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Influence of project manager's competencies on project management success

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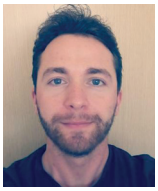

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Research Paper

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Influence of project manager's competencies on project management success

Project management (PM) has been a demanding profession in construction industry due to its dynamic nature originating from the uncertainties in budget, technology, and development processes, which put emphasis on the necessity for highly capable project managers. This study develops an extensive PM success model and investigates the influence of project manager's competencies on the PM success. The resulting model reveals that the project manager's competencies can play a big role in determining the PM success in construction projects. Leadership is identified as the most influential project manager competency followed by responsibility and commitment. Researchers and senior industry practitioners such as managers or boards of directors are expected to benefit from the developed model by recognizing the influences of project managers on the PM success and taking notice of the recommendations provided.

Key words:
project manager's competencies, project management success, construction projects, project management

Prethodno priopćenje

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Utjecaj kompetencija voditelja projekta na uspješnost upravljanja projektima

Upravljanje projektima je vrlo zahtjevno područje u građevinarstvu zbog svojih dinamičkih osobitosti koje proizlaze iz nesigurnosti u pogledu dostupnosti sredstava, tehnologije i razvojnih procesa, te se zbog toga pokazuje potreba za angažmanom vrlo sposobnih voditelja projekata. U ovom je radu razvijen opsežan model za uspješnost upravljanja projektima, a istražuje se utjecaj kompetentnosti voditelja projekta na uspješnost upravljanja projektima. Rezultirajući model pokazuje da kompetentnost voditelja projekta može u velikoj mjeri utjecati na uspješnost upravljanja građevinskim projektima. Sposobnost vođenja definirana je kao najznačajnija kompetencija voditelja projekta, a potom slijede odgovornosti i požrtvovnost. Očekuje se da će istraživači i rukovodeće osobe zaposlene u praksi, npr. voditelji ili članovi upravnih odbora, imati korist od razvijenog modela kroz jasnije prepoznavanje utjecaja voditelja projekta na uspješnost upravljanja projektima te kroz usvajanje preporuka iznesenih u ovom radu.

Ključne riječi:
kompetencije voditelja projekta, uspješnost upravljanja projektima, građevinski projekti, upravljanje projektim

1. Introduction

Project management (PM) success has continuously been a trendy topic in project management literature. In the 1970s, it was evaluated in terms of time, cost, and functionality. Quality aspects were also included in the evaluation during the 1980s and 1990s [1]. It was stated that a successfully managed project had to be performed in accordance with its quality/performance specifications [2, 3]. The PM success is an ambiguous, comprehensive, and multidimensional concept [4]. It has been defined by various researchers in several ways such as achieving the project goals and expectations regarding the financial, social, technical, and professional issues [5]; having the expected or better results in terms of schedule, safety, cost, quality, and participant satisfaction [6]; performing everything as expected [7]; completing project on time, within budget, at high quality, and with satisfied clients [8]; and meeting the specifications and achieving high level of satisfaction [9]. The definitions mainly focused on issues regarding time, cost, quality, safety, and client satisfaction.

PM has been a challenging issue for many industries [10], especially for construction industry, where uncertainties in the budget, technology, and development processes make the industry highly dynamic [11]. The dynamic nature of the industry and resulting challenges emphasize the significance and necessity of having competent project managers, who play a fundamental role in achieving the PM success. Talented project managers are expected to lead to the projects with better outcomes. According to Clarke [12], project managers having high emotional quotient can perform better at overcoming difficulties confronted during the project.

This study aims to develop a comprehensive PM success model and observe the influence of project manager's competencies on the PM success. It contributes to the body of knowledge in that it

- evaluates the impacts of project manager competencies on the PM success
- unveils the direct and indirect links between proposed model components through development of hypotheses.

The developed model could be utilized both by industry practitioners and researchers to figure out the extent to which project manager's competencies can influence the project outcomes.

The paper is organized as follows. Section 2 summarizes previous studies and their focus areas. The developed success model is described in Section 3. Section 4 explains the methodology: preparation of questionnaire survey, collection of data, and how the data is analysed. Section 5 presents the findings: the resultant model, reliability value and fit indices of the model, and factor loadings of model variables. Finally, Section 6 includes the discussion part and interpretation of results, as well as some recommendations.

2. Literature review

The PM success and project manager's competencies are two crucial topics that have been extensively investigated in the academia. Many studies have been conducted to analyse them from different aspects. As explained below separately, the focus areas of previous studies can be summarized under three main headings: determinants of the PM success, project manager's qualifications, and the effect of project managers on the PM success.

