

From Past to Present – the Development of Project Success Research

Sina Moradi

Doctoral Researcher of Construction Management and Economics at Tampere University,
Finland

Kalle Kähkönen

Professor of Construction Management and Economics at Tampere University, Finland

Kirsi Aaltonen

Associate Professor of Project Management at University of Oulu, Finland

Abstract- Project success research has been a field of importance for more than three decades. The research field has been developing along the passed the time; however, our understanding of this development is very limited. This study aims at understanding the longitudinal developments in the project success research field and discussing and elaborating further results based on previous studies. For this purpose, a literature study was conducted where the emergent research interests were identified. After that, two separate syntheses of success factors and criteria were developed for identifying the most often present ones (later termed weighty). The findings of this study present the evolution process of project success research. This directs one's attention to the nature of project success research, leading research questions, main targets, outcomes, and chronological presentation of the obtained results. In addition, this study led to interesting results concerning project success factors and criteria. The findings suggest that there are 65 factors contributing to project success, among which communication, top management support, project manager's competency, clear objectives and realistic obligation, monitoring and feedback, and risk management are the critical ones. Moreover, 13 frequently mentioned project success criteria in the literature were identified where meeting cost, meeting time, customer satisfaction, meeting quality, and business success are the top five ones. The findings of this study can be insightful for the research community and project practitioners to be aware of the development process of project success research.

Keywords: Project success criteria; project success factors; project management.

1. INTRODUCTION

Project success has been a popular research field during the last three decades. A large amount of research has been conducted to address different aspects of project success. For example, several studies have tried to define project success as clearly as possible (for instance, Baccarini, 1999; Jugdev and Müller, 2005; Shenhar et al., 2001). Some scholars have pursued to identify factors and criteria for project success (for instance, Andersen et al., 2006; Cooke-Davies, 2002; Chua et al., 1997; Pinto and Slevin, 1987; Pinto and Prescott, 1988). The efforts concerning identification of success factors and criteria can be divided into two main parts: success factors and criteria of general significance (for various types of projects) (for instance Ağa, 2016; Cooper and Kleinschmidt, 1987; Chipulu et al., 2014; Davis, 2014; de Carvalho et al., 2015; Hussein et al., 2015; Ika et al., 2011; Lim and Mohamed, 1999; Malach-Pines et al., 2009; Müller and Jugdev, 2012; Mirza et al., 2013; Martens et al., 2018; Nanthagopan et al., 2019; Scott-Young and Samson, 2008; Serrador and Turner, 2014; Turner, 2004; Taherdoost and Keshavarzsaleh, 2016; ul Musawir et al., 2017), and success factors and criteria for specific project types or contexts, e.g., construction and IT projects (for instance Cozijnsen et al., 2000; Chua et al., 1999; Chang et al., 2013; Daniel et al., 2018; Espinosa et al., 2006; Engelbrecht et al., 2017; Fortune and White, 2006; Handzic et al., 2016; Müller and Turner, 2007; Rodriguez-Repiso et al., 2007; Standing et al., 2006; Sudhakar, 2012).

The nature of these studies on project success research, their motivations, and the gained outcomes can be seen as the main cornerstones of project success research development. Analyses such as mapping of the development of project success research have been addressed in a very limited manner. Moreover, this research effort, which is as comprehensive as possible, can provide new knowledge contributions by its overall analyses of the research results gained so far.

Such analyses can provide further understanding of the critical success factors on the resultant flourishing projects of various business contexts. This study aims at contributing towards the mentioned knowledge gaps through: (1) Mapping the development of project success research through describing its changing trends and obtained outcomes, and (2) Exploring the results of previous studies in a manner that is as comprehensive as possible.

This paper is structured into five sections. The first one is presenting the point of departure, which describes the conceptual background. The second section is about the research methodology and relating the research process. The third one presents the results of this study. The fourth one presents the discussions about the obtained results. Finally, the last one includes the main conclusions.

2. THEORETICAL BACKGROUND

2.1 DEFINITIONS

The project is considered an overall success if the project meets the technical performance specifications and/or mission to be performed, and if there is a high level of satisfaction concerning the project outcome among key people in the parent organization, key people in the project team, and key users or clientele of the project effort (de Wit, 1986). Success on a project

means that certain expectations for a given participant were met, whether owner, planner, engineer, contractor or operator. These expectations may be different for each participant (Sanvido et al., 1992). Project success as a concept can cover different aspects from achieving the project time and cost targets to the stakeholder satisfaction and business success (Baccarini, 1999; Martens et al., 2018; Müller and Turner, 2010). Baccarini (1999) defined project management success and product success as two distinct components of project success. According to another definition by Shenhar et al. (2001), the project success means different things for different people; an architect may consider success in terms of aesthetic appearance, an engineer in terms of technical competence, an accountant in terms of dollars spent under budget, a human resources manager in terms of employee satisfaction. Chief executive officers rate their success in the stock market.

Jugdev and Müller (2005) stated that success is an interesting word; the word connotes different things to different people and is very context-dependent. Trying to pin down what success means in the project context is akin to gaining consensus from a group of people on the definition of “good art.” Müller and Turner (2007a) defined project success factors and project success criteria as two components of project success. Mertens et al. (2018) stated that project success is related to the goals and benefits that are provided in a project for its organization as a whole, dealing with the effectiveness, objectives, and benefits that are provided by the project, and success in project management is related to the direct actions from a project manager, applying tools as determined by the scope, deadline, and cost of each project.

As can be understood, several researchers have defined project success. There are some common points, e.g., meeting time and cost, and customer satisfaction, among those definitions which can provide a basis for a more comprehensive definition. This study defines project success as a concept comprised of four components as follows:

- Project management success: meeting time, cost, scope, and quality
- Project execution success: meeting technical requirements and safety goals
- Business success: reoccurring business and meeting expected commercial success
- Stakeholder satisfaction: meeting various expectations of different project stakeholders

2.2 PROJECT SUCCESS FACTORS (PSFs)

In addition to the efforts for defining the project success itself conceptually, several studies have addressed the identification of the project success factors (PSFs). Success factors are the set of circumstances, facts, or influences that contribute to the result (Lim and Mohamed, 1999). Two studies carried out by Pinto and Slevin (1987), and Pinto and Prescott (1988) can be considered as pioneering efforts over project success factors. The first one showed which success factors have relevance in different phases of the project life cycle (Pinto and Slevin, 1987). The second one explained the critical project success factors resulting in nine factors such as clarity of goals and general direction, top management support, and client consultation (Pinto and Prescott, 1988). Then, other studies conducted by Chua et al. (1997 and 1999) tried to address success factors for specific performance targets in a project. As a result of these studies, different success factors for budget, schedule, and quality performances and also for general purposes (all objectives) were identified and presented. Project failure studies have also provided valuable results for explaining possibilities for successful projects (for instance, Cooke-Davies, 2002; Cozijnsen, 2000; LIM and LING, 2002).

In 2004 and 2005, a context-oriented approach, addressing specific project types and environments in which projects operate within, was formed toward identifying success factors of construction projects. Different studies were carried out to detect success factors of construction projects (for instance, Chan et al., 2004; Carù et al., 2004; Chileshe and Haupt, 2005; Nguyen et al., 2004; Phua and Rowlinson; 2004). Addressing success factors and causes of failures of specific contexts or project types were continued in the next years. For instance, Fortune and White (2006) conducted a study, which identified success factors of different attributes in the project such as goals and objectives, decision making, and environment. Moreover, other studies have paid attention toward identifying project success factors for other aims such as delivering results in time and cost and also success factors and barriers in construction and in information system projects (Agarwal and Rathod, 2006; Espinosa et al., 2006; Frödell et al., 2008; Koutsikouri et al., 2008; Rodriguez-Repiso et al., 2007).

