A network-based model for the assessment of success in PPP healthcare projects

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Abstract

With the objectives including the reduction of whole life costs, increasing construction and operation efficiencies and enhancing service quality, Public-Private Partnership (PPP) schemes have been increasingly used in healthcare projects throughout the world. Besides its advantages, several issues were reported in the literature regarding the success of healthcare PPPs. Poor project performance is a key concern, while performance is determined by the occurrence of multiple interrelated factors. In this study, it was aimed to develop a network-based success model for PPP healthcare projects, which encompasses the whole project life cycle and various project dimensions, by considering the interdependence among the Critical Success Factors (CSFs). A framework comprised of 33 CSFs organized in six groups was proposed based on the findings of an extensive literature review and semi-structured expert interviews. Project success was modeled with the Analytic Network Process (ANP) through three group discussion sessions held with experts from the private sector. The model was tested via the assessment of two real projects' performance by the experts. The proposed model, which is a unique attempt in this area, can be used by decision-makers during the pre-tender, planning and execution phases of a PPP healthcare project to develop strategies for performance improvement.

Keywords: Public-private partnership; healthcare projects; critical success factors; analytic network process; project performance assessment

Introduction

A number of political, constitutional, social and economic issues in infrastructure development have led various governments to initiate Public-Private Partnerships (PPPs) based upon long-term contracts (Grimsey and Lewis 2002). Having been implemented in countries at various levels of growth, PPPs target the promotion of infrastructure development, reduction of costs, increasing constructional and operational efficiencies, and enhancing service performance through private sector experience, competence and resources (Zhang 2006). For the planning, construction and/or operation of infrastructural facilities, PPPs bring together public and private sector stakeholders through an organized collaboration, in which, risks, expenditures, advantages, resources and obligations are shared or re-allocated (Koppenjan 2005).

PPP model has also been utilized in healthcare projects widely in the last two decades (Cruz and Marques 2013). PPPs for healthcare projects enable to maximize design and operational efficiencies by means of the strong collaboration of technical advisors including healthcare planners, construction contractor and operator to provide innovative solutions through design, construction and operation integration (Javed et al. 2013). Complex project development; difficulties in achieving consensus, fulfilling a wide range of design criteria and incorporating flexibility; shifts in design demand and constraints in design innovation were listed as the challenges of implementation for PPP healthcare facilities management (Hashim et al. 2016). Scope changes, an inability to adapt and respond to risk and uncertainty, ineffectual project management, poor governance and optimism bias were revealed as issues causing the poor performance of hospital mega-projects (Love and Ika 2021).

The United Kingdom (UK) and the United States of America (USA) were the pioneers in undertaking PPP healthcare arrangements (Torchia et al. 2015). The use of PPP model for the

delivery of infrastructure projects is a prominent issue for Turkey, the country where the data used in this research came from, owing to the reform undertaken in the healthcare system since 2004. Accordingly, a great number of large-scale healthcare projects have been planned out across the country, some of which have already been put into operation. On the other hand, adoption of PPP scheme for infrastructure projects has been a controversial issue for Turkey since 1990s. Several deficiencies related to legal framework and government policies have been mentioned in the literature as well as poor management (Tekin and Celik 2010; Karasu 2011) which mainly stem from project size and complexity.

The major problems regarding the management of PPP healthcare projects in Turkey, which may also be relevant for other developing countries, are associated with turbulent country conditions and uncertainties during the project life cycle. Risks stem from high number of stakeholders involved, difficulties in coordination and communication, complexity of the design schemes, immature legal framework, contractual deficiencies and inexperience of government and private sector in PPP healthcare projects. A recent study on five major PPP healthcare projects in Turkey revealed that variation orders are significant and total fixed investment cost may even increase by 80% (Ejder 2022).

Although it is apparent that there are several risk factors that may impede the success of PPP healthcare projects, there is a lack of research on holistic consideration of the determinants and drivers of success. A critical success factor (CSF) is defined as an element/parameter that is necessary for a project to achieve its preset objectives. Definition of CSFs for a project requires identification of factors that may lead to high performance in terms of project objectives such as cost, time and client satisfaction. On the other hand, performance emerges as a result of occurrence of interrelated factors rather than individual impacts of factors. A gap has been identified in project management literature that identifies CSFs for healthcare PPP projects considering the interrelations between them and proposes an assessment method that can be

used by decision-makers through the project's life cycle so that proactive strategies can be developed. Thus, the aim of this study has been defined as construction of a network-based structure with CSFs specific to PPP healthcare projects to model performance and develop a quantitative method for performance assessment. For this purpose, CSFs were identified by an extensive literature review, validated by domain experts and finally, Analytic Network Process (ANP) was utilized to quantify performance by considering the interrelations between the identified CSFs.

Research objectives and methodology

This study targets to contribute to the existing body of PPP project success literature with the attempt to form a network-based structure of CSFs for PPP healthcare projects and developing a quantitative method that can be used for assessment of project performance. The steps of the research and expected output at each step are outlined with a flowchart as shown in Figure 1. The ultimate aim is to develop the quantitative project success model that can be used by decision-makers to assess performance and develop strategies for improving performance considering the interrelated CSFs.

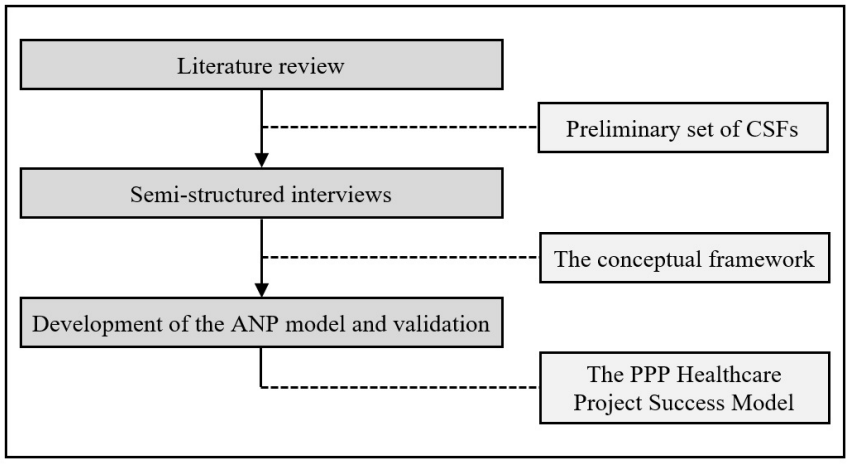


Figure 1. The flowchart outlining the major steps of the research and their outputs

