Application for Integrated Performance Measurement of Construction Projects. *Journal of Management in Engineering, 30*(6), 04014027. doi:10.1061/(asce)me.1943-5479.0000287.

Nevo, D., & Chan, Y. E. (2007). A Delphi study of knowledge management systems: Scope and requirements. *Information & Management, 44*(6), 583-597. doi:10.1016/j.im.2007.06.001.

Ngacho, C., & Das, D. (2014). A performance evaluation framework of development projects: An empirical study of Constituency Development Fund (CDF) construction projects in Kenya. *International Journal of Project Management, 32*(3), 492-507. doi:10.1016/j.ijproman.2013.07.005.

Nitithamyong, P., & Skibniewski, M. J. (2006). Success/Failure Factors and Performance Measures of Web-Based Construction Project Management Systems: Professionals' Viewpoint. *Journal of Construction Engineering and Management, 132*(1), 80-87. doi:10.1061/(asce)0733-9364(2006)132:1(80).

Nudurupati, S., Arshad, T., & Turner, T. (2007). Performance measurement in the construction industry: An action case investigating manufacturing methodologies. *Computers in Industry, 58*(7), 667-676. doi:10.1016/j.compind.2007.05.005.

Nunnally, J.C., (1978). *Psychometric Theory.* McGraw-Hill, New York.

Ochieng, E., & Price, A. (2010). Managing cross-cultural communication in multicultural construction project teams: The case of Kenya and UK. *International Journal of Project Management, 28*(5), 449-460. doi:10.1016/j.ijproman.2009.08.001.

Odeyinka, H. A., Lowe, J., & Kaka, A. (2008). An evaluation of risk factors impacting construction cash flow forecast. *Journal of Financial Management of Property and Construction, 13*(1), 5-17. doi:10.1108/13664380810882048.

Papke-Shields, K. E., Beise, C., & Quan, J. (2010). Do project managers practice what they preach, and does it matter to project success? *International Journal of Project Management, 28*(7), 650-662. doi:10.1016/j.ijproman.2009.11.002.

Pate-Cornell, M., Tagaras, G., & Eisenhardt, K. (1990). Dynamic optimization of cash flow management decisions: A stochastic model. *IEEE Transactions on Engineering Management, 37*(3), 203-212. doi:10.1109/17.104290.

Pheng, L. S., & Leong, C. H. (2000). Cross-cultural project management for international construction in China. *International Journal of Project Management, 18*(5), 307-316. doi:10.1016/s0263-7863(99)00027-7.

Pinto, J. K., & Slevin, D. P., (1988). Project success: Definitions and measurement techniques. *Project Management Journal,* 19(1), 67-72.

PMI, (2005). *Construction Extension to the PMBOK® Guide Third Edition*, Project Management Institute, Newtown Square, PA.

PMI, (2013). *A Guide to the Project Management Body of Knowledge,* Project Management Institute, Newtown Square, PA.

Popaitoon, S., & Siengthai, S. (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,* 32(6), 908-920. http://dx.doi.org/10.1016/j.ijproman.2013.12.002.

Qureshi, T. M., Warraich, A. S., & Hijazi, S. T. (2009). Significance of project management performance assessment (PMPA) model. *International Journal of Project Management, 27*(4), 378-388. doi:10.1016/j.ijproman.2008.05.001.

Rad, P.F. (2003), Project Success Attributes, *Cost Engineering,* 45 (4), 23-29.

Rayner, P., Reiss, G., (2001). *The programme management maturity model.* Wetherby: The Programme Management Group.

Reed, M. S. (2008). Stakeholder participation for environmental management: A literature review. *Biological Conservation, 141*(10), 2417-2431. doi:10.1016/j.biocon.2008.07.014.

Robinson, H., Carrillo, P., Anumba, C., & A-Ghassani, A. (2005). Review and implementation of performance management models in construction engineering organizations. *Construction Innovation: Information, Process, Management, 5*(4), 203-217. doi:10.1108/14714170510815258.

Rowlinson, S., & Cheung, Y. K. (2008). Stakeholder management through empowerment: Modelling project success. *Construction Management and Economics, 26*(6), 611-623. doi:10.1080/01446190802071182.

Ruparathna, R., & Hewage, K. (2015). Review of Contemporary Construction Procurement Practices. *Journal of Management in Engineering J. Manage. Eng., 31*(3), 04014038. doi:10.1061/(asce)me.1943-5479.0000279.

Salazar-Aramayo, J., da-Silveira, R.R., de-Almeida, R.M., & de Castro-Dantas, T. (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,* 31 (4), 589-601. http://dx.doi.org/10.1016/j.ijproman.2012.09.016.

Schapper, P.R., Veiga Malta, N.J., & Gilbert, L.D., (2006). An analytical framework for the management and reform of public procurement, *Journal of Public Procurement,* 6 (1–2), 1-26.