Studies on project management success determinants have focused on the effects of various factors on the PM success. Mavi and Standing [13] identified critical success factors of project management and categorized them into five criteria groups as

1. project
2. project management
3. organization
4. external environment
5. sustainability.

The analysis of data obtained from 26 Australian construction project managers revealed that critical factors are: top management and sponsor support, stakeholder expectations, and end-user imposed restrictions. Gunduz and Almuajebh [14] listed 40 construction-process success factors and compiled them into seven categories: project-related factors, company- and work-related factors, client related factors, project management factors, design-team related factors, contractor related factors, project-manager related factors. Project financial issues, managerial aspects, and authorities' approval mechanism were identified as the significant areas. Lazauskas et al. [15] developed a computational model to check whether an unfinished residential building achieves its construction project objectives. The developed model was composed of financial, economic, social, market, and technical criteria. Alzahrani and Emsley [16] assessed the effects of constructors' attributes on the PM success and identified critical success factors. They distributed a questionnaire survey to construction professionals and implemented a factor analysis to specify the clusters. The results revealed nine clusters, namely

1. quality and safety
2. previous performance
3. environment
4. technical and management aspects
5. resource
6. organization
7. experience
8. size and type of previous projects
9. finance.

The most significant factors were determined as turnover history, adequacy of resources, size of previous projects, quality policy, image of the company, and waste disposal.

Majority of the studies focusing on project managers have investigated the project managers' competencies. Chipulu et al. [17] explored the key competences that are required from project managers across multiple industries. They coded the contents of 2306 online project manager job advertisements in India, United Kingdom, Canada, United States, China, Malaysia, Hong Kong, and Singapore. They extracted six dimensions of competence by means of three-way multidimensional scaling. The dimensions were detected as

- generic and area-specific skills
- expertise in area-specific and generic skills
- managerial skills
- personal attributes
- experience in methodology and professional capabilities
- risk management throughout project lifespan.

Fisher [18] presented evaluations of PM practitioners with the focus on capabilities and behaviour an influential project manager should have. As a result of literature review and after face to face interviews and focus group meetings, the following six specific and associated behaviours were identified:

1. leading others
2. authentizotic behaviour
3. influencing others
4. realizing behavioural features
5. managing conflicts
6. cultural awareness.

Moradi et al. [19] assessed project managers' competencies in collaborative construction projects in Finland. The most influential competencies were specified as group capabilities, language proficiency, and leveraging diversity. Alvarenga et al. [20] defined the core competencies of project managers for achieving the PM success. Surveying project managers on the importance of 28 competencies revealed communication, commitment, and leadership as the most effective competencies. The competencies were categorized into seven groups as:

1) leadership
2) self-management
3) interpersonal
4) communication
5) technical
6) productivity
7) managerial.

Another group of studies investigated the effects of project managers on the PM success. Ljevo et al. [21] analysed the effects of key factors of construction project management on the PM success. They identified the most significant factors as communication, expertise/knowledge, coordination of participants, and planning and control. Muller and Turner [22] studied the interrelation between the type of the project and leadership style of the project manager; and how it affects the PM success. They used a model of managerial, emotional, and intellectual skills to identify project manager's leadership styles. They concluded that (1) leadership styles of project managers have an impact on the PM success and (2) different project types require different leadership styles. Bandić and Orešković [23] evaluated management efficiency of construction companies. They used the Balanced Scorecard model to shape and implement business strategies of construction companies. Alvarenga et al. [24] questioned the relevance of project managers to the PM success. The result of the survey involving 740 project management professionals highlighted project managers as the most hypercritical factor of success. The authors concluded that education and training of project managers would require a balance between soft and hard skills of project management. Radujković and Sjekavica [25] developed a model to enhance PM performance of construction companies. Eweje et al. [26] questioned the influence of information feed on the strategic value obtained from mega projects. They conducted a global survey of 69 managers working in mega-projects. The results revealed an obvious correlation between the information-feed and long-term strategic value. The greatest influence was attributed to externally focused types of information.

The objective of this study is to investigate the influence of project managers' competencies on the PM success. It is of prime significance to find out whether the competencies of project managers against project characteristics can have great influence on the PM success and if so, which project manager competencies are the most influential ones. Thus, this study intends to fill the gap by developing a framework reflecting relations and quantifying the direct and indirect links between the PM success, project manager's competencies, and other PM success determinants such as the project characteristics and company specific factors.