Literature review

Many researchers have examined the CSFs for PPP projects in various sectors and countries starting from the late 1990s, through literature review, case studies, interviews and surveys. For example, Qiao et al. (2001) examined the successful application of BOT projects in China and identified eight CSFs: appropriate project identification; stable political and economic situation; attractive financial package; acceptable toll/tariff levels; reasonable risk allocation; selection of suitable subcontractors; management control; and technology transfer. Likewise, Jefferies et al. (2002) suggested a conceptual CSFs framework for the BOOT projects, through a single case study research conducted in Australia. The factors include an efficient approval process; developed legal/economic framework; political stability and support; resource management ability; a comprehensive feasibility study; financial capability; and an appropriate consortium structure. Zhang (2005) aimed to identify factors that are critical to the success of PPPs in general, based on a win-win principle for public and private sectors. Factors are categorized into five main aspects, which are: economic viability; appropriate risk allocation via reliable contractual arrangements; sound financial package and favorable investment environment; and reliable concessionaire consortium with strong technical strength, as revealed by rank order with the conducted analysis. There exist similar studies regarding different countries. For example, Hwang and Lim (2013) investigated the CSFs as well as the critical risk factors and preferred risk allocations for PPP projects in Singapore. Well-organized public agency; appropriate risk allocation and sharing; strong private consortium; and transparency in procurement process were the highest ranked factors according to the findings of the research. Al-Saadi and Abdou (2016) explored key success factors of PPP infrastructure projects in the United Arab Emirates (UAE). The findings revealed that availability and effectiveness of proper regulatory and legal framework for PPPs; proper risk allocation and sharing among project stakeholders; clear project brief and client outcomes; comprehensive and business viability of project feasibility study; and proper project value management systems during

different project phases are the factors that strongly affect PPP project success. Osei-Kyei and Chan (2017) compared CSFs for PPPs in developing and developed countries using Ghana and Hong Kong as examples. When the results for both countries were interpreted together, it was concluded that the most critical factors are favorable legal and regulatory framework; transparent PPP process; clarity of roles and responsibilities among parties; and political stability. Debela (2022) aimed to identify the CSFs of PPP road projects in Ethiopia. According to the research findings, the highest ranked factors were listed as follows: presence of an enabling PPP policy; well-organized and committed public agency; stable political and social environment; and favorable legal framework. Although the ranking of CSFs change from country to country, they are usually related with country conditions as well as risk sharing mechanisms, consortium related factors and project management success. Thus, there have been considerable interest from researchers to identify general CSFs based on empirical findings.

There are also some studies that focus on a specific phase of PPP projects. Li et al. (2005) examined 18 potential CSFs for PPP/PFI construction projects in the UK with regards to their perceived importance at the project development stage. Accordingly, the most important factors were revealed as follows: a strong private consortium; appropriate risk allocation and risk sharing; and available financial market. Chan et al. (2010) later adopted the CSFs framework proposed by Li et al. (2005) to explore the factors pertaining to the success of PPP infrastructure projects in China. According to the findings, the highest ranked factors include favorable legal framework; appropriate risk allocation and risk sharing; commitment and responsibility of public and private sectors; stable macroeconomic condition; and available financial market. Liu et al. (2015) proposed a phase-based CSFs framework for PPP infrastructure projects employing a project management success perspective. The study grouped the key managerial activities for process management of PPP infrastructure projects in three project phases, i.e. Initiation and Planning, Procurement, and Partnership. Other researchers employed the CSF

concept at specific stages of the PPP arrangement, which includes the exploration of the factors that affect the success of PPP projects at feasibility stage (Ng et al. 2010), briefing stage (Tang et al. 2013) and operational stage (Osei-Kyei et al. 2017).

There are limited number of studies that link CSFs with the level of performance in a PPP project. Yuan et al. (2012) examined the PPP stakeholders' perceptions of performance indicators in PPPs and developed a conceptual model for performance management and measurement. Accordingly, the most important factors for improving performance in PPP projects were revealed as: reasonable procurement, design, and planning by public sector partners; effective process control by private sector partners; and the satisfaction of both the public and private sectors. Kuru and Artan (2020) proposed a canvas model for risk assessment and performance estimation in PPPs. With a different perspective, Wang (2018) took the interrelations among the different dimensions of PPPs into account and developed a multi-level hierarchical model with CSFs for the operation phase of a reservoir and water supply project. According to the results, efficient and well-structured payment mechanism is the most important CSF when interaction among CSFs is considered.

The literature was also reviewed in terms of CSFs research especially focusing on the healthcare PPP type, and it was seen that studies pertaining to the successful delivery of healthcare PPP projects were rather limited. Nevertheless, since almost 70 percent of the signed PFI projects in the UK belong to the health sector (Akintoye 2007), healthcare projects have been taken into consideration significantly in the UK-based PPP success studies such as the study conducted by Li et al. (2005). Besides these, Abdou and Al Zarooni (2011) intended to develop a preliminary list of possible CSFs for the UAE public healthcare projects, which was reported as the first stage of an ongoing research project. As mentioned by Abdou and Al Zarooni (2011), this preliminary work requires additional research and validation. Their CSF list included: a comprehensive project feasibility study; clear project brief and client outcomes; proper

integration of public and customer/end users' needs; and proper project control systems during different project phases.

Impact of management factors and strategies specific to healthcare PPP projects were also covered in the literature. These studies include the investigation of the early involvement of facilities management requirements' impact at the design stage of a PFI project (Edum-Fotwe et al. 2003), healthcare PFI projects in terms of the risk management approaches adopted (Akintoye and Chinyio 2005), the specific aspects of the operational phase of PFI projects to provide improvements in future PFI contracts (Robinson and Scott 2009) and performance-based output specifications for hospital PPP/PFI projects (Javed et al. 2013).