Senescu, R. R., Aranda-Mena, G., & Haymaker, J. R. (2013). Relationships between Project Complexity and Communication. *Journal of Management in Engineering, 29*(2), 183-197. doi:10.1061/(asce)me.1943-5479.0000121.

Shah, H. (2012). *A Guide to the Engineering Management Body of Knowledge Third Edition.* American Society For Engineering Management.

Shen, L., Wu, Y., & Zhang, X. (2011). Key Assessment Indicators for the Sustainability of Infrastructure Projects. *Journal of Construction Engineering and Management, 137*(6), 441-451. doi:10.1061/(asce)co.1943-7862.0000315.

Sibanyama, G., Muya, M., & Kaliba, C. (2012). An Overview of Construction Claims: A Case Study of the Zambian Construction Industry. *International Journal of Construction Management, 12*(1), 65-81. doi:10.1080/15623599.2012.10773185.

Singh, K. (2003). Strategic HR orientation and firm performance in India. *The International Journal of Human Resource Management, 14*(4), 530-543. doi:10.1080/0958519032000057574.

Skibniewski, M. J., & Ghosh, S. (2009). Determination of Key Performance Indicators with Enterprise Resource Planning Systems in Engineering Construction Firms. *Journal of Construction Engineering and Management, 135*(10), 965-978. doi:10.1061/(asce)0733-9364(2009)135:10(965).

Song, L., & Abourizk, S. M. (2005). Quantifying Engineering Project Scope for Productivity Modeling. *Journal of Construction Engineering and Management, 131*(3), 360-367. doi:10.1061/(asce)0733-9364(2005)131:3(360).

Song, L. Z., & Song, M. (2010). The Role of Information Technologies in Enhancing R&D-Marketing Integration: An Empirical Investigation. *Journal of Product Innovation Management, 27*(3), 382-401. doi:10.1111/j.1540-5885.2010.00723.x.

Sousa, V., Almeida, N. M., & Dias, L. A. (2014). Risk-based management of occupational safety and health in the construction industry – Part 1: Background knowledge. *Safety Science, 66*, 75-86. doi:10.1016/j.ssci.2014.02.008.

Steiger, J. H., Lind, J. C., (1980). *Statistically based tests for the number of common factors.* Paper presented at the annual meeting of the Psychometric Society, Iowa City, IA.

Steiger, J.H. (1989). *Causal modeling: a supplementary module for SYSTAT and SYGRAPH.* SYSTAT; Evanston, IL: 1989.

Steiger, J. H. (2000). Point Estimation, Hypothesis Testing, and Interval Estimation Using the RMSEA: Some Comments and a Reply to Hayduk and Glaser. *Structural Equation Modeling: A Multidisciplinary Journal, 7*(2), 149-162. doi:10.1207/s15328007sem0702_1.

Tabassi, A. A., & Bakar, A. A. (2009). Training, motivation, and performance: The case of human resource management in construction projects in Mashhad, Iran. *International Journal of Project Management, 27*(5), 471-480. doi:10.1016/j.ijproman.2008.08.002.

Takim, R., & Akintoye, A. (2002). Performance Indicators for Successful Construction Project Performance. In U. of Northumbria (Ed.), 2, 545-55. *18th Annual ARCOM Conference.*

Tam, V. W., Shen, L., & Kong, J. S. (2011). Impacts of multi-layer chain subcontracting on project management performance. *International Journal of Project Management, 29*(1), 108-116. doi:10.1016/j.ijproman.2010.01.005.

Tappura, S., Sievänen, M., Heikkilä, J., Jussila, A., & Nenonen, N. (2015). A management accounting perspective on safety. *Safety Science, 71*, 151-159. doi:10.1016/j.ssci.2014.01.011.

Testa, F., Iraldo, F., & Frey, M. (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, 92*(9), 2136-2144. doi:10.1016/j.jenvman.2011.03.039.

Thiry, M. (2002). Combining value and project management into an effective programme management model. *International Journal of Project Management, 20*(3), 221-227. doi:10.1016/s0263-7863(01)00072-2.

Tiller, S. R. (2012). Organizational Structure and Management Systems. *Leadership Manage. Eng. Leadership and Management in Engineering, 12*(1), 20-23. doi:10.1061/(asce)lm.1943-5630.0000160.

Toor, S., & Ogunlana, S. O. (2009). Construction professionals' perception of critical success factors for large-scale construction projects. *Construction Innovation: Information, Process, Management, 9*(2), 149-167. doi:10.1108/14714170910950803.

Tucker, L. R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika, 38*(1), 1-10. doi:10.1007/bf02291170.

Turner, J.R., & Muller, R., (2005). The project manager's leadership style as a success factor on projects: A literature review. *Project Management Journal,* 36 (2), 49–61.

Ulmer, R. R. (2001). Effective Crisis Management through Established Stakeholder Relationships: Malden Mills as a Case Study. *Management Communication Quarterly, 14*(4), 590-615. doi:10.1177/0893318901144003.