3. Project management success model

3.1. Determinants of PM success

A PM success model is proposed in this study to investigate the influences of project characteristics, company specific factors, and project managers' competencies on the PM success. A comprehensive literature review is conducted to identify the factors under these three determinants of the PM success and the PM success criteria. The factors mentioned in the literature are recorded and refined in order to avoid ones with similar meanings. The refined list of the factors and their sources are presented in Table 1.

Table 1. Project management success factors

Factors	Literature sources																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
PM1		✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
PM2	✓			✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	
PM3	✓	✓	✓	✓		✓	✓			✓	✓		✓	✓	✓			✓	✓			✓	✓	✓
PM4		✓				✓	✓	✓					✓	✓										
PM5		✓		✓		✓		✓		✓	✓				✓	✓		✓		✓		✓	✓	
PM6				✓	✓			✓			✓	✓	✓		✓		✓		✓	✓				
PM7			✓		✓	✓	✓	✓		✓								✓	✓	✓		✓	✓	✓
PM8			✓			✓									✓		✓	✓	✓				✓	
PM9											✓	✓			✓				✓				✓	
PC1	✓		✓			✓	✓	✓	✓				✓						✓	✓		✓	✓	✓
PC2								✓																
PC3								✓	✓				✓	✓	✓		✓	✓		✓				
PC4					✓		✓			✓												✓	✓	
PC5	✓		✓			✓	✓	✓	✓				✓						✓	✓		✓	✓	✓
PC6															✓		✓							
PC7	✓		✓		✓			✓	✓		✓	✓		✓	✓	✓		✓	✓		✓			✓
PC8			✓	✓	✓			✓	✓		✓	✓		✓	✓	✓		✓	✓		✓			✓
CS1	✓		✓	✓	✓	✓	✓	✓					✓	✓	✓			✓	✓		✓	✓		✓
CS2					✓							✓	✓											
CS3	✓		✓		✓	✓		✓				✓								✓			✓	
CS4	✓	✓	✓		✓	✓	✓	✓			✓	✓	✓	✓		✓	✓				✓		✓	
CS5	✓	✓	✓			✓	✓	✓					✓			✓	✓				✓			
CS6	✓							✓			✓	✓		✓		✓	✓				✓		✓	
CS7		✓	✓													✓	✓				✓		✓	
CS8	✓		✓		✓	✓	✓			✓	✓					✓					✓			✓
CS9	✓	✓				✓	✓	✓			✓	✓		✓		✓	✓				✓		✓	
CS10			✓				✓	✓			✓	✓		✓	✓								✓	
CS11			✓	✓			✓	✓													✓			
SC1	✓		✓	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓
SC2	✓		✓	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓
SC3	✓		✓	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓
SC4					✓				✓			✓				✓		✓			✓			
SC5	✓		✓	✓	✓			✓	✓		✓	✓	✓	✓	✓		✓							
SC6			✓	✓	✓			✓	✓				✓	✓	✓									✓

Project Manager's Competencies: PM1: Leadership and Strategic Decision Making, PM2: Planning, Monitoring and Management, PM3: Communication and Social Interaction, PM4: Innovativeness and Opportunity Seeking, PM5: Technical Experience, PM6: Responsibility and Commitment, PM7: Effective Team Selection and Management, PM8: Clear Project Policies; PM9: Top Management Handling
Project Characteristics: PC1: Cooperation and Performance Level, PC2: Clarity of Project Objectives, PC3: Completeness of Contract, PC4: Completeness of Design, PC5: Performance of Other Parties, PC6: Relative Significance of Project, PC7: Time Limitation, PC8: Quality Requirements
Company Specific Factors: CS1: Communication with Other Participants, CS2: Communication with Authorities, CS3: Top Management Support, CS4: Planning, Monitoring and Management Efficiency, CS5: Consultation and Troubleshooting Ability, CS6: Clear Project Objectives and Policies, CS7: Financial Management and Solid Economic Structure, CS8: Human Resources Management, CS9: Technology Utilization for Reliable Communication, CS10: Clear and Simple Organizational Structure, CS11: Experience in Similar Projects
Project Management Success: SC1: Time Performance, SC2: Quality Performance, SC3: Cost Performance, SC4: HSSE Performance, SC5: End-User and Customer Satisfaction, SC6: Satisfaction of Project Team Members