From 2011 to 2018, research attention has increasingly been broader in terms of studying both general and specific success factors of projects. Accordingly, a few studies have provided evidence for generic success factors such as monitoring, coordination, training, clear definition of the project goal, communication, competent project manager and teamwork (for instance Berssaneti and Carvalho, 2015; Ika et al., 2011; Joslin and Müller, 2016; Jugdev et al., 2013; Müller and Jugdev, 2012; Mirza et al., 2013; Montequin et al., 2016; Rolstadås et al., 2014). At the same time, other studies have tried to discover specific success factors. For example, software development projects, construction projects, post-disaster housing reconstruction projects, BOT projects, time success, IT projects, petroleum industry and PPP (public partnership projects) success have been addressed by different researchers, and several success factors such as risk management, good coordination and communication, transparency, accountability and planning efforts have been identified (Alzahrani and Emsley, 2013; Ahmadabadi and Heravi, 2019; Almarri and Boussabaine., 2017; Doulabi and Asnaashari, 2016; Daniel et al., 2018; Engelbrecht et al., 2017; Gupta et al., 2013; Handzic et al., 2016; Heravi and Ilbeigi, 2012; Mišić and Radujković, 2015; Maqbool and Sudong, 2018; Mavi and Standing, 2018; Nguyen and Hadikusumo, 2018; Ophiyandri et al., 2013; Peetawan and Suthiwartnarueput, 2018; Rodriguez-Segura et al., 2016; Rezvani et al., 2016; Sudhakar, 2012; Sanchez and Terlizzi, 2017; Tsiga et al., 2017; Ullah et al., 2017; Wu et al., 2017 and 2018; Yamin and Sim, 2016; Zheng et al., 2014; Zuo et al., 2018). More details of the mentioned success factors in the literature are presented in the results section.

2.3 PROJECT SUCCESS CRITERIA (PSC)

In addition to conducting studies to address project success factors, several studies have also been undertaken to discover appropriate project success criteria for measuring project success. Criteria are the set of principles or standards by which judgment is made (Lim and Mohamed, 1999). The presented success criteria by Freeman and Bale (1992) can be considered as a starting effort in this subject. These PSC include seven components of which five of them have been more frequently mentioned than others: technical performance, efficiency orientation (meeting time, cost and quality), managerial and organizational implications (mainly customer satisfaction), personal growth and manufacturability and business performance. Shenhar et al. (1997) presented another PSC for measuring project success, which includes four components: project efficiency, impact on the customer, business success, and preparing for the future. After that, Lim and Mohammad (1999) introduced other PSC based on macro and micro viewpoints.

Macro viewpoint addresses the timely completion and satisfaction components, and micro viewpoints deal with completion of time, cost, quality, performance, and safety. Moreover, Agarwal and Rathod (2006) stated that meeting scope, time, cost, and customer satisfaction are the project success criteria. Another study conducted by Müller and Turner (2007b) presented a new set of project success criteria. This includes 10 components: end-user satisfaction, supplier satisfaction, team satisfaction, other stakeholder's satisfaction, performance in terms of time, cost and quality, meeting user requirements, project achieves its purpose, customer satisfaction, and reoccurring business. In two other undertaken studies by Lam et al., (2007 and 2010), meeting time, cost, quality, safety goals, and environmental friendliness were presented as project success criteria. After that, several studies were conducted by different researchers which mainly emphasized on time, scope, cost, quality, safety, satisfaction and meeting technical requirements as project success criteria (Al-Tmeemy et al., 2011; Albert et al., 2017; Davis, 2016 and 2017; Gomes and Romão, 2016; Koops et al., 2016 and 2017; Osei-Kyei and Chan, 2018; Rohman et al., 2017; Sebestyen, 2017; Pankratz and Basten, 2018). Findings of analyzing the mentioned success criteria in the literature are presented in the results section.

3. METHODOLOGY

The literature study behind this paper addressed as comprehensively as possible the previous research on project success. For this purpose, ScienceDirect and the Emerald databases were chosen to locate the relevant studies. The selection of the forgoing databases was carried out based on the data access possibilities. The following keywords were utilized for searching: project success, project success factor, and project success criteria. As a result of searches through the mentioned keywords and checking for their presence in the title, 114 papers were found. Next, abstract and content of all found papers were fully reviewed, and 19 papers were excluded in the results of this effort; because the purpose and result of those papers had no match to project success, and its supplementary concepts include project success factor and criteria. Therefore, 95 remaining relevant papers were analyzed for three main purposes, (i) describing the nature of project success research, (ii) discovering and depicting leading research questions, main targets, and outcomes over the conducted studies and subsequently mapping the evolution process of project success research, and (iii) addressing the mentioned success factors and success criteria in the literature.

As one of the main results, the evolution process of project success research was mapped through analyzing the nature of project success research, the leading research questions, the main targets, and the main outcomes. In addition, several success factors and success criteria were extracted from the previous studies. According to obtained project success factors and project success criteria, two matrixes of mentioned PSFs and PSC in the previous studies and their references were provided. Due to a few similarities among identified PSFs and PSC, two syntheses of them were developed with a ranking column based on the frequency of appearance (Appendices A and B). The development of those syntheses was conducted by identifying those project success factors or criteria which had very close or similar meaning or title. In this study, the identified success factors and criteria with more than one frequency of appearance were qualified as weighty ones, and those with only one frequency of appearance qualified as notable ones.

4. RESULTS

4.1 EVOLUTION MAP of PROJECT SUCCESS RESEARCH

The Figure 1 shows the evolution map of project success research. This map comprises five main components: the nature of project success research, the leading research questions, the main research targets, the main outcomes, and the chronological presentation of the outcomes. The following paragraph provides a detailed explanation of the mentioned components.

The first part of Figure 1 presents the nature of project success research. Basically, it seems that project success research has been interested in increasing the success chance of the project through an improved understanding of the project success concept and its different components. Hence, three groups of leading research questions have been adopted. These questions are related to the concept of project success, viewpoints on that, measurement of project success, and finally, success factors that would be useful and helpful for realizing project goals and benefits. In other words, those three groups of leading research questions account for understanding the definition of project success, project success criteria, and project success factors.

The nature of project success research besides leading research questions over conducted studies have created different research targets and also led to a growing trend towards the context-oriented studies, as pointed out in Figure 1. The main reason for this growing trend could be the fact that the specific contexts or project types have had to be addressed separately in terms of success, as it has been mentioned by different researchers such as Shenhar (2001). Due to the undertaken research in the area of project success, three main outcomes have been achieved, which are mentioned in the following:

- The increasing maturity of adapted definitions for project success and its components;
- Development of understandings towards expected common (general) and unique (context-oriented) goals and benefits of projects as a measurement way to judge project success;
- Identification of project success factors generally (for all types of projects) and particularly (for specific project type, context or target)

Additionally, the mentioned growing trend towards the context-oriented studies has consequently led to gradual customization of project success knowledge for specific targets and contexts, as can be understood from the chronological presentation of the outcomes. For instance, considerable improvements have been obtained in our understandings of the different aspects of success in the construction and information technology projects. The Figure 1 presents the evolution process of project success research.