As summarized above, various lists of CSFs have been proposed for PPP projects, based on different project procurement systems and considering different project phases in different countries. All these studies are guiding for the success of PPP projects in general, but the studies that consider healthcare projects and uses CSFs to assess project success are limited. When the relevant literature on the success of PPP projects was examined, it was observed that notable majority of studies carried out in this area accepted that the CSFs are independent from each other. On the other hand, there is interaction between the CSFs and studies based on the assumption that the CSFs are not interrelated have a deficiency in terms of reflecting the reality and prediction of performance (Wang 2018). Clarification of the links between factors vital to project success would enable improved industry understanding of how to more effectively measure and improve PPP project performance (Yuan et al. 2012). The previously mentioned research carried out by Wang (2018) is the only study that considered the links between the success factors for PPP projects, with a focus on the operation phase of a reservoir and water supply project, and included environmental and societal issues in relation with the specific project type investigated. Considering the healthcare project type focus of this paper, a research gap was identified in the literature concerning the assessment of PPP healthcare project success

with a holistic approach covering the inherent interrelationships between the multifaceted clusters and factors, and also encompassing the aspect of project performance assessment and improvement.

Development of the conceptual framework

To use in model development, a PPP healthcare project success framework was formed by synthesizing the factors extracted from the relevant studies depicted in the previous section. List of factors filtered from this preliminary set of 64 CSFs is presented in Table 1.

Table 1. Factors identified through the literature review

CSFs	References															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Stable political system	*	*				*		*	*	*					*	*	
Political support		*			*	*		*	*						*	*	
Stable macro-economic environment	*				*	*		*		*					*	*	*
Favorable economic policy		*			*	*		*		*					*	*	
Favorable legal framework	*	*			*	*		*		*	*				*	*	
Appropriateness of financing option	*							*									
Fixed and low interest rate financing, stable debt currency and equity finance, low financial charges						*											
Financial capability of the investors		*							*								
Sufficient project profitability						*		*		*							
Government guarantees	*				*			*								*	
Clear project brief									*				*		*	*	
Customer/end users' needs integration							*		*				*			*	
A comprehensive project feasibility study		*							*				*	*	*		
Project technical feasibility	*				*			*	*	*							
Sound financial analysis						*				*			*				
A transparent procurement process					*						*			*		*	
A competitive procurement process	*				*					*				*		*	
Comprehensiveness of contract documents	*									*	*			*			
Stakeholder participation in developing specifications				*			*					*					
An experienced multi-disciplinary team	*					*							*			*	
Public sector client's financial strength																*	
Well-organized and committed public agency	*				*					*	*		*		*	*	
PPP experience and knowledge of the public sector	*							*		*							
Strong private consortium		*			*	*		*	*		*		*		*	*	
Project company competence		*															
PPP experience and knowledge of the private sector		*								*							
Subcontractors' performance	*																
Suppliers' performance																	
Long-term availability of suppliers						*											
Clarity of responsibilities among parties								*	*	*	*		*			*	
Effective participant communication									*	*			*			*	*
Effective risk management						*				*			*	*			*
Appropriate risk allocation and sharing	*		*	*	*	*		*	*	*	*		*		*	*	
Efficient dispute resolution									*	*				*			*
Design and operation integration			*									*					
Design optimization and flexibility			*									*					
Consistent performance monitoring								*	*			*					*
Satisfying environmental standards	*	*				*		*	*	*						*	
Effective safety and health management	*					*				*				*			*
Effective cost and time management										*				*		*	
Effective quality management	*							*		*				*			
An efficient approval process		*							*							*	*

Effective supervision mechanism										*						
A proper documentation system								*				*				
Effective facility management	*				*	*		*			*		*	*		
Periodic service delivery evaluation	*				*									*		
Operation in good condition in the transfer phase	*															
Hand-over requirements stipulated in the specifications									*							

* Inclusion of the specific factor in the reference

References: A-Qiao et al. (2001); B-Jefferies et al. (2002); C-Edum-Fotwe et al. (2003); D-Akintoye and Chinyio (2005); E-Li et al. (2005); F-Zhang (2005); G-Robinson and Scott (2009); H-Ng et al. (2010); I-Abdou and Al Zarooni (2011); J-Yuan et al. (2012); K-Hwang et al. (2013); L-Javed et al. (2013); M-Tang et al. (2013); N-Liu, Love, Smith et al. (2015); O-Al-Saadi and Abdou (2016); P-Osei-Kyei and Chan 2017); Q-Osei-Kyei et al. (2017).

In order to assess the perceived importance of these factors and obtain a robust framework to be drawn on for the construction of the model, semi-structured interviews were conducted with the participation of a company which has the biggest share in the execution of PPP healthcare projects in Turkey. It is a pioneer company for the Turkish construction industry, operating in fields such as construction, energy and real estate development. The company has a high level of activity in both domestic and international markets, together with its branches. Besides its extensive PPP project portfolio and experience in this specific project type, the other reasons for the selection of the respective company can be given as follows: its mature project partnership structure by means of cooperating with strong financiers; tripartite organization structure covering the investment, construction and operation of the projects; inclusive implementations regarding the issues such as information technology and sustainability; and the cooperation of the company with competent consultants. In virtue of its mature structure and organizational culture, and its extensive PPP healthcare project portfolio, the company was asked to participate not only in the semi-structured interviews but also in the subsequent stages of the research.

The semi-structured interviews were carried out face-to-face, separately with six experts responsible for the management of the PPP healthcare projects carried out by the company. The selection was made based on the healthcare PPP project experience of the experts, their level of responsibility in the projects and field of duty. It was attempted to include experts specialized in different fields and a team consisting of the engineering office director, project management

office director, technical office director, a design office executive and a project executive responsible for the communication with the public agency and consultants was formed. Two of these experts were also asked to attend the ANP sessions to take the advantage of their familiarity with the study. The average total experience of the experts was 16 years in construction sector and 3.5 years in healthcare PPP projects. Each interview lasted for approximately one and a half hour. Each interview was recorded and transcribed. Each interviewee was given a copy of the interview transcription for review and to ensure overall consistency and correctness. Details of this section were demonstrated in previous research conducted by the authors (The authors' paper will be referenced).

The respondents were asked to evaluate the level of impact that each factor has on the success of a PPP healthcare project, using the 1-5 point Likert scale and their comments were obtained on each factor. The gathered data were analyzed and the mean value and standard deviation were revealed for each factor. It is worth noting that the goal was not to collect statistical data and draw generalizable conclusions about the importance of the CSFs. Instead, the assessments were used to obtain more robust interpretations of the expert opinion on the most crucial factors, as well as to identify the irrelevant ones and the misleading statements, in order to establish a basis for the model to be developed in the subsequent stage of the research. The factors with a mean rating below 4.0 and factors that the experts identified as not applicable were eliminated, some overlapping factors were combined and some misleading or unclear ones were paraphrased. Besides, an additional factor was introduced to the framework by the experts in semi-structured interviews. That factor covers enhancement of the pre-tender feasibility study and carrying out a comprehensive technical and financial review by the contractor early on in the design-construction phase with the input from the private sector stakeholders.