References: 1-Belout and Gauvreau [27], 2-Zavadskas et al. [28], 3-Pheng and Chuan [29], 4-Ogunlana et al. [30], 5-Dainty et al. [31], 6-Turner and Muller [1], 7-Chan et al. [11], 8-Duy Nguyen et al. [32], 9-Chan and Chan [33], 10-Odusami et al. [34], 11-Bryde and Robinson [35], 12-Wang and Huang [36], 13-Muller and Turner [37], 14-Rodney Turner et al. [38], 15-Muller and Turner [22], 16-Hughes et al. [39], 17-Camilleri [40], 18-Edum-Fotwe and Mccaffer [41], 19-Shen and Liu [42], 20-Mustapha and Naoum [43], 21-Arditi and Gunaydin [44], 22-Chen et al. [45], 23-Iyer and Jha [46], 24-Yang et al. [47]

3.2. Interactions between model components

- A conceptual model was developed to figure out how the determinants interact directly or indirectly and affect the PM success. Six hypotheses were constructed to test interactions between the components of the proposed model. While three of the hypotheses are based on the relationships between the determinants and the PM success, the remaining three hypotheses are based on the interrelations between the determinants. The proposed model is presented in Figure 1 and the constructed hypotheses are as follows:
- Hypothesis 1 (H_1): Favourability of "company specific factors" has a direct and positive impact on "project characteristics".
  Corporate firms are less likely to take part in projects with unfavourable conditions (tight schedule, incomplete contract, etc.). They adopt a proactive culture to manage the risks in an effective way. A proactive culture implies anticipating and preventing problems before rather than responding to them later on. They invest self-initiated efforts to bring about change in the work environment [48].
- Hypothesis 2 (H_2): Favourability of "company specific factors" has a direct and positive impact on "project manager's competencies".
  Selection of an appropriate project manager is a crucial step in project management. Corporate firms use sophisticated multicriteria decision-making techniques (such as AHP, ANP, VIKOR, TOPSIS, etc.) to select an effective project manager. The utilization of such techniques for personnel selection has given satisfactory results [49].
- Hypothesis 3 (H_3): Favourability of "project characteristics" has a direct and positive impact on "project manager's competencies".
  Project manager selection is a complicated task that aims to assign the most appropriate candidate for a project of some given characteristics. An effective selection implies that the experience, knowledge, and skills of the project manager are in line with the size, complexity, and risk of the project [49], demonstrating strong connection between the project characteristics and competencies of the project manager.
- Hypothesis 4 (H_4): Favourability of "company specific factors" has a direct and positive impact on "project management success".
  A positive relation between company specific factors and the PM success has been suggested in the literature. According to Muller and Jugdev [50], the PM success depends on the interactions between personal, team, project, and organizational success. A study conducted by Deshpandé et al. [51] revealed that companies with corporate structure could outperform the ones dominated by internal cohesiveness and rules. Belassi et al. [52] identified significant effects of organizational culture on new product development projects.
- Hypothesis 5 (H_5): Favourability of "project characteristics" has a direct and positive impact on "project management success".
  It is easier to achieve the PM success in projects characterized by favourable conditions (lower economic and political risks, adequate funding, complete design and contract, etc.). This thesis has also been supported by a couple of studies presented in the literature. Chan et al. [11] consider project-related factors as one of the main determinants of the PM success. Chua et al. [53] presented positive influence of project characteristics on The PM success.
- Hypothesis 6 (H_6): Effectiveness of "project manager's competencies" has a direct and positive impact on "project management success".
  This hypothesis is the focal point of this study. An appropriately selected project manager can achieve an incredible success in projects with many unforeseen obstacles and problems [49]. Belassi and Tukel [54] considered project manager-related factors (ability to coordinate, commitment, etc.) as the crucial determinants of success or failure in projects. Munns and Bjeirmi [55] emphasized the need to appreciate the role of project managers within projects.