Nature of project success research:										
To increase success chance of projects through improving understandings of project success concept, its different components and enablers										
Leading research questions										
<i>What</i> would be the appropriate definition of project success? <i>What</i> are the different aspects of project success?			<i>What</i> a project should deliver and how it can be considered as a successful maneuver? <i>How</i> can we judge the project success?			<i>What</i> can be helpful for a project to reach its goals and benefits? <i>What</i> are the enablers of project success?				
Main research targets										
					A growing trend towards context-oriented research from past to the present					
Identifying success enablers over the stages of project life cycle (Pinto and Slevin, 1987; Pinto and Prescott, 1988) <u>Starting point</u>	Developing a universal framework to measure project success (Freeman and Bale, 1992; Shenhar et al., 1997) <u>Significant step towards success measurement</u>	Identifying success factor of construction project based on objectives of budget, time, and quality (Chua et al., 1997 and 1999) <u>Starting point of context-oriented studies</u>	Defining project success. (Baccarini, 1999) <u>The only focused study to define project success</u>	Addressing success enablers, way of judging success and causes of failure in general (Lim and Mohamed, 1999; Cozijnsen et al., 2000; and Cooke-Davies, 2002) <u>Paying attention to failure causes</u>	Identifying success factor in construction projects (Duy Nguyen et al., 2004; Chan et al., 2004) <u>Growing interest</u>	Assessing our evolving understanding of success factors and frameworks in the past 40 years (Jugdev and Muller, 2005) <u>A Review</u>	Identifying success criteria and as well as causes of failure in specific project types such as construction and IT (Standing et al., 2006; Lam et al., 2007; Al-Tmeemy et al., 2011) <u>Increasing interest toward context-oriented studies</u>	Addressing different aspects of project success in general and in specific contexts such as construction and IT projects (Alzahrani, 2013; Serrador, 2014; Almarri, 2017) <u>Taking deeper in success aspects of construction and IT industry</u>		
Other researchers such as Shenhar et al. (2001), Muller and Turner (2007) and Mertens et al. (2018) have also adapted other definitions of project success in their studies.										
Main outcomes										
<i>Increasing maturity of adapted definitions for project success and its components</i>			<i>Development of understandings towards expected common (general) and unique (context-oriented) goals and benefits of projects as a measurement way to judge project success</i>			<i>Identification of project success factors generally (for all types of projects) and particularly (for specific project, context or target)</i>				
Chronological presentation of outcomes										
Gradual customization of project success knowledge for specific targets and contexts										
Discovery of success factors in different stages of project life cycle	Adaption of several definitions of project success and identifying new success factors	Picture of different aspects of project success and showing the importance of post-project outcomes on its success	Identification of effects of leadership, competency and teamwork shortages in project failure	Highlight importance of satisfaction and business success in project success	Discovery of weighty factors of construction project's success such as enough funding and resources,	Clarification of contribution of some factors such as cultural differences and competent project manager on project success	Identification of specific success criteria in different project types such as, construction and IT	Identification of general and specific success factors for BOT, PPP, Petroleum and IT projects	Adaption of success criteria for specific project types and contexts such as PPP, information system and toll road projects	
1985-1990	1991-2000		2000-2003		2004-2005	2006-2010		2011-2018		

Fig.1. The evolution map of project success research

4.2 WEIGHTY and NOTABLE PROJECT SUCCESS FACTORS

The weighty and notable project success factors were identified through analyzing the outcomes of the conducted studies, making a synthesis of 338 identified success factors, excluding similarities, and finally reaching to a final list of 132 success factors (Appendix A). Based on this list, there are 65 weighty success factors that contribute to project success more than the 67 notable ones. Among those weighty factors, there are six ones with equal to or more than 10 appearances in the previous studies, which were found to be the critical success factors for projects. These critical success factors include communication, top management support, project manager's competency, clear objectives and realistic obligations, monitoring and feedback, and risk management. Look at table 1 for their frequency of appearance and relating ranking. Appendix A presents the resultant success factors with their literature sources.

Table1. Top 10 weighty project success factors

Project success factors	Appearance	Rank	Project success factors	Appearance	Rank
Communication	17	1	Stakeholder involvement	6	8
Top management support	12	2	Project size	5	9
Project manager's competency	11	3	Quality control		
Clear objectives & realistic obligations			Teamwork		
Monitoring & feedback	10	4	Design efforts	6	10
Risk management			Strong business case		
Team competency	9	5	Economic risks		
Adequacy of funding	8	6	Contractual aspects		
Coordination	7	7	Commitment to the project		
Planning efforts			Project complexity		
Organization structure			Effective safety program		
Political environment			Leadership		

4.3 WEIGHTY PROJECT SUCCESS CRITERIA

Analyzing the previous studies also resulted in identifying 257 success criteria. Due to a few similarities among found success criteria, a synthesis of them was created, and they were ranked according to their frequencies of appearance. Then, success criteria with more than one frequency of appearance were qualified as weighty ones. Findings show that there are 13 weighty project success criteria where meeting cost, meeting time, customer satisfaction, meeting quality, business success, and technical performance are the top 5 ones in the ranking (Figure 2, look at Appendix B for references).

Success criteria/reference	Shenhar et al., 1997	Freeman and Bale, 1992	Lim and Mohamed, 1999	Cooper and Kleinschmidt, 1987	Shenhar et al., 2001	Agarwal and Rathod, 2006	Müller and Turner, 2007	Lam et al., 2007	Lam et al., 2010	Ika et al., 2011	Al-Tmeemy et al., 2011	Chipulu et al., 2014	Koops et al., 2016 and 2017	Davis, 2016 and 2017	Gomesa and Romão, 2016	Rohman et al., 2017	Osei-Kyei and Chan, 2018	Pankratz and Baster, 2018	Rank (based on appearance)	
Meeting cost	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
Meeting time	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	2
Customer satisfaction	✓	✓	✓		✓	✓	✓	✓			✓	✓	✓	✓	✓				✓	3
Meeting quality			✓				✓	✓	✓		✓	✓	✓	✓					✓	4
Business success	✓	✓			✓		✓				✓								✓	5
Technical performance		✓	✓											✓	✓			✓		5
Safety			✓						✓			✓	✓							6
Meeting scope						✓	✓			✓		✓			✓					6
Preparing for the future	✓			✓	✓															7
Project specific political or social factors													✓							8
Effect on the professional image of client organization													✓							8
Benefit to stakeholder group														✓						8
Meeting expectations													✓							8

Fig. 2. The identified weighty project success criteria

5. DISCUSSION

The evolution map of project success research points out the nature of activities in this research field, leading research questions and main outcomes. It also shows the emerging interest for conducting target and context-oriented studies. The main reason behind the constitution of this interest is the widely distributed contingency thinking among the research community advocating that “one size does not fit all”; the contingency theory which was developed by Shenhar (2001) and stated that project type should affect the selection of project leaders, team members, and skill development needs. This mapped evolution process of project success research shows that general findings of project success have had limited explanatory power, mainly because of the uniqueness of the project that imposes many challenges and issues to project performance and subsequently its success, and general knowledge of project success is insufficient to overcome those challenges. Hence, customization of project success knowledge has been emerged as a requirement for each specific project type or context to overcome barriers and increase the success potential of projects. Accordingly, the contingency theory for projects developed by Shenhar (2001) can be developed; Project type not only affects the selection of

the project human resources and their required competencies but also requires defining specific criteria, for measuring project success, and identifying certain factors, for facilitating the realization of project success criteria. This is one of the most important implications of the mapped evolution process of project success research in this study. This contingency perspective could be extremely insightful for industry practitioners to spend enough time defining success measurement way as well as the factors facilitating the meeting of those success criteria specified for every single project at the beginning of the project. It can also be a valuable starting point for future relevant studies. The mapped process of project success research itself can also be insightful for the research community to know the past and recent research streams in the project success domain and to get idea for the future possible studies.

The mapped evolution process of project success research also reflects the evolution of the project management field in general. During recent decades, project management has been represented by a set of efforts to use proper knowledge, techniques, and tools for meeting project goals. These goals, generally, have been defined as completing projects on time, within budget, and in a satisfying level of quality. Meanwhile, considerable efforts have been made to figure out what can facilitate the meeting of the mentioned goals, and consequently, industry practitioners, together with the research community, have tried to find out what factors can contribute to project success and what kind of success criteria could be appropriate for projects. This explained evolution can be understood from the map. It can be stated that the identified nature of project success research, its leading research questions, and subsequent main targets, have supported the development of the project management profession in specific aspects. These aspects are increasing the maturity of understandings in project success by clearly defining project success, then finding reasonable measurement criteria for judging it, and finally looking for factors which can facilitate meeting the success criteria.