By means of the assessment of the data gathered through the conducted semi-structured interviews, the revised conceptual framework was formed with 33 factors organized in six

groups, which are: 1) External Environment (E), 2) Financial Characteristics (F), 3) Project Stakeholders (PS), 4) Planning, Tender and Contracting Processes (P), 5) Project Management (PM), and 6) Design, Construction and Operation Processes (DCO). The final version of the framework (Table 2) was shown to the experts and their approval was obtained.

Table 2. CSFs for PPP healthcare projects

ID	Cluster / Factor
E	**External Environment**
E1	A stable political environment and strong government support
E2	Favorable global economic conditions and exchange rates, a strong and stable economic environment in the host country
E3	A transparent and mature legal and regulatory framework
E4	Convenient location, favorable weather and site conditions
F	**Financial Characteristics**
F1	Favorable financing interest rates and financing costs, the strength and profitability of the project
F2	Provision of adequate government guarantees
F3	Inclusion of investors and sponsors with sufficient financial strength in the project
PS	**Project Stakeholders**
PS1	Public agency's well-established organizational structure, resource adequacy, sufficient knowledge and experience in healthcare projects and the BLT model
PS2	Public agency consultant's experience, competence, adequate staffing, sufficient knowledge and experience in healthcare projects and the BLT model
PS3	Contractor's experience, technical and management competencies, resource adequacy, sufficient knowledge and experience in healthcare projects and the BLT model
PS4	Contractor's consultants' (*e.g.* traffic, ESIA, fire, risk, green building) experience, competence, adequate staffing, sufficient knowledge and experience in healthcare projects and the BLT model
PS5	Operator's experience, competence, resource adequacy, sufficient knowledge and experience in healthcare projects and the BLT model
PS6	Design firm's experience, competence, resource adequacy, sufficient knowledge and experience in healthcare projects and the BLT model
PS7	Subcontractors' (*e.g.* electrical, mechanical) experience, competence, resource adequacy, sufficient knowledge and experience in healthcare projects and the BLT model
PS8	Suppliers' experience, competence, commercial strength and long-term accessibility
P	**Planning, Tender and Contracting Processes**
P1	Clear definition of project scope and public authority's requirements prior to the tender process, proper integration of end users' needs, inputs of operational staff, healthcare experts and all other interest groups in this process
P2	Preparation of a comprehensive and realistic feasibility study prior to tender
P3	A well-designed, competitive and transparent tender process, clarity and adequacy of tender documents
P4	Comprehensive and clear final contract documentation prepared by the public agency and the contractor
PM	**Project Management**
PM1	Effective budget and schedule planning with the consideration of the entire project life cycle, including the operation and transfer phases
PM2	Ensuring the active involvement of project stakeholders through all project management processes, and adequate and effective communication/coordination between project stakeholders
PM3	Effective control and supervision by the public agency through the life cycle of the project and an efficient governmental approval process
PM4	Efficient monitoring, evaluation, reporting and control of project performance
PM5	Establishment of an efficient system for controlling project changes and resolving disputes
PM6	Effective implementation of risk management processes across all project phases
PM7	Establishment of a proper documentation system for the project and storage of lessons learned through an accessible PPP projects database
DCO	**Design, Construction and Operation Processes**
DCO1	Further development of the pre-tender feasibility study and preparation of a detailed technical and financial analysis early on in the design-construction phase with the contribution of the private sector stakeholders
DCO2	With the contribution of the stakeholders early on in the design-construction phase, further development of the project specifications prepared by the public agency
DCO3	Providing the integration of design with the construction and operation phases, ensuring its flexibility and optimization

DCO4	Effective site management
DCO5	Establishment of an efficient quality, health, safety and environment management system for the construction and operation phases
DCO6	Taking the necessary measures to provide and maintain maximum performance throughout the operation phase
DCO7	Ensuring the proper transfer of the facility to the public authority at the end of the contract phase

Moreover, several points were mentioned on the interdependency between the factors during the semi-structured interviews. Expert 1 denoted that several external environment factors such as a stable political and economic environment, a transparent and mature legal and regulatory framework and strong government support have an impact on the sufficient profitability of the project and inclusion of investors with sufficient financial strength in the project. In a similar vein, Expert 5 pointed out that fixed and low interest rate financing, low financial charges, sufficient profitability of the project and adequate government guarantees; a comprehensive feasibility study; and a transparent, competitive and clearly defined tender process also have an impact on inclusion of investors with sufficient financial strength in the project. As stated by Expert 3, early collaboration of project team and assuring their continuous involvement through all project phases, effective control and supervision of the public agency throughout the project life cycle and an effective governmental approval process have an influence on providing the integration of design with the construction and operation phases. These and many other similar interrelationships were emphasized by the experts in semi-structured interviews along with their examples and were taken into account in the design of the study.

The analytic network process (ANP)

In selection of the method to be used in model development, the interdependencies inherent between a number of the identified success factors were determinative. Accordingly, the ANP was identified as the most appropriate method, capable of interconnecting the criteria and also suitable for the use of qualitative parameters in the analysis. Due to the confidentiality issues, it was impossible to collect significant amount of statistical data on the PPP healthcare projects being executed in Turkey. On the other hand, the ANP enabled to draw on the expertise and

experiences of the practitioners. ANP is a multi-criteria decision making/prediction method that deduces the priority or weight for the included criteria or components (Saaty and Vargas 2013). It uses a network structure to model a problem instead of a hierarchy and is regarded as more satisfactory in terms of capturing the real-world circumstances when compared to the AHP (Saaty and Vargas 2013).

Although not as high as the number of studies that employed the AHP, there is a number of ANP applications in the construction management literature. These include the use of the method in project selection (Cheng and Li 2005), assessment of business failure risks of construction firms (Dikmen et al. 2010), development of a risk management maturity system for large-scale construction projects (Jia et al. 2013) and measuring the complexity of mega construction projects (He et al. 2015). In this study, the ANP is utilised to quantify importance weights of identified CSFs considering interrelations between them and quantify performance based on importance weights of and ratings assigned to CSFs.

ANP model development

To enable the implementation of the ANP, the links among the success factors (*i.e.* nodes) and thus among the factor groups (*i.e.* clusters) were explored. The factors were elaborated with definitive sub-items to provide insight. Project success was used as a broad term encompassing on-time and on-budget delivery, conformity to quality specifications and to health and safety requirements, profitability, green building performance, functionality, participants' satisfaction, meeting design goals, contribution to the company's reputation and conformity to users' expectations.