Vidogah, W., & Ndekugri, I. (1997). Improving Management of Claims: Contractors' Perspective. *Journal of Management in Engineering, 13*(5), 37-44. doi:10.1061/(asce)0742-597x(1997)13:5(37).

Walker, D. H., Bourne, L. M., & Shelley, A. (2008). Influence, stakeholder mapping and visualization. *Construction Management and Economics, 26*(6), 645-658. doi:10.1080/01446190701882390.

Wanberg, J., Harper, C., Hallowell, M. R., & Rajendran, S. (2013). Relationship between Construction Safety and Quality Performance. *Journal of Construction Engineering and Management, 139*(10), 04013003. doi:10.1061/(asce)co.1943-7862.0000732.

Wang, J., Lin, W., & Huang, Y. (2010). A performance-oriented risk management framework for innovative R&D projects. *Technovation, 30*(11-12), 601-611. doi:10.1016/j.technovation.2010.07.003.

Wang, X., & Huang, J. (2006). The relationships between key stakeholders' project performance and project success: Perceptions of Chinese construction supervising engineers. *International Journal of Project Management, 24*(3), 253-260. doi:10.1016/j.ijproman.2005.11.006.

Wardani, M. A., Messner, J. I., & Horman, M. J. (2006). Comparing Procurement Methods for Design-Build Projects. *Journal of Construction Engineering and Management, 132*(3), 230-238. doi:10.1061/(asce)0733-9364(2006)132:3(230).

Westerveld, E. (2003). The Project Excellence Model®: Linking success criteria and critical success factors. *International Journal of Project Management, 21*(6), 411-418. doi:10.1016/s0263-7863(02)00112-6.

Yang, L., Huang, C., & Wu, K. (2011). The association among project manager's leadership style, teamwork and project success. *International Journal of Project Management, 29*(3), 258-267. doi:10.1016/j.ijproman.2010.03.006.

Yang, L., Chen, J., & Wang, H. (2012). Assessing impacts of information technology on project success through knowledge management practice. *Automation in Construction, 22*, 182-191. doi:10.1016/j.autcon.2011.06.016

Yeo, K., & Ning, J. (2002). Integrating supply chain and critical chain concepts in engineer-procure-construct (EPC) projects. *International Journal of Project Management, 20*(4), 253-262. doi:10.1016/s0263-7863(01)00021-7.

Yildiz, A. E., Dikmen, I., Birgonul, M. T., Ercoskun, K., & Alten, S. (2014). A knowledge-based risk mapping tool for cost estimation of international construction projects. *Automation in Construction, 43*, 144-155. doi:10.1016/j.autcon.2014.03.010.

Yosha, O. (1995). Information Disclosure Costs and the Choice of Financing Source. *Journal of Financial Intermediation, 4*(1), 3-20. doi:10.1006/jfin.1995.1001.

Youndt, M. A., Snell, S. A., Dean, J. J., & Lepak, D. P. (1996). Human Resource Management, Manufacturing Strategy, And Firm Performance. *Academy of Management Journal, 39*(4), 836-866. doi:10.2307/256714.

Zaneldin, E. K. (2006). Construction claims in United Arab Emirates: Types, causes, and frequency. *International Journal of Project Management, 24*(5), 453-459. doi:10.1016/j.ijproman.2006.02.006.

Zanoni, R. & Audy, J., (2004). Project Management Model: Proposal for Performance in a Physically Distributed Software Development Environment, *Engineering Management Journal, 16* (2), 28-34, doi:10.1080/10429247.2004.11415246.

Zhang, P., & Ng, F. F. (2013). Explaining Knowledge-Sharing Intention in Construction Teams in Hong Kong. *Journal of Construction Engineering and Management, 139*(3), 280-293. doi:10.1061/(asce)co.1943-7862.0000607.

Zhao, X., Hwang, B., & Low, S. P. (2013). Developing Fuzzy Enterprise Risk Management Maturity Model for Construction Firms. *Journal of Construction Engineering and Management, 139*(9), 1179-1189. doi:10.1061/(asce)co.1943-7862.0000712.

Zhi, H. (1995). Risk management for overseas construction projects. *International Journal of Project Management, 13*(4), 231-237. doi:10.1016/0263-7863(95)00015-i.

Zou, P. X., Chen, Y., & Chan, T. (2010). Understanding and Improving Your Risk Management Capability: Assessment Model for Construction Organizations. *Journal of Construction Engineering and Management, 136*(8), 854-863. doi:10.1061/(asce)co.1943-7862.0000175.

Zsidisin, G. A., Panelli, A., & Upton, R. (2000). Purchasing organization involvement in risk assessments, contingency plans, and risk management: An exploratory study. *Supply Chain Management: An International Journal, 5*(4), 187-198. http://dx.doi.org/10.1108/13598540010347307.