Furthermore, the analysis of project success literature led to another interesting outcome i.e., weighty project success factors. Consequently, it became clear that communication, top management support, project manager's competency, clear objectives and realistic obligation, monitoring and feedback, and risk management are the critical success factors for projects. These findings are in line with previous studies (For instance, Pinto and Slevin, 1987; Pinto and Prescott, 1988; Fortune and White, 2006; Sudhakar, 2012; Nguyen et al., 2004; Rolstadås et al., 2014) and also standards of practice (for instance, PMBOK) which have emphasized the importance of factors such as communication, top management support and project manager's competency in project success.

6. CONCLUSIONS

This study aimed at understanding the longitudinal developments in the project success research field, and discussing and elaborating further results based on previous studies. It was carried out through mapping the evolution of project success research and identifying weighty project success factors and success criteria. The obtained results provide a basis for the following conclusions:

- Project success research has led to the constitution of interest to conduct context-oriented studies and customization of project success knowledge for specific targets, contexts, or project types.

- There are 65 weighty factors that contribute to project success, among which communication, top management support, project manager's competency, clear objectives and realistic obligation, monitoring and feedback, and risk management are the critical ones.
- There are 13 weighty project success criteria where meeting cost, meeting time, customer satisfaction, meeting quality, business success, and technical performance are the top 5 ones.

The gained findings are capable of explaining the nature and certain outputs of project success research in a novel manner. This includes the evolution map of project success research, weighty project success factors, and project success criteria. These findings can provide new insights for project managers, project team members, project owners, and other stakeholders of the project to increase the success chance of the project by explaining the weighty success factors and criteria. As the limitation of this study, it should be acknowledged that certain keywords were used in a couple of databases (ScienceDirect and Emerald) for literature review, which subsequently narrowed the scope of the study.

About Authors



Sina Moradi (sina.moradi@tuni.fi) is Doctoral Researcher of Construction Management and Economics at Civil Engineering Department of Tampere University (www.tuni.fi) in Finland. The focus of his doctoral dissertation is on project managers' competencies in collaborative construction projects. His current research interests include project managers' competencies, project success, lean construction and sustainability.



Dr. Kalle Kähkönen (kalle.kahkonen@tuni.fi) is Professor of Construction Management and Economics at Tampere University (www.tuni.fi). His former employer was VTT Technical research Centre of Finland (www.vtt.fi). He holds degrees from two universities (Helsinki Univ. of Technology & University of Reading, UK). Prof. Kähkönen's main research interests and activities are presently addressing collaborative construction operations and digitalization in the built environment sector.

Professor Kähkönen has acted as supervisor, pre-examiner or opponent over 30 doctoral dissertations in Finland and abroad. Kalle Kähkönen is the board member of global research society Building Research Council (CIB).



Kirsi Aaltonen (Dr. Tech) is Associate Professor of Project Management at University of Oulu, Finland, where she heads Project Business Research Team in the Industrial Engineering and Management Research Unit. She has published widely on project stakeholder management and engagement in *Scandinavian Journal of Management*, *International Journal of Project Management*, *International Journal of Production and Operations Management*, *Industrial Marketing Management*, *Project Management Journal* and *International Journal of Managing Projects in Business*. Her current research interests are in the areas of stakeholder management in complex projects, integrated project deliveries and institutional change in project-based industries.

References

- Aga, D. A. (2016). Transactional leadership and project success: the moderating role of goal clarity. *Procedia Computer Science*, 100, pp. 517-525.
- Agarwal, N., & Rathod, U. (2006). Defining 'success' for software projects: An exploratory revelation," *International journal of project management*, 24(4), pp. 358-370.
- Ahmadabadi, A.A. and Heravi, G. (2019). The effect of critical success factors on project success in Public-Private Partnership projects: A case study of highway projects in Iran. *Transport Policy*, 73, pp.152-161.
- Almarri, K., & Boussabaine, H. (2017). Interdependency of the critical success factors and ex-post performance criteria of PPP projects. *Built Environment Project and Asset Management*, 7(5), pp. 546-556.
- Alzaharani, J.I. and Emsley, M.W. (2013). The impact of contractors' attributes on construction project success: A post construction evaluation. *International Journal of Project Management*, 31(2), pp.313-322.
- Al-Tmeemy, S. M. H. M., Abdul-Rahman, H., & Harun, Z., "Future criteria for success of building projects in Malaysia," *International Journal of Project Management*, 29(3), pp. 337-348, 2011.
- Albert, M., Balve, P., & Spang, K., "Evaluation of project success: a structured literature review," *International Journal of Managing Projects in Business*, 10(4), pp. 796-821, 2017.
- Andersen, E.S., Birchall, D., Arne Jessen, S. and Money, A.H. (2006). Exploring project success. *Baltic journal of management*, 1(2), pp.127-147.
- Baccarini, D. (1999). The logical framework method for defining project success. *Project management journal*, 30(4), pp. 25-32, 1999.
- Berssaneti, F. T., & Carvalho, M. M. (2015). Identification of variables that impact project success in Brazilian companies. *International Journal of Project Management*, 33(3), pp. 638-649, 2015.
- Cooke-Davies, T. (2002). The "real" success factors on projects. *International journal of project management*, 20(3), pp. 185-190.
- Cooper, R.G. and Kleinschmidt, E.J. (1987). New products: what separates winners from losers? *Journal of product innovation management*, 4(3), pp.169-184.
- Chua, D. K. H., Loh, P. K., Kog, Y. C., & Jaselskis, E. J. (1997). Neural networks for construction project success. *Expert Systems with Applications*, 13(4), pp. 317-328.
- Chipulu, M., Ojiako, U., Gardiner, P., Williams, T., Mota, C., Maguire, S., & Marshall, A. (2014). Exploring the impact of cultural values on project performance: The effects of cultural values, age and gender on the perceived importance of project success/failure factors. *International Journal of Operations & Production Management*, 34(3), pp. 364-389, 2014.
- Chua, D. K. H., Kog, Y. C., & Loh, P. K. (1999). Critical success factors for different project objectives. *Journal of construction engineering and management*, 125(3), pp. 142-150.
- Cozijnsen, A. J., Vrakking, W. J., & van IJzerloo, M. (2000). Success and failure of 50 innovation projects in Dutch companies. *European Journal of Innovation Management*, 3(3), pp. 150-159.
- Carù, A., Cova, B., & Pace, S. (2004). Project Success: Lessons from the Andria Case. *European Management Journal*, 22(5), pp. 532-545.
- Chan, A. P., Scott, D., & Chan, A. P. (2004). Factors affecting the success of a construction project. *Journal of construction engineering and management*, 130(1), pp. 153-155.
- Chang, A., Chih, Y. Y., Chew, E., & Pisarski, A. (2013). Reconceptualising mega project success in Australian Defence: Recognising the importance of value co-creation. *International Journal of Project Management*, 31(8), pp. 1139-1153.
- Chileshe, N., & Haupt, T. C. (2005). Modelling critical success factors of construction project management (CPM)," *Journal of Engineering, Design and Technology*, 3(2), pp 140-154.