In the proposed model, six factor groups were positioned on the same hierarchical level and *PPP healthcare project success* was placed on top of the hierarchy. The *Financial Characteristics* cluster is influenced by the *External Environment, Project Stakeholders* and *Planning, Tender and Contracting Processes* clusters. This cluster is also inner-dependent,

covering factors that have dependence upon each other. The *Planning, Tender and Contracting Processes* cluster is influenced by the *Project Stakeholders* cluster. The *Project Management* cluster is influenced by the *Project Stakeholders* and *Planning, Tender and Contracting Processes* clusters. And finally, the *Design, Construction and Operation Processes* cluster is influenced by the *Project Stakeholders*, *Planning, Tender and Contracting Processes* and *Project Management* clusters. A screenshot of the ANP model constructed using the Super Decisions Software is presented in Figure 2.

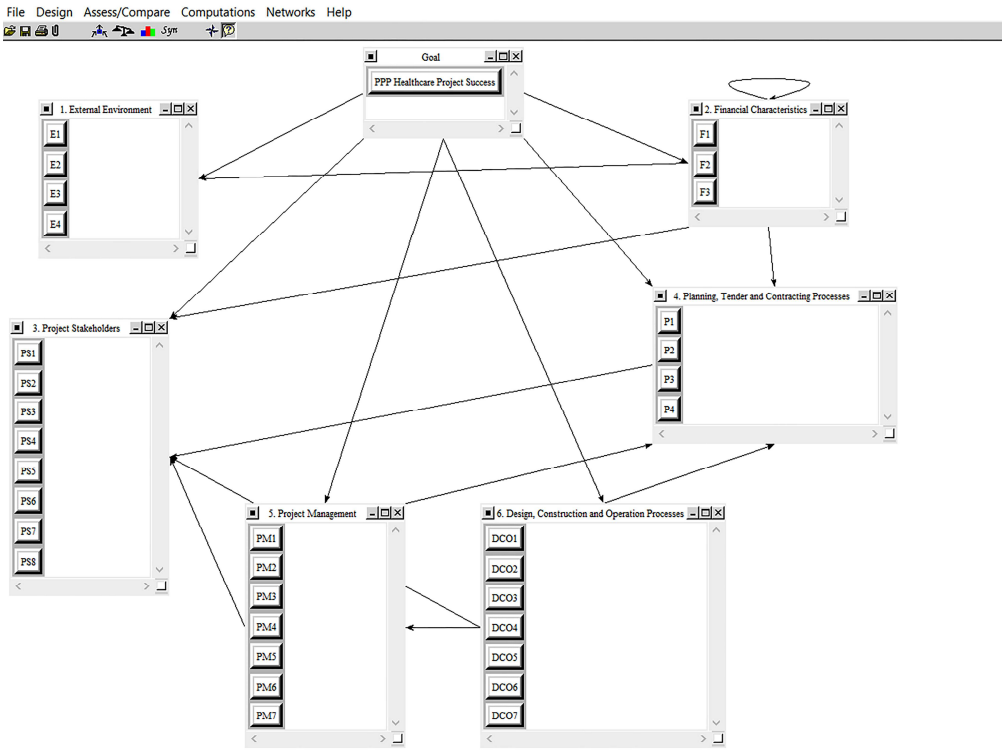


Figure 2. ANP model for PPP healthcare project success

For the implementation of the ANP, three group discussion sessions were held with private sector experts that were selected among the professionals involved in PPP healthcare projects carried out in Turkey. Due to the decision to hold collective sessions to facilitate the implementation of the ANP method, all of the experts were selected from one single company. The company was thoroughly introduced under the section *Development of the conceptual framework*.

To facilitate the decision-making process, the number of experts in the model development

sessions was delimited to five, forming a group with prominent experience and knowledge in the relevant area. For the evaluation process carried out in the implementation of the ANP, a small group of senior management or experts is usually considered adequate to offer useful data (Cheng and Li 2005). In studies employing a similar methodology with the use of the ANP, a team formed with a similar number of experts was deemed suitable (Ozorhon et al. 2007; Dikmen et al. 2010; Tohumcu and Karasakal 2010; Erol et al. 2022).

The experts were selected based on their experience with healthcare PPP projects having reached to the stage of construction completion and moved into the operation phase. It was also attempted to include experts specialized on various areas such as project design, finance, planning and operation. The information about the experts is given in Table 3.

Table 3. Information about the experts participated in the sessions

Expert	Position and Expertise	Years of Experience in	
		Construction Sector	Healthcare PPP Projects
A	Director of Project Management Office, Civil Engineer (PhD)	22	8
B	Director, Civil Engineer (MSc)	17	4
C	Coordinator of Project Management Office, Civil Engineer (MSc)	15	3
D	Design Manager, Architect (MSc)	14	2.5
E	Project Executive, Architect	12	3.5

A description of the research, the method to be used and the tasks to be performed through the sessions were e-mailed to the experts a week before the gathering, together with the assumptive interrelations among the factors in the form of matrices, for them to be familiar with the process. The relevant tasks for the sessions were identified as follows: (1) Reviewing and revising the proposed interrelations between the factors, (2) Performing the pairwise comparisons by using the ANP matrices, and (3) Testing the performance of the built model via examples of real projects from their own experiences. The sessions lasted about two to three hours.