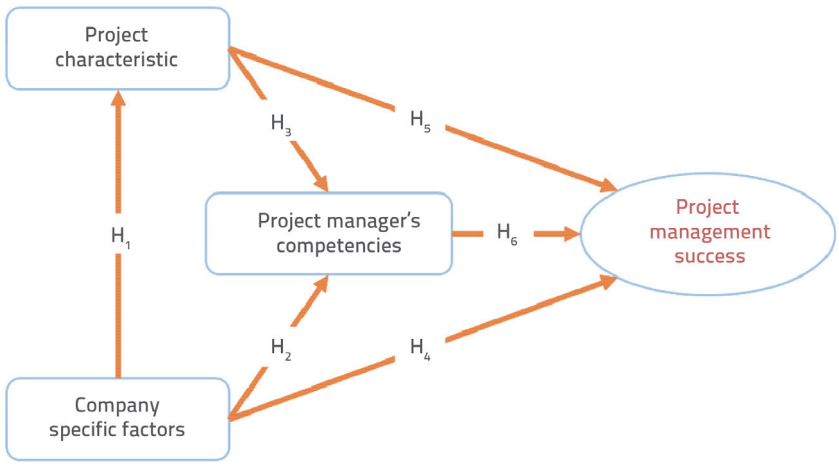

Figure 1. Project management success model

4. Research methodology

A questionnaire survey was prepared and administered via e-mail to the construction companies that are members of the Turkish Construction Employers Association (TCEA), Turkish Contractors Association (TCA), and Association of Turkish Consulting Engineers and Architects (ATCEA). Out of 307 questionnaires that were sent out, 80 completed questionnaires were returned, which corresponds to a response rate of 26 %. The conservative and simplistic approach is to obtain as many as 200 samples for Structural

Equation Modelling (SEM), which is the model to be utilized for the analysis. However, SEM models can also perform quite well with samples ranging from 50 to 100 [56]. The study conducted by Xiong et al. [57] reviewed SEM applications in construction industry. It was reported that out of 84 models developed, 26 models included a sample size of less than 100, 39 models had a sample size between 100 and 200, and only 19 models had a sample size of over 200.

The respondents were requested to fill in the questionnaires based on the PM success of the projects they have completed so far. The obtained data represented 80 projects and were collected from 38 construction companies where multiple responses were provided by some of them. The responses were collected from construction companies operating 17 years on an average, and their average annual turnover was 523 million USD. The projects were dominantly composed of transport projects (46 %) followed by industrial (20 %), heavy construction (13 %), high rise building (11 %), and residential projects (10 %). An average project value was 332 million USD. Clients were distributed as private (60 %) and public (40 %). The respondents' companies were involved in these projects as prime contractor (59), client (9), subcontractor (5), consultant (4), and designer (3).

The survey was composed of two main sections including (1) company and project information and (2) evaluation of the influences of The PM success determinants and assessment of The PM success criteria. The PM success determinants were separated into project manager's competencies, project characteristics, and company specific factors. The respondents were requested to assess the impacts of these factors on the PM success using a five-point Likert Scale ranging from 1: very low to 5: very high.

SEM was used to investigate validity of the proposed model and interrelations among the model components. SEM is a multi-variate statistical analysis technique that employs a confirmatory approach to test hypotheses among the latent and measured variables [58]. A latent variable cannot be directly observed. Instead, it must be inferred from measured variables. It is also called the construct, factor, or unobserved variable. A measured variable, as the name implies, is measurable and can be directly observed. It is also called as the manifest, observed variable, or indicator variable.

SEM is also known as causal analysis, causal modelling, analysis of covariance structures, simultaneous equation modelling, path analysis, confirmatory factor analysis, or dependence analysis. There are various commercially available SEM software packages such as LISREL, SIMPLIS, SAS CALIS, AMOS, and EQS. AMOS (Analysis of Moment Structures) is used as a SEM software package as it is user friendly and the processes are easy to follow.

SEM is an excellent technique for analysing complicated multidimensional relationships. It provides complete and concurrent tests for all the relationships. SEM is typically composed of two parts, namely the measurement model and the structural model [59]. While the former indicates the way hypothetical constructs are measured on the basis of model variables, the latter presents interactions between latent variables [58]. It is necessary to test validity of hypothesized constructs. There are two validity types to be achieved: content and construct validity. Content validity implies the extent to which the components covering the domain of meaning represent their construct [60]. Construct validity, on the other hand, represents the degree to which a latent variable can measure what it intends to.

5. Research findings

As indicated by Garver and Mentzer [61], there are no formal statistical tests to analyse content validity and, therefore, judgments of the researchers are applied. A comprehensive literature review has been conducted to come up with the indicators of each proposed construct. In order to establish the content validity of the constructs and revise them, a pilot study was conducted with an experienced industry practitioner and two university professors.

The construct validity is composed of three main elements:

- convergent validity
- discriminant validity
- reliability.

The first one examines whether all variables that measure the same latent variable cluster together and a single latent variable are formed. They are evaluated by examining goodness of fit indices and factor loadings. Examining the factor loadings is crucial because deleting the statistically insignificant ones can enhance the internal reliability and fit indices. Discriminant validity represents the principle that different constructs are not highly correlated to prevent constructs from measuring the same thing. It can be evaluated by examining inter-correlations between the measures of a construct [58].