- Duy Nguyen, L., Ogunlana, S. O., & Thi Xuan Lan, D. (2004). A study on project success factors in large construction projects in Vietnam. *Engineering, Construction and Architectural Management*, 11(6), pp. 404-413.
- Doulabi, R. Z., & Asnaashari, E. (2016). Identifying success factors of healthcare facility construction projects in Iran. *Procedia engineering*, 164, pp. 409-415.
- Davis, K. (2014). Different stakeholder groups and their perceptions of project success. *International journal of project management*, 32(2), pp. 189-201.
- Davis, K. (2016). A method to measure success dimensions relating to individual stakeholder groups. *International Journal of Project Management*, 34(3), pp 480-493.
- Davis, K. (2017). An empirical investigation into different stakeholder groups perception of project success. *International Journal of Project Management*, 35(4), pp. 604-617.
- Daniel, S., Midha, V., Bhattacharjee, A. and Singh, S.P. (2018). Sourcing knowledge in open source software projects: The impacts of internal and external social capital on project success. *The Journal of Strategic Information Systems*, 27(3), pp.237-256.
- de Carvalho, M. M., Patah, L. A., & de Souza Bido, D. (2015). Project management and its effects on project success: Cross-country and cross-industry comparisons. *International Journal of Project Management*, 33(7), pp 1509-1522.
- de Wit, A. (1986). Measuring project success: an illusion. Proc, Project Management Institute, Montreal, Canada, 13-21.
- Engelbrecht, J., Johnston, K. A., & Hooper, V. (2017). The influence of business managers' IT competence on IT project success. *International Journal of Project Management*, 35(6), pp. 994-1005.
- Espinosa, J. A., DeLone, W., & Lee, G. (2006). Global boundaries, task processes and IS project success: a field study. *Information Technology & People*, 19(4), pp 345-370.
- Fortune, J., & White, D. (2006). Framing of project critical success factors by a systems model. *International journal of project management*, 24(1), pp. 53-65.
- Frödell, M., Josephson, P. E., & Lindahl, G. (2008). Swedish construction clients' views on project success and measuring performance," *Journal of Engineering, Design and Technology*, 6(1), pp. 21-32.
- Freeman, M., & Beale, P. (1992). Measuring project success. *Project Management Journal* 1, pp. 8-17, 1992.
- Gupta, A., Chandra Gupta, M., & Agrawal, R. (2013). Identification and ranking of critical success factors for BOT projects in India. *Management Research Review*, 36(11), pp. 1040-1060.
- Gomes, J., & Romão, M. (2016). Improving project success: A case study using benefits and project management. *Procedia Computer Science*, 100, pp 489-497.
- Handzic, M., Durmic, N., Kraljic, A., & Kraljic, T. (2016). An empirical investigation of the relationship between intellectual capital and project success. *Journal of Intellectual Capital*, 17(3), pp 471-483.
- Hussein, B. A., Ahmad, S. B., & Zidane, Y. J. (2015). Problems associated with defining project success. *Procedia Computer Science*, 64, pp. 940-947.
- HWEE LIM, E. N. G., & YEAN YNG LING, F. L. O. R. E. N. C. E. (2002). Model for predicting clients' contribution to project success. *Engineering, Construction and Architectural Management*, 9(5/6), pp 388-395.
- Heravi, G., & Ilbeigi, M. (2012). Development of a comprehensive model for construction project success evaluation by contractors. *Engineering, Construction and Architectural Management*, 19(5), pp. 526-542.
- Ika, L. A., Diallo, A., & Thuillier, D. (2011). The empirical relationship between success factors and dimensions: The perspectives of World Bank project supervisors and managers," *International Journal of Managing Projects in Business*, 4(4), pp. 711-719.

- Joslin, R., & Müller, R. (2016). The impact of project methodologies on project success in different project environments. *International Journal of Managing Projects in Business*, 9(2), pp. 364-388.
- Jugdev, K., Perkins, D., Fortune, J., White, D., & Walker, D. (2013). An exploratory study of project success with tools, software and methods. *International Journal of Managing Projects in Business*, 6(3), pp. 534-551.
- Jugdev, K., & Müller, R. (2005). A retrospective look at our evolving understanding of project success. *Project management journal*, 36(4), pp. 19-31.
- Koutsikouri, D., Austin, S., & Dainty, A. (2008). Critical success factors in collaborative multi-disciplinary design projects. *Journal of Engineering, Design and Technology*, 6(3), pp. 198-226.
- Koops, L., Bosch-Rekvelde, M., Coman, L., & Hertogh, M. (2016). Identifying perspectives of public project managers on project success: Comparing viewpoints of managers from five countries in North-West Europe. *International Journal of Project Management*, 34(5), pp. 874-889.
- Koops, L., Coman, L., Bosch-Rekvelde, M., Hertogh, M., & Bakker, H. (2017). Public perspectives on project success—influenced by national culture? *Procedia-Social and Behavioral Sciences*, 194, pp. 115-124.
- Koops, L., van Loenhout, C., Bosch-Rekvelde, M., Hertogh, M., & Bakker, H. (2017). Different perspectives of public project managers on project success. *Engineering, Construction and Architectural Management*, 24(6), pp. 1294-1318.
- Lam, E. W., Chan, A. P., & Chan, D. W. (2010). Benchmarking success of building maintenance projects. *Facilities*, 28(5/6), pp. 290-305.
- Lim, C. S., & Mohamed, M. Z. (1999). Criteria of project success: an exploratory re-examination. *International journal of project management*, 17(4), pp. 243-248.
- Lam, E. W., Chan, A. P., & Chan, D. W. (2007). Benchmarking the performance of design-build projects: Development of project success index. *Benchmarking: An International Journal*, 14(5), pp. 624-638.
- Maqbool, R. and Sudong, Y. (2019). Critical success factors for renewable energy projects; empirical evidence from Pakistan. *Journal of cleaner production*, 195, pp.991-1002.
- Mavi, R. K., & Standing, C. (2018). Critical success factors of sustainable project management in construction: A fuzzy DEMATEL-ANP approach. *Journal of Cleaner Production*, 194, pp. 751-765.
- Martens, C. D. P., Machado, F. J., Martens, M. L., & de Freitas, H. M. R. (2018). Linking entrepreneurial orientation to project success. *International Journal of Project Management*, 36(2), pp. 255-266.
- Malach-Pines, A., Dvir, D., & Sadeh, A. (2009). Project manager-project (PM-P) fit and project success,” *International Journal of Operations & Production Management*, 29(3), pp. 268-291.
- Mirza, M. N., Pourzolfaghar, Z., & Shahnazari, M. (2013). Significance of scope in project success. *Procedia Technology*, 9, pp. 722-729.
- Mišić, S., & Radujković, M. (2015). Critical drivers of megaprojects success and failure. *Procedia Engineering*, 122, pp. 71-80.
- Montequin, V. R., Cousillas, S. M., Alvarez, V., & Villanueva, J. (2016). Success Factors and Failure Causes in Projects: analysis of cluster patterns using self-organizing maps. *Procedia Computer Science*, 100, pp 440-448.
- Müller, R., & Rodney Turner, J. (2010). Attitudes and leadership competences for project success. *Baltic Journal of Management*, 5(3), pp. 307-329.
- Müller, R., & Turner, R. (2007a). The influence of project managers on project success criteria and project success by type of project. *European management journal*, 25(4), pp. 298-309.
- Müller, R. and Turner, J.R. (2007b). Matching the project manager’s leadership style to project type. *International journal of project management*, 25(1), pp.21-32.
- Müller, R., & Jugdev, K. (2012). Critical success factors in projects: Pinto, Slevin, and Prescott—the elucidation of project success. *International Journal of Managing Projects in Business*, 5(4), pp. 757-775.