First session: finalization of the network

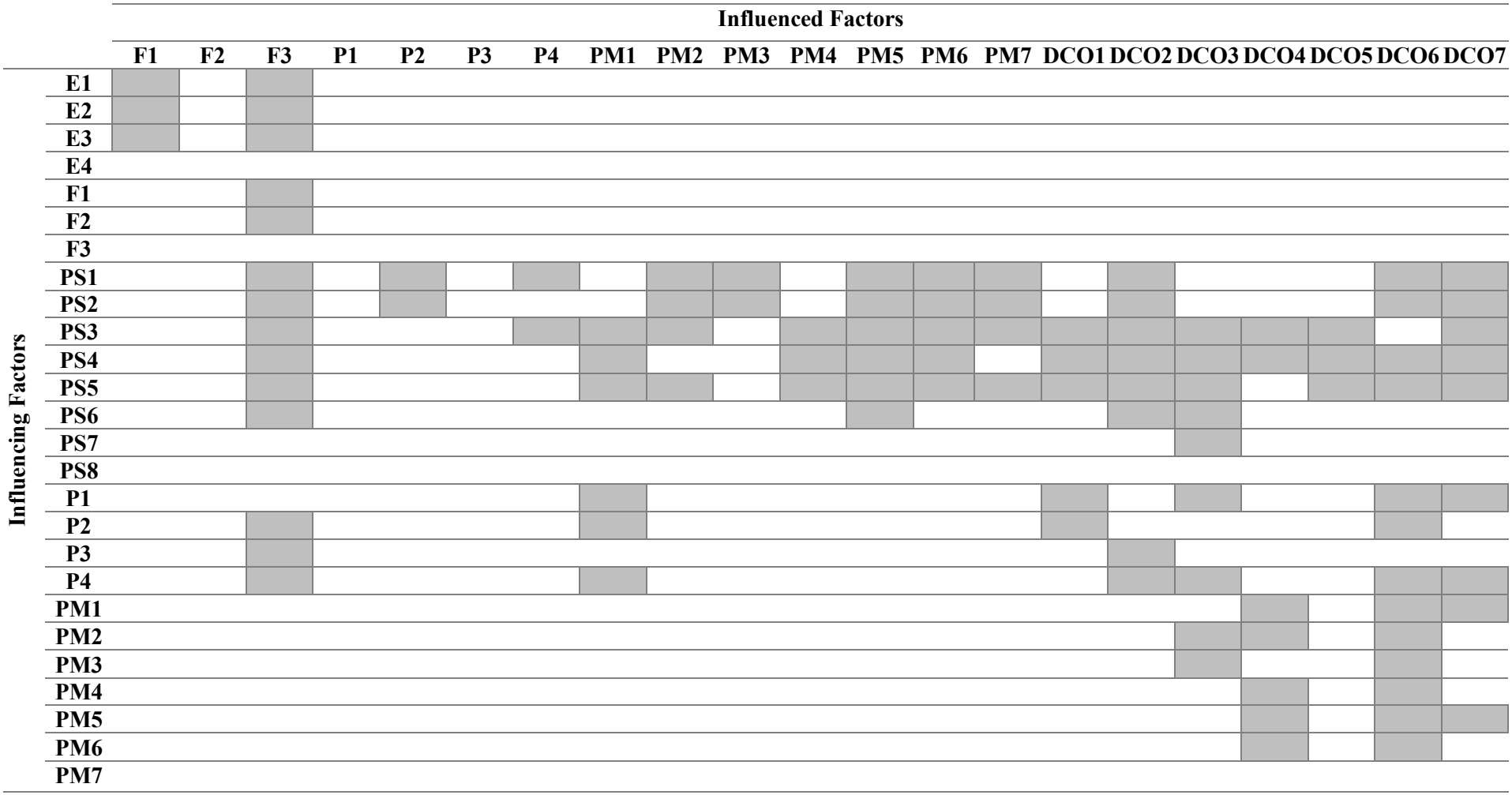
In the first session, the previous phases and objectives of the research, the proposed conceptual

framework and the principles of the ANP were elucidated to the experts, together with the tasks asked to be performed by them. All factors and their definitive sub-items were discussed, together with the cluster and node interrelations and the conceptual model was finalized.

Table 4 shows the factor interdependencies, in which, the factor influences upon each other are depicted. Three factors from the *External Environment* cluster are interrelated with the factor F1, since the stability of the political environment in the host country and strong government support; global and local economic conditions; and the maturity of the legal and regulatory framework all affect the financing interest rates and financing costs and the strength and profitability of the project. These three factors also have an influence on the inclusion of investors and sponsors with sufficient financial strength in the project, which is factor F3. It was pointed out by the experts that the legal and regulatory framework has critical importance for the creditors, in addition to the global economic conditions and economic environment in the host country. F3 is also influenced by factors F1 and F2, since favorable financing interest rates and financing costs, the strength and profitability of the project and provision of adequate government guarantees attract strong investors and sponsors globally. The competence, experience and qualifications of the major stakeholders; a comprehensive feasibility study conducted prior to tender; a competitive and transparent tender process; and the comprehensiveness and clarity of the contract documents are the other factors affecting F3. Of the *Planning, Tender and Contracting Processes* cluster, the preparation of a comprehensive and realistic pre-tender feasibility study (P2) and comprehensive and clear final contract documentation (P4) are dependent to the competence and experience of specific stakeholders. In a similar vein, various *Project Management* and *Design, Construction and Operation Processes* factors are influenced by the qualifications and experience of various project stakeholders. Of the *Project Management* factors, the only factor under the influence of the *Planning, Tender and Contracting Processes* cluster is PM1 (Effective budget and schedule

planning with the consideration of the entire project life cycle, including the operation and transfer phases), which is dependent to the clarity and comprehensiveness of project scope definition, feasibility study and final contract documentation (P1, P2 and P4). Besides, *Design, Construction and Operation Processes* factors are affected by multiple factors from the *Planning, Tender and Contracting Processes* and *Project Management* clusters.

Table 4. Factor interdependencies



LEGEND

Factor influence pointing out node interrelations

External Environment	E1, E2, E3, E4
Financial Characteristics	F1, F2, F3
Project Stakeholders	PS1, PS2, PS3, PS4, PS5, PS6, PS7, PS8
Planning, Tender and Contracting Processes	P1, P2, P3, P4
Project Management	PM1, PM2, PM3, PM4, PM5, PM6, PM7
Design, Construction and Operation Processes	DCO1, DCO2, DCO3, DCO4, DCO5, DCO6, DCO7

Second session: pairwise comparisons and construction of the model

For the construction of the model, the elements and clusters within the model were compared in pairs, with respect to the given criterion. The pairwise comparisons were performed by using the 1-9 point scale of the ANP. In the scale, a score of 1 indicates equal importance of the two compared elements/clusters, where a score of 9 indicates overwhelming dominance of one element/cluster over the other.

Prior to the second session, the revised 29 comparison matrices were printed and distributed to the experts. In the second session, the pairwise comparison evaluations were made with consensus decision making among the experts. These evaluations were fed into the software simultaneously during the session. The inconsistency ratio provided by the software was monitored at all steps of the evaluation process. A computed ratio lower than 0.10 was deemed aeptable for the consistency (Saaty and Vargas 2013). Pairwise comparisons were conducted among: (1) the CSFs, in terms of their relative importance; (2) the CSFs, in terms of the magnitude of their interdependencies; (3) the factor groups, in terms of their relative importance; (4) the factor groups, in terms of the magnitude of their interdependencies, all with respect to the control criterion.