Table 2 presents the factor loading for each latent and constituent variable of the model. The analyses conducted in AMOS demonstrate the significance of all factor loadings at α = 0.05. Therefore, it is not necessary to remove any variable from the model.

The scale reliability represents internal consistencies of latent variables and is determined by Cronbach's alpha. The main goal of reliability testing is to determine how well latent variables are expressed by their observed indicators. The latent variables and the corresponding Cronbach's alpha values are shown in Table 3.

The values are considered to be satisfactory if they are greater than 0.70, which is the minimum satisfactory value suggested by Nunally [62].

Table 2. Model variables with factor loadings

No.	Model variables	Factor loadings
F1	**Project manager's competencies**	
V1	Leadership and strategic decision making	0.822
V2	Planning. monitoring and management	0.793
V3	Communication and social interaction	0.707
V4	Innovativeness and opportunity seeking	0.735
V5	Technical experience	0.718
V6	Responsibility and commitment	0.817
V7	Effective team selection and management	0.793
V8	Clear project policies	0.726
V9	Top management handling	0.775
F2	**Project characteristics**	
V10	Cooperation and performance level	0.735
V11	Clarity of project objectives	0.681
V12	Completeness of contract	0.778
V13	Completeness of design	0.534
V14	Performance of other parties	0.761
V15	Relative significance of project	0.785
V16	Time limitation	0.742
V17	Quality requirements	0.771
F3	**Company specific factors**	
V18	Communication with other participants	0.654
V19	Communication with authorities	0.530
V20	Top management support	0.570
V21	Planning. monitoring and management efficiency	0.768
V22	Consultation and troubleshooting ability	0.781
V23	Clear project objectives and policies	0.804
V24	Financial management and solid economic structure	0.772
V25	Human resources management	0.771
V26	Technology utilization for reliable communication	0.719
V27	Clear and simple organizational structure	0.712
V28	Experience in similar projects	0.671
F4	**Project management success**	
V29	Time performance	0.856
V30	Quality performance	0.847
V31	Cost performance	0.771
V32	HSSE performance	0.544
V33	End-user and customer satisfaction	0.829
V34	Satisfaction of project team members	0.753

Table 3. Latent variables and corresponding Cronbach's alpha coefficients

Latent variables	Cronbach's alpha values
Project manager's competencies	0.926
Project characteristics	0.897
Company specific factors	0.913
Project management success	0.890

The overall fit of the model can be determined by checking the goodness of fit indices through Chi-square (χ^2). This test is useful to understand whether or not a significant difference exists between the actual and predicted matrices. In order to assess the goodness of fit by checking the proposed model against the null or independence model, some other indices are also utilized such as Tucker-Lewis index (TLI) [63], relative fit index (RFI) [64], and comparative fit index (CFI) [65]. The root mean square error of approximation (RMSEA) [66] involves an intrinsic correction for model complexity.

Table 4 shows the reliability value (Cronbach's alpha) and fit indices of the model. The χ^2/df ratios are determined to be less than three, as proposed by Kline [59]. The RFI, TLI, and CFI values are around 0.9, implying a good fit. In addition, the RMSEA values are less than the recommended value, which is 0.10 [59]. The correlation matrices determined for all the constructs are below 0.90, indicating that there is no multicollinearity [67].

Table 4. Reliability value and fit indices of the model

Index	Recommended value	Model
Cronbach's alpha	> 0.7	0.971
χ^2/df	< 3.0	1.467
RFI	0 (no fit) to 1 (perfect fit)	0.674
CFI		0.876
TLI		0.867
RMSEA	< 0.10	0.077

The hypotheses developed between the constructs are tested by SEM. Six hypothesis have been developed in total. Three of them represent the relationships between the PM success determinants and the PM success. The remaining three hypotheses represent the interrelations between the PM success determinants. The resultant structural equation model with path coefficients is shown in Figure 2. The arrows indicate the direction of impact between the model parameters and the number located on each arrow represents the path coefficient. Path coefficients can be considered as regression weights where there is no intercept term.