- Nanthagopan, Y., Williams, N. and Thompson, K. (2019). Levels and interconnections of project success in development projects by Non-Governmental Organisations (NGOs). *International Journal of Managing Projects in Business*, Vol. 12 No. 2, pp. 487-511.
- Nguyen, H. T., & Hadikusumo, B. H. (2018). Human resource related factors and engineering, procurement, and construction (EPC) project success. *Journal of Financial Management of Property and Construction*, 23(1), pp. 24-39.
- Osei-Kyei, R. and Chan, A.P. (2018). Evaluating the project success index of public-private partnership projects in Hong Kong: The case of the Cross Harbour Tunnel. *Construction Innovation*, 18(3), pp.371-391.
- Ophiyandri, T., Amaratunga, D., Pathirage, C., & Keraminiyage, K. (2013). Critical success factors for community-based post-disaster housing reconstruction projects in the pre-construction stage in Indonesia. *International Journal of Disaster Resilience in the Built Environment*, 4(2), pp. 236-249.
- Pankratz, O., & Basten, D. (2018). Opening the black box: Managers' perceptions of IS project success mechanisms," *Information & Management*, 55(3), pp. 381-395.
- Pinto, J.K. and Slevin, D.P. (1987). Critical factors in successful project implementation. *IEEE transactions on engineering management*, (1), pp.22-27.
- Pinto, J. K., & Prescott, J. E. (1988). Variations in critical success factors over the stages in the project life cycle. *Journal of management*, 14(1), pp. 5-18.
- Peetawan, W. and Suthiwartnarueput, K. (2018). Identifying factors affecting the success of rail infrastructure development projects contributing to a logistics platform: A Thailand case study. *Kasetsart Journal of Social Sciences*, 39(2), pp.320-327.
- Project Management Institute. (2017). *A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Sixth Edition*. Newtown Square, PA: Author.
- Phua, F. T., & Rowlinson, S. (2004). How important is cooperation to construction project success? A grounded empirical quantification. *Engineering, Construction and Architectural Management*, 11(1), pp. 45-54.
- Purna Sudhakar, G. (2012). A model of critical success factors for software projects. *Journal of Enterprise Information Management*, 25(6), pp. 537-558.
- Rolstadås, A., Tommelein, I., Morten Schiefloe, P., & Ballard, G. (2014). Understanding project success through analysis of project management approach. *International journal of managing projects in business*, 7(4), pp. 638-660.
- Rezvani, A., Chang, A., Wiewiora, A., Ashkanasy, N. M., Jordan, P. J., & Zolin, R. (2016). Manager emotional intelligence and project success: The mediating role of job satisfaction and trust. *International Journal of Project Management*, 34(7), pp. 1112-1122.
- Rohman, M. A., Doloi, H., & Heywood, C. A. (2017). Success criteria of toll road projects from a community societal perspective. *Built Environment Project and Asset Management*, 7(1), pp. 32-44.
- Rodriguez-Segura, E., Ortiz-Marcos, I., Romero, J. J., & Tafur-Segura, J. (2016). Critical success factors in large projects in the aerospace and defense sectors. *Journal of Business Research*, 69(11), pp. 5419-5425.
- Rodriguez-Repiso, L., Setchi, R., & Salmeron, J. L. (2007). Modelling IT projects success: Emerging methodologies reviewed. *Technovation*, 27(10), pp. 582-594.
- Sanchez, O. P., & Terlizzi, M. A. (2017). Cost and time project management success factors for information systems development projects. *International Journal of Project Management*, 35(8), pp. 1608-1626.
- Sanvido, V., Grobler, F., Parfitt, K., Guvenis, M., & Coyle, M. (1992). Critical success factors for construction projects. *Journal of construction engineering and management*, 118(1), 94-111.
- Scott-Young, C., & Samson, D. (2008). Project success and project team management: Evidence from capital projects in the process industries. *Journal of Operations Management*, 26(6), pp. 749-766.
- Sebestyen, Z. (2017). Further Considerations in Project Success. *Procedia Engineering*, 196, pp. 571-577.

- Serrador, P., & Turner, R. (2014). The relationship between project success and project efficiency. *Project Management Journal*, 46(1), pp. 30-39.
- Shenhar, A.J. (2001). One size does not fit all projects: Exploring classical contingency domains. *Management science*, 47(3), pp.394-414.
- Shenhar, A. J., Levy, O., & Dvir, D. (1997). Mapping the dimensions of project success. *Project management journal*, 28(2), pp. 5-13.
- Shenhar, A. J., Dvir, D., Levy, O., & Maltz, A. C. (2001). Project success: a multidimensional strategic concept. *Long range planning*, 34(6), pp. 699-725.
- Standing, C., Guilfoyle, A., Lin, C., & Love, P. E. (2006). The attribution of success and failure in IT projects. *Industrial Management & Data Systems*, 106(8), pp. 1148-1165.
- Taherdoost, H., & Keshavarzsaleh, A.(2016). Critical Factors that Lead to Projects' Success/Failure in Global Marketplace. *Procedia Technology*, 22, pp. 1066-1075.
- Turner, J. R. (2004). Five necessary conditions for project success. *International journal of project management*, 5(22), pp. 349-350.
- Tsiga, Z., Emes, M., & Smith, A. (2017). Critical success factors for projects in the petroleum industry. *Procedia Computer Science*, 121, pp. 224-231.
- Ullah, F., Thaheem, M. J., Siddiqui, S. Q., & Khurshid, M. B. (2017). Influence of Six Sigma on project success in construction industry of Pakistan. *The TQM Journal*, 29(2), pp. 276-309.
- ul Musawir, A., Serra, C. E. M., Zwikael, O., & Ali, I. (2017). Project governance, benefit management, and project success: Towards a framework for supporting organizational strategy implementation. *International Journal of Project Management*, 35(8), pp 1658-1672.
- Wu, G., Liu, C., Zhao, X., & Zuo, J. (2017). Investigating the relationship between communication-conflict interaction and project success among construction project teams. *International Journal of Project Management*, 35(8), pp. 1466-1482.
- Wu, G., Zhao, X., Zuo, J., & Zillante, G. (2018). Effects of contractual flexibility on conflict and project success in megaprojects. *International Journal of Conflict Management*, 29(2), pp. 253-278.
- Yamin, M., & Sim, A. K. (2016). Critical success factors for international development projects in Maldives: Project teams' perspective. *International Journal of Managing Projects in Business*, 9(3), pp. 481-504.
- Zheng, Q., Guo, W., An, W., Wang, L., & Liang, R. (2014). Factors facilitating user projects success in co-innovation communities. *Kybernetes*, 47(4), pp. 656-671.
- Zuo, J., Zhao, X., Nguyen, Q.B.M., Ma, T. and Gao, S. (2018). Soft skills of construction project management professionals and project success factors: A structural equation model. *Engineering, Construction and Architectural Management*, 25(3), pp.425-442.

Appendix A. Details of identified project success factors from literature

Success factors and references	Appearance	rank
Communication (Pinto and Slevin, 1987; Chua et al., 1999, Chan et al., 2004, Phua and Rowlinson, 2004; Fortune and White, 2006; Espinosa et al., 2006, Andersen et al., 2006; Young and Samon, 2008; Sudhakar, 2012; Ophiyandri et al., 2013; Chang et al., 2013; Rolstades et al., 2014; Davis, 2014; Montequin et al., 2016; Wu et al., 2017; Zuo et al., 2018; Maqbool and Sudong, 2018)	17	1
Top management support (Pinto and Slevin, 1987; Pinto and Prescott, 1987; Andersen et al., 2006; Fortune and White 2006; Sudhakar, 2012; Rolstades et al., 2014; Davis, 2014; Berssaneti and Carvalho, 2015; Gomesa and Romaoa, 2016; Tsiga et al., 2017; Mavi and Standing, 2018; Maqbool and Sudong, 2018)	12	2