The first step was to pairwise-compare the relative importance of the CSFs, with respect to PPP healthcare project success. The question posed was: “Which factor is more important for PPP healthcare project success and how much more important?”. An example matrix for this step is provided in Table 5, which shows the results obtained from the assessment of the importance of the *Project Management* factors. The points attached by the experts for the pairwise comparisons of the factors with respect to their importance for PPP healthcare project success are shown in the intermediate columns, whereas the revealed factor weights from these comparisons are shown in the rightmost column. According to the obtained factor weights, PM5 (Establishment of an efficient system for controlling project changes and resolving disputes)

was revealed as the leading factor among the *Project Management* factors.

Table 5. Judgment for the importance of the *Project Management* factors

Project Success	PM1	PM2	PM3	PM4	PM5	PM6	PM7	Weight
PM1	1	1	2	2	1	2	5	0.20057
PM2	1	1	2	2	1	2	5	0.20057
PM3	1/2	1/2	1	1/3	1/3	1	4	0.08937
PM4	1/2	1/2	3	1	1/3	2	4	0.13829
PM5	1	1	3	3	1	4	4	0.25018
PM6	1/2	1/2	1	1/2	1/4	1	3	0.08467
PM7	1/5	1/5	1/4	1/4	1/4	1/3	1	0.03636
Inconsistency ratio = 0.03311								

The second step was to analyze the interdependencies between the factors. The question posed was: "Considering PPP healthcare project success, given a factor, which of the two factors influences it more, and how much more?". For each factor, the factors that are considered to have an influence on that factor are compared to each other in terms of the magnitude of their influence. Examples of the matrices that are based on the interrelationships between the factors are given in Tables 5-7. In these matrices, the values provided in the intermediate columns are the points attached by the experts with respect to the factor's magnitude of influence on the given factor. Table 6 shows *Planning, Tender and Contracting Processes* factors' influences on factor F3 (Inclusion of investors and sponsors with sufficient financial strength in the project). P2 (Preparation of a comprehensive and realistic feasibility study prior to tender) was evaluated to be significantly more influential on F3 when compared to P3 (A well-designed, competitive and transparent tender process, clarity and adequacy of tender documents) and P4 (Comprehensive and clear final contract documentation prepared by the public agency and the contractor), since the feasibility study is one of the leading issues that the project creditors attach importance to. Table 7 shows the influences on the factor PM5 (Establishment of an efficient system for controlling project changes and resolving disputes), which was the highest ranked factor in this cluster with respect to its importance. It was revealed that PS1 (Public agency's well-established organizational structure, resource adequacy, sufficient knowledge and experience in healthcare projects and the BLT model) is the most influential factor, followed

by PS2 (Public agency consultant's experience, competence, adequate staffing, sufficient knowledge and experience in healthcare projects and the BLT model) on PM5. It was pointed out by the experts that the greatest responsibility for establishing such a system belongs to the public sector stakeholders.

Table 6. *Planning, Tender and Contracting Processes* influences on F3

F3	P2	P3	P4	Weight
P2	1	4	4	0.66667
P3	1/4	1	1	0.16667
P4	1/4	1	1	0.16667
Inconsistency ratio = 0.00000				

Table 7. *Project Stakeholders* influences on PM5

PM5	PS1	PS2	PS3	PS4	PS5	PS6	Weight
PS1	1	3	2	6	2	9	0.38201
PS2	1/3	1	2	3	2	4	0.21032
PS3	1/2	1/2	1	3	1	4	0.15359
PS4	1/6	1/3	1/3	1	1/3	2	0.06116
PS5	1/2	1/2	1	3	1	4	0.15359
PS6	1/9	1/4	1/4	1/2	1/4	1	0.03932
Inconsistency ratio = 0.02353							

Table 8 shows the influences of the factors in the *Project Management* cluster on the factor DCO6 (Taking the necessary measures to provide and maintain maximum performance throughout the operation phase). Among these, the most influential factors are PM3 (Effective control and supervision by the public agency through the life cycle of the project and an efficient governmental approval process), PM1 (Effective budget and schedule planning with the consideration of the entire project life cycle, including the operation and transfer phases) and PM2 (Ensuring the active involvement of project stakeholders through all project management processes, and adequate and effective communication/coordination between project stakeholders), as to the descending order of influence.

Table 8. *Project Management* influences on DCO6

DCO6	PM1	PM2	PM3	PM4	PM5	PM6	Weight
PM1	1	3	1/2	3	3	3	0.26924
PM2	1/3	1	1/2	3	1	3	0.15838
PM3	2	2	1	3	3	3	0.31197
PM4	1/3	1/3	1/3	1	1	1	0.08117
PM5	1/3	1	1/3	1	1	1	0.09807
PM6	1/3	1/3	1/3	1	1	1	0.08117
Inconsistency ratio = 0.03930							

In a similar vein, the third step was to pairwise-compare the relative importance of the clusters with respect to PPP healthcare project success and the fourth step was to examine the interdependencies between the clusters. Subsequent to the completion of the pairwise comparisons for the whole network, construction of a synthesized supermatrix was required to process the impact of the interdependencies exist within the model. Accordingly, the importance weight of each element was computed by the use of the software.

Third session: model testing

In the third session, the expert team was asked to use the built model to assess two real PPP healthcare projects that they had been involved in. In Table 9, general information is given about the projects. It was asked from the experts to assign a rating to each of the 33 factors using the 1-5 point Likert scale via consensus decision making, considering the extent to which these factors were realized in their project (1: Very low, 2: Low, 3: Medium, 4: High, 5: Very high). The rank order of the factors with respect to their global priority values, expert team's evaluations and the revealed results are presented in Table 10. The weighted ratings for the factors were calculated by multiplying the factor importance weights with the ratings provided by the experts and the project success rating was obtained by summing them up for each project. Accordingly, a success rating of 3.21 was attained for Project 1 and 3.47 was attained for Project 2, both corresponding to the medium-to-high level. The outcome was regarded as expectable by the experts, since Project 1 was the very first experience of the company with PPP healthcare projects. As mentioned by the expert group, although it was a project of a smaller scale and relatively easy to manage when compared to Project 2, the company had been unfamiliar with the project structure, stakeholders, inherent bureaucracy and so forth, during the course of Project 1. Despite the fact that Project 2 was a more complex one with a much larger project area, the experts considered some of the inherent processes of the organization to be relatively more mature during the course of Project 2. But still, the expert team pointed out that there is

still need for improvement, therefore interpreted the rating of 3.47 as reasonable.