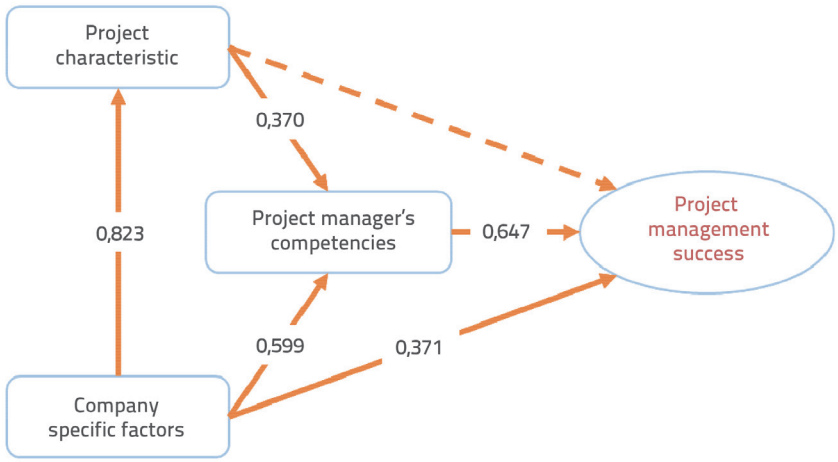

Figure 2. Structural equation model with path coefficients

The strength of association between the model constructs are evaluated based on an interpretation guideline suggested by Murari [68]. According to the guideline, a weak association exists for path coefficients from 0.1 to 0.3, a moderate association is observed for path coefficients between 0.3 to 0.5, and a strong association is implied by path coefficients of more than 0.5.

6. Discussion

The objective of this study is to evaluate impacts of project manager's competencies on the PM success. The findings demonstrate that project managers are as influential as (or even more influential than) the corporate structure of the company in determining project outcomes. The path coefficients obtained from the structural equation model indicate that project manager's competencies have a strong direct effect on the PM success. Company specific factors have been shown to have a moderate direct effect on PM success. Additionally, company specific factors can implicitly impact the PM success by affecting the project manager's competencies. An insignificant path has been identified between project characteristics and the PM success.

Project teams are formed and oriented to complete assignments in line with the plan and budget. Project managers can increase project efficiency and effectiveness of the project team by coordinating the team members and ensure completion of assignments within the predetermined time. They keep the team united and increase their motivation so that they move as a team and raise productivity. The factor loadings of the measured variables of project manager's competencies are above 0.7, indicating that all of them are crucial components. The most significant project manager competencies are observed as "leadership and strategic decision-making skills" and "responsibility and commitment". Leadership is an indispensable competency for project managers, as has frequently been emphasized in the literature [69-71]. It shows the degree of social influence to lead the team towards achieving a common goal. More emphasis is placed on people rather than tasks. Project managers lacking leadership features may fail to utilize opportunities, effectively manage team members, and accomplish project objectives. Responsibility and commitment may seem like two words with similar meanings. However, while responsibility is an obligation to successfully accomplish the tasks assigned to a person, commitment is defined as dedication of a person to pursue a course of action. The latter involves a voluntary obligation rather than an obligation imposed by an agent. These two features are of vital importance to project managers, and they can significantly influence the PM success as indicated by a number of scholars [54, 55, 72]. Project managers who enthusiastically dedicate themselves to the project can increase motivation of the project team members to achieve project goals. Thus, in order to complete the project successfully, construction companies should assign committed project managers with leadership features.

A number of non-governmental organizations operating in Turkey (i.e., UPYE, PMI Turkey, and IPYD) promote project management and support project management professionals to achieve efficient use of limited sources. Project managers can acquire or improve crucial skills in leadership and strategic decision making through attending conferences, seminars, and training programs offered by these organisations. Nevertheless, project management framework in Turkey lacks a legislative framework. Sumer and Kiraz [73] identified developing PM standards and issuing legal regulations as crucial obstacles to effective project management.

Company-specific factors are realized to have both direct and indirect effects on the PM success. The direct influence of the company-specific factors on the PM success is at moderate level. However, they can also indirectly contribute to the PM success through impact on the project manager's competencies. This indirect contribution might be attributed to the fact that corporate construction companies typically work with qualified project managers in order to reduce the possibility of failure. The most significant company-specific factor is identified as "clear project objectives and policies".

The interaction between project characteristics and The PM success has shown to be insignificant, meaning that corporate firms with talented project managers can achieve success in projects with different characteristics. A limited indirect influence might be observed as having a positive impact on the project manager's competencies. It could be explained by the fact that construction companies generally

assign the most talented project managers to troublesome projects in order to prevent failure. The most significant project characteristic is specified as "relative significance of project".