Project manager's competency (Chua et al. 1999; Nguyen et al., 2004; Chan et al., 2004; Tuner, 2004; Fortune and White, 2006; Rolstades et al., 2014; Davis, 2014; Taherdoost and Keshvarzsaleh, 2016; Mistic and Radujkovic 2017; Tsiga et al., 2017; Mavi and Standing, 2018)	11	3
Clear objectives and realistic obligations (Chua et al., 1999; LIM and LING 2002; Fortune and White, 2006; Scott-Young and Samon, 2008; Sudhakar, 2012; Mirzaa et al., 2013; Rolstades et al., 2014; Davis, 2014; Aga, 2016; Montequin et al., 2016; Maqbool and Sudong, 2018)		
Monitoring & feedback (Pinto and Slevin, 1987; Chua et al., 1997, Chan et al., 2004; Phua and Rowlinson, 2004; Chileshe and Haupt, 2005; Fortune and White, 2006; Ika et al., 2011; Rolstades et al., 2014; Yamin and Sim, 2016; Tsiga et al., 2017)	10	4
Risk management (Chua et al., 1999; Cooki-Davis, 2002; Tuner, 2004; Fortune and White, 2006; Gomesa and Romaoa, 2016; Wu et al., 2018; Almarri and Boussabanie, 2017; Tsiga et al., 2017; Ahmadabdi and Heravi, 2019; Mertens et al., 2018)		
Team competency (Andersen et al., 2006; Nguyen et al., 2004; Fortune and White, 2006; Espinosa et al., 2006; Young and Samon, 2008; Rolstades et al., 2014; Tsiga et al., 2017; Nguyen and Hasikusumo, 2018; Maqbool and Sudong ,2018)	9	5
Adequacy of funding (Chua et al., 1999; Nguyen et al., 2004; Phua and Rowlinson, 2004; Fortune and White, 2006; Ophiyandri et al., 2013; Gupta et al., 2013; Gomes and Romaoa, 2016; Maqbool and Sudong, 2018)	8	6
Coordination (Espinosa et al., 2006; Ika et al., 2011; Sudhakar, 2012; Ophiyandri et al., 2013; Davis, 2014; Yamin and Sim, 2016; Maqbool and Sudong 2018)	7	7
Planning efforts (Pinto and Slevin, 1987; Pinto and Prescott, 1987; Chan et al., 2004; Sudhakar ,2012; Doulabi and Asnaashari, 2016; Tsiga et al., 2017; Peetawan and Suthiwartnarueput, 2018)		
Organization structure (Andersen et al., 2006; Chua et al., 1997; Chileshe and Haupt, 2005; Fortune and White, 2006; Young and Samon, 2008, Mistic and Radujkovic, 2017; Tsiga et al., 2017)	6	8
Political environment (Andersen et al., 2006; Chan et al., 2004; Phua and Rowlinson, 2004; Fortune and White, 2006; Doulabi and Asnaashari ,2016; Tsiga et al., 2017; Maqbool and Sudong, 2018)		
Stakeholder involvement (Andersen et al., 2006; Frodell et al., 2008; Sudhakar, 2012; Ophiyandri et al., 2013; Rolstades et al., 2014; Zheng et al., 2018)	5	9
Project size (Andersen et al. 2006; Chan et al., 2004, Fortune and White 2006; Alzahrani and Emsley, 2013; Tsiga et al., 2017)		
Quality control (Sudhakar, 2012; Alzahrani and Emsley, 2013; Doulabi and Asnaashari, 2016; Tsiga et al., 2017; Maqbool and Sudong, 2018)	4	10
Teamwork (Frodell et al., 2008; Sudhakar, 2012; Doulabi and Asnaashari, 2016; Zuo et al., 2018; Maqbool and Sudong 2018)		
Design efforts (Chua et al. 1997 and 1999; Phua and Rowlinson, 2004; Ika et al., 2011; Yamin and Sim, 2016)	3	11
Strong business case (Shenhar et al., 1997; Chileshe and Haupt, 2005; Fortune and White, 2006; Rolstades et al., 2014)		
Economic risks (Chua et al., 1999; Phua and Rowlinson, 2004; Doulabi and Asnaashari, 2016; Almarri and Boussabanie, 2017)	4	10
Contractual aspects (Chua et al., 1999; Phua and Rowlinson, 2004; Tsiga et al., 2017; Wu et al., 2018)		
Commitment to project (Nguyen et al., 2004; Andersen et al., 2006; Frodell et al., 2008; Taherdoost and Keshvarzsaleh, 2016)	3	11
Project complexity (Chan et al., 2004; Fortune and White, 2006; Carvalho et al., 2015; Tsiga et al., 2017)		
Effective safety program (Chan et al., 2004; Phua and Rowlinson, 2004; Tsiga et al., 2017; Peetawan and Suthiwartnarueput, 2018)	3	11
Leadership (Fortune and White, 2006; Young and Samon, 2008; Zuo et al., 2018; Maqbool and Sudong, 2018)		
Procurement method (Chan et al., 2004; Gupta et al., 2013; Ahmadabdi and Heravi, 2019)	3	11
Troubleshooting (ability to handle unexpected crises and deviations from plan) (Pinto and Slevin, 1987; Pinto and Prescott, 1987; Maqbool and Sudong, 2018)		
Client acceptance (Pinto and Slevin, 1987; Pinto and Prescott, 1987; Sudhakar, 2012)	3	11
Technical tasks (availability of required technology and expertise) (Pinto and Slevin, 1987; Pinto and Prescott, 1987; Chileshe and Haupt, 2005)		

Government support (Ophiyandri et al., 2013; Gupta et al., 2013; Ahmadabdi and Heravi, 2019)				
Meeting budget goals (Shenhar et al., 1997; Frodell et al., 2008; Davis, 2014)				
Meeting scope (Serrador and Turner, 2014; Gomes and Romaoa, 2016; Doulabi and Asnaashari, 2016)				
Meeting time goals (Shenhar et al., 1997; Serrador and Turner, 2014; Davis, 2014)				
Customer satisfaction (Shenhar et al., 1997; Davis, 2014; Berssaneti and Carvalho, 2015)				
Trust (LIM and LING, 2002; Ophiyandri et al., 2013; Rezvani et al., 2016)				
Project manager's commitment (Chua et al., 1999; Young and Samon 2008; Montequin et al., 2016)				
Availability of resources (Nguyen et al., 2004; Alzahrani and Emsley, 2013; Gomes and Romaoa, 2016)				
Keeping project plans up to date (Cooki-Davis, 2002; Fortune and White, 2006; Rolstades et al., 2014)				
Cooperation (Phua and Rowlinson, 2004; Tuner, 2004; Davis, 2014)				
Client's experience (Chan et al., 2004; Phua and Rowlinson, 2004; Tsiga et al., 2017)				
Institutional environment (standards and permits) (Ika et al., 2011; Yamin and Sim, 2016; Tsiga et al., 2017)				
Training (Fortune and White, 2006; Yamin and Sim, 2016; Nguyen and Hasikusumo, 2018)				
Development of project management (Mistic and Radujovic, 2015; Berssaneti and Carvalho, 2015; Rodriguez-Segura et al., 2016)				
Project environment (Rodriguez-Segura et al., 2016; Taherdoost and Keshvarzsaleh, 2016; Doulabi and Asnaashari, 2016)				
Market impact and business opportunity (Shenhar et al., 1997; Gomes and Romaoa, 2016)			2	12
Reliability of output and accuracy of output (Sudhakar, 2012; Peetawan and Suthiwartnarueput, 2018)				
Project mission (Pinto and Slevin, 1987; Pinto and Prescott, 1987)				
Client consultation (Pinto and Slevin, 1987; Pinto and Prescott, 1987)				
Cognitive ability (Espinosa et al., 2006; Zuo et al., 2018)				
Cost management (Doulabi and Asnaashari, 2016; Tsiga et al., 2017)				
Actually used by customer (Shenhar et al., 1997; Davis, 2014)				
Project team background (Andersen et al., 2006; Taherdoost and Keshvarzsaleh, 2016)				
Technological or industrial environment (Andersen et al., 2006; Chan et al., 2004)				
Social environment (Chan et al., 2004 ; Tsiga et al., 2017)				
Control meetings (Chua et al., 1997 and 1999)				
Constructability (Chua et al. 1997 and 1999)				
Project manager's experience (Chua et al., 1997 ; Chan et al., 2004)				
Reduce ambiguity (Sudhakar, 2012; Maqbool and Sudong, 2018)				
Project type (Chan et al., 2004 ; Tsiga et al., 2017)				
Project nature (Chan et al., 2004 ; Tsiga et al., 2017)				
Short construction period (Cooki-Davis, 2002; Gupta et al., 2013)				
Learning from experience (Cooki-Davis, 2002; Fortune and White, 2006)				
Maximize stability (Sudhakar, 2012; Maqbool and Sudong, 2018)				
High public enthusiasm for project (Phua and Rowlinson, 2004; Koutsikouri et al., 2008)	1	13		
Stakeholder management (Mistic and Radujovic, 2015; Gomes and Romaoa, 2016)				
Innovativeness (Koutsikouri et al., 2008; Mertens et al., 2018)				
Project urgency (Pinto and Slevin, 1987)				
Project uniqueness (Andersen et al., 2006)				
Project manager's emotional intelligence (Rezvani et al., 2016)				
To have a governing structure (Chang et al., 2013)				
Job satisfaction (Rezvani et al., 2016)				
Personnel(recruitment, selection, training) (Pinto and Slevin, 1987)				
Meeting operational specifications (Shenhar et al., 1997)				
Meeting technical specifications (Shenhar et al., 1997)				
Fulfilling customer needs (Shenhar et al., 1997)				
Solving a major operational problem (Shenhar et al., 1997)				
Effective change management (Rolstades et al., 2014)				
Project attributes (Taherdoost and Keshvarzsaleh, 2016)				
Physical environment (Tsiga et al., 2017)				

Team turnover (Chua et al., 1997)		
Expended money for controlling (Chua et al., 1997)		
Company image (Alzahrani and Emsley, 2013)		
Respecting cultural differences (Mistic and Radujovic, 2015)		
Opened a new line of product (Shenhar et al., 1997)		
Developed a new technology (Shenhar et al., 1997)		
Transparency and accountability (Ophiyandri et al., 2013)		
Client and user (Rodriguez-Segura et al., 2016)		
Site inspection (Chua et al., 1999)		
Stakeholder expectations (Mavi and Standing, 2018)		
Capability of contractor's key person (Chua et al., 1999)		
End user's imposed restrictions (Mavi and Standing, 2018)		
Client is credit worthy (LIM and LING, 2002)		
Client does not contribute to project complexity (LIM and LING, 2002)		
Client is not litigious (LIM and LING, 2002)		
Facilitator capacity (Ophiyandri et al., 2013)		
Appropriate reconstruction policy (Ophiyandri et al., 2013)		
Waste disposal (Alzahrani and Emsley, 2013)		
Private sector capability (Ahmadabdi and Heravi, 2019)		
Project popularity (Zheng et al., 2018)		
Pro-activeness (Mertens et al., 2018)		
National environment (Carvalho et al., 2015)		
Ethics (Doulabi and Asnaashari, 2016)		
A mature scope change control process (Cooki-Davis, 2002)		
Good partnering (Ahmadabdi and Heravi, 2019)		
Suitable project metrics (Cooki-Davis, 2002)		
Reducing cost (Maqbool and Sudong, 2018)		
Availability of relevant and realistic information to make decision about business case (Wu et al., 2017)		
Personal friendship between project firms (Phua and Rowlinson, 2004)		
Good weather condition (Phua and Rowlinson, 2004)		
Minimal government red tape (Phua and Rowlinson, 2004)		
Agreed success criteria among stake holders (Tuner, 2004)		
Owner interest in project performance (Tuner, 2004)		
Contingent reward of transactional leadership (Aga, 2016)		
Nature of client(public or private)(Chan et al., 2004)		
Size of client organization (Chan et al., 2004)		
Increasing efficiency (Maqbool and Sudong, 2018)		
Client emphasis on time, cost and quality (Chan et al., 2004)		
Client's ability to brief (Chan et al., 2004)		
Decision making ability(client)(Chan et al., 2004)		
Successful beneficiary identification (Ophiyandri et al., 2013)		
Project management methodologies and tools (Mistic and Radujkovic, 2017)		
Cross functional project team (Scott-Young and Samon, 2008)		
Achievement motivation skill (Zuo et al., 2018)		
Virtual office usage (Scott-Young and Samon, 2008)		
Conflict management skill (Zuo et al., 2018)		
Shared values (Koutsikouri et al., 2008)		
Research & development (Peetawan and Suthiwartnarueput, 2018)		
Delivering strategic benefits (Davis, 2014)		
Social support (Almarri and Boussabanie, 2017)		
Turnover history (Alzahrani and Emsley, 2013)		
Stakeholder endorsement of project plans (Andersen et al., 2006)		
Well-structured and formal project approach (Andersen et al., 2006)		
Understood and accepted project purpose (Andersen et al., 2006)		

Appendix B. Details of identified project success criteria from literature

Project success criteria in the literature		
Presented success criteria	Frequency	Rank
Meeting Cost (Al-Tmeemy et al., 2011; Agarwal and Rathod, 2006; Cooper and Kleinschmidt, 1987; Davis, 2016, 2017; Freeman and Bale, 1992; Lim and Mohamed, 1999; Shenhar et al., 2001; Müller and Turner, 2007; Lam et al. 2007 and 2010; ka et al., 2011; Koops et al, 2016,2017; Gomes and Romãoa, 2016; Osei-Kyei and Chan, 2018; Pankratz and Basten, 2018; Shenhar et al., 1997)	18	1
Meeting Time (Al-Tmeemy et al., 2011; Agarwal and Rathod, 2006; Chipulu et al., 2014; Davis, 2016 and 2017; Freeman and Bale, 1992; Gomes and Romãoa, 2016; Ika et al., 2011; Koops et al., 2016 and 2017; Lim and Mohamed, 1999; Lam et al. 2007 and 2010; Müller and Turner, 2007; Pankratz and Basten, 2018; Shenhar et al., 1997; Shenhar et al., 2001)	15	2
Customer satisfaction (Al-Tmeemy et al., 2011; Agarwal and Rathod, 2006; Davis 2016 and 2017; Freeman and Bale, 1992; Gomes and Romãoa, 2016; Koops et al., 2016,2017; Lim and Mohamed, 1999; Müller and Turner, 2007; Shenhar et al., 2001; Shenhar et al., 1997; Pankratz and Basten, 2018;)	13	3
Meeting Quality (Al-Tmeemy et al., 2011; Chipulu et al., 2014; Davis, 2016 and 2017; Koops et al., 2016 and 2017; Lim and Mohamed, 1999; Lam et al., 2007 and 2010; Müller and Turner, 2007; Osei-Kyei and Chan, 2018;)	11	4
Business success (Al-Tmeemy et al., 2011; Freeman and Bale, 1992; Shenhar et al., 1997; Shenhar et al., 2001; Müller and Turner, 2007; Osei-Kyei and Chan, 2018)	6	5
Technical performance (Freeman and Bale, 1992; Davis, 2016 and 2017; Gomes and Romãoa, 2016; Lim and Mohamed, 1999; Osei-Kyei and Chan, 2018)		
Safety (Chipulu et al., 2014; Koops et al., 2016,2017 ; Lim and Mohamed, 1999; Lam et al., 2010)	5	6
Meeting Scope (Agarwal and Rathod, 2006; Chipulu et al., 2014; Gomes and Romãoa, 2016; Ika et al., 2011; Müller and Turner, 2007)		
Preparing for the future (Cooper and Kleinschmidt, 1987; Shenhar et al., 1997; Shenhar et al., 2001)	3	7
Project specific political or social factors (Koops et al., 2016 and 2017)	2	8
Effect on the professional image of client organization (Koops et al., 2016 and 2017)		
Benefit to stakeholder group (Davis, 2016 and 2017)	1	9
Meeting expectations (Davis, 2016, 2017)		
Personal growth (Freeman and Bale, 1992)		
Manufacturability (Freeman and Bale, 1992)		
Sustainability (Ika et al., 2011)		
The project team (Chipulu et al., 2014)		
Functionality (Lam et al., 2007)		
Environmental friendliness (Lam et al., 2010)		
Contractor satisfaction (Pankratz and Basten, 2018)		
Relevance/country (Ika et al., 2011)		
Relevance/beneficiaries (Ika et al., 2011)		
Impact (Ika et al., 2011)		
Sustainability (Ika et al., 2011)		
Organizational goals (Chipulu et al., 2014)		
Leadership and decision making (Chipulu et al., 2014)		
Improve the quality of life and community engagement (Rohman et al., 2017)		
Provide peace of mind (Psychological needs, Present smooth traffic and regulation compliance environment) (Rohman et al., 2017)		
Meeting functional requirements and Meeting non-functional requirements (Pankratz and Basten, 2018)		
System is used by the end users (Pankratz and Basten, 2018),		