The PM success indicators mostly have factor loadings above 0.7, with HSSE performance as an exception (0.544). Three major success indicators having factor loadings above 0.8 are "time performance", "quality performance", and "end-user and customer satisfaction". This is also in accordance with the literature as the effects of these indicators on The PM success have been mentioned in a number of studies [27, 31, 36, 37, 40].

7. Conclusions

The study assesses the role of project managers in determining the PM success. From this perspective, a comprehensive PM success model reflecting relations between the PM success determinants is developed. Data are collected from 80 projects through a questionnaire survey. SEM is used to test validation of the framework and direct and indirect effects between the PM success and its components.

Findings of the study indicate that project manager's competencies have the greatest direct influence on the PM success. The leadership and decision-making capability has been observed as the most significant indicator of project manager's competencies, and is followed by responsibility and commitment. It was noticed that company specific factors can both directly and implicitly affect the PM success. While their direct effect is at moderate level, they have an additional implicit effect on the PM success by affecting project manager's competencies. It was established that the interaction between project characteristics and the PM success is insignificant.

Construction companies are advised to pay utmost attention to their project manager assignments. It has been clearly demonstrated that project managers can significantly alter project outcomes. Therefore, it becomes more of an issue for the construction firms to employ appropriate project managers for their projects. They should pay attention to the assignment of self-dedicated project managers having high leadership skills enabling them to successfully complete the projects. Considering the corporate structure, companies should properly specify their project objectives. The definition of scope, allocation of resources, and establishment of deadlines, are of prime importance. Moreover, in order to increase productivity and mitigate project risks, companies should make use of the knowledge and expertise of consulting firms.

The main limitation of the study might be considered as lack of variation in respondent types. Due to the fact that the data was limited to the responses of Turkish construction companies, it reflects their opinions shaped by their experiences. However, considering the wide range of projects undertaken by the companies with various areas of expertise, and the fact that these companies carry on business in domestic and overseas projects, it can be concluded that the data represent international contractors and that findings can be generalized. Another limitation is that the sample is limited to in-house project management practices, which excludes projects sponsored by another organization and with PM consultancy services.

Appendix A. Sample questionnaire

Section 1: Company and project information

Please answer the following questions based on your company information and project experience.

1. Area of expertise of the company
   a. Investor
   b. Prime Contractor / Subcontractor
   c. Project Management and Consultancy
   d. Project Design
   e. Other
2. Company experience in construction industry
3. Annual turnover of the company
4. Type of project client
   a. Public
   b. Private
5. Type of project
   a. Industrial
   b. Heavy Construction
   c. High Rise Buildings
   d. Residential
   e. Highway Construction
6. Actual project duration
7. Total project value
8. Company status in the project
   a. Partnership
   b. Prime Contractor
   c. Subcontractor
   d. Designer
   e. Consultant
9. Your position in the project
   a. Project / Department / Section Manager
   b. Site Manager
   c. Site Engineer
   d. Designer / Architect
   e. Technical Office Engineer
10. Contract type
    a. EPC
    b. Lump Sum
    c. Unit Price
    d. Cost + Fee
    e. Incentive Contract

Section 2: Project success determinants

Please indicate the level of the following items for a previously completed project.

Project manager skills	**Very low level**	**Low level**	**Medium level**	**High level**	**Very high level**
Leadership and strategic decision making					
Planning, monitoring and management					
Communication and social interaction					
Innovativeness and opportunity seeking					
Technical experience					
Responsibility and commitment					
Effective team selection and management					
Clear project policies					
Top management handling					

Please indicate the level of the following items for a previously completed project.

Project characteristics	**Very low level**	**Low level**	**Medium level**	**High level**	**Very high level**
Cooperation and performance level					
Clarity of project objectives					
Completeness of contract					
Completeness of design					
Performance of other parties					
Relative significance of project					
Time limitation					
Quality requirements					

Please indicate the level of the following items for a previously completed project.

Company specific factors	**Very low level**	**Low level**	**Medium level**	**High level**	**Very high level**
Communication with other participants					
Communication with authorities					
Top management support					
Planning, monitoring and management efficiency					
Consultation and troubleshooting ability					
Clear project objectives and policies					
Financial management and solid economic structure					
Human resources management					
Technology utilization for reliable communication					
Clear and simple organizational structure					
Experience in similar projects					

Section 3: Project success indicators

Please indicate the level of the following items for a previously completed project.

Project manager skills	Very low level	Low level	Medium level	High level	Very high level
Time performance					
Quality performance					
Cost performance					
HSSE performance					
End-user and customer satisfaction					
Satisfaction of project team members					

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