Table 9. General information for the test cases

	Project 1	Project 2
Project Size (m^2)	142,000	540,000
Current Project Phase	Operation	Operation
Project Start Date	2014	2015
Construction Finish Date	2016	2017

Table 10. Obtained data regarding the two test cases

Factor ID	Rank	Weight	Project 1		Project 2		Factor ID	Rank	Weight	Project 1		Project 2	
			Rating	Weighted Rating	Rating	Weighted Rating				Rating	Weighted Rating	Rating	Weighted Rating
PS3	1	0.134	3	0.402	4	0.536	PM2	18	0.018	3	0.054	4	0.072
F3	2	0.105	5	0.525	5	0.525	DCO1	19	0.017	4	0.068	4	0.068
PS1	3	0.098	1	0.098	2	0.196	PM1	20	0.017	4	0.068	3	0.051
F2	4	0.062	5	0.310	5	0.310	DCO2	21	0.015	4	0.060	4	0.060
P4	5	0.058	4	0.232	4	0.232	DCO3	22	0.015	3	0.045	4	0.060
PS5	6	0.048	3	0.144	3	0.144	PM4	23	0.012	5	0.060	4	0.048
E1	7	0.045	5	0.225	5	0.225	DCO4	24	0.010	5	0.050	5	0.050
E2	8	0.044	4	0.176	4	0.176	DCO6	25	0.010	3	0.030	4	0.040
P1	9	0.040	1	0.040	1	0.040	PM3	26	0.009	2	0.018	2	0.018
PS2	10	0.038	1	0.038	1	0.038	PM6	27	0.008	3	0.024	3	0.024
F1	11	0.033	4	0.132	4	0.132	PS7	28	0.006	3	0.018	3	0.018
E3	12	0.028	1	0.028	2	0.056	DCO5	29	0.005	4	0.020	3	0.015
PS6	13	0.027	4	0.108	3	0.081	PS8	30	0.004	4	0.016	3	0.012
PS4	14	0.026	4	0.104	4	0.104	DCO7	31	0.003	3	0.009	4	0.012
P3	15	0.020	1	0.020	1	0.020	PM7	32	0.003	2	0.006	3	0.009
P2	16	0.020	2	0.040	2	0.040	E4	33	0.002	2	0.004	1	0.002
PM5	17	0.020	2	0.040	3	0.060	**Total Rating**			**3.21 / 5.00**		**3.47 / 5.00**	

To determine the critical factors for performance improvement regarding the test cases, factors were ranked with respect to their deficient weighted rating points. To calculate a factor's deficient rating point, the weighted rating of a factor was subtracted from the highest possible weighted rating for the factor, which is a product of the factor's importance weight and the highest possible rating (*i.e.* 5.00). The ranked list was presented to the experts during the session. Most of the common critical factors for the projects pertain to the *Project Stakeholders*, *Planning, Tender and Contracting Processes* and *External Environment* clusters. On the other hand, the success rating was revealed to be sensitive to the factors PM2 addressing the active involvement of and communication between project stakeholders and DCO3 pointing out construction and operation integration and design flexibility and optimization for Project 1; whereas PS6 related to the capabilities and characteristics of the design firm and PM1 concerned with effective budget and schedule planning were distinctive for Project 2.

Accordingly, it can be inferred that the model was capable of giving project-specific results.

The experts regarded the model as comprehensive and reasonable, since it covers external factors; factors related to the public sector stakeholders and contractual issues; and the factors pertaining to the private sector stakeholders and the relevant processes as well. It was commented that the model gives a holistic picture about CSFs in a project. As mentioned by the experts, rather than focusing only on the internal factors for performance, the system provides a wide-angle assessment for the companies, indicating the importance of exogeneous factors such as factors related to the public sector stakeholders. The examination of the interrelationships that are normally ignored in the assessments was regarded as beneficial in terms of providing an in-depth assessment of project success. The experts commented that the model structure can be used at different stages of the project by making additions and subtractions when needed.

The model was also deemed useful by means of showing the impact of each deficiency on the performance rating. The experts stated that the model supports communication between the project participants about the project risk factors, success factors and relevant strategies for project performance improvement. According to their comments, the model can facilitate the decision-making process for the managerial actions and guide for the preparation of an improvement plan for project performance. It was also stated that the model can be used to make performance comparisons among different projects carried out by the company and learn from previous experiences.

Discussion of findings about the CSFs

The results show that, when the interrelations between factors are taken into account, the factor with the highest importance weight in the model is contractor's experience, technical and management competencies, resource adequacy, sufficient knowledge and experience in healthcare projects and the Build-Lease-Transfer (BLT) model (PS3). It was also revealed that

inclusion of investors and sponsors with sufficient financial strength in the project (F3) and public agency's well-established organizational structure, resource adequacy, sufficient knowledge and experience in healthcare projects and the BLT model (PS1) also contribute significantly to project success. It can be said that these first three factors constitute the backbone of a successful PPP healthcare project, together with provision of adequate government guarantees (F2) and comprehensive and clear final contract documentation prepared by the public agency and the contractor (P4) in the fourth and fifth ranks.

There are some common points between these results and the results of some previous studies that explored the importance of PPP success factors. *A strong private consortium* ranked first in the survey analysis of Li et al. (2005) and was among the factors at the top of the list in studies of Zhang (2005), Ng et al. (2010), Yuan et al. (2012), Hwang et al. (2013), Al-Saadi and Abdou (2016), Osei-Kyei and Chan (2017), and Kuru and Artan (2020). *A well-organized and committed public agency* ranked first in the study of Hwang et al. (2013) and ranked among the top factors in studies of Li et al. (2005), Yuan et al. (2012), Osei-Kyei and Chan (2017), and Debela (2022). In previous studies, different project stakeholders were not considered separately under individual factors, but were evaluated within the scope of a single factor that deals with the experience and capabilities of the project team. By doing so in this study, the factors covering the experience and competence of the operator, public agency consultants, design firm and contractor's consultants were revealed with high importance weights in the model, in descending order. PS5, namely *operator's experience, competence, resource adequacy, sufficient knowledge and experience in healthcare projects and the BLT model*, ranked sixth according to the findings, which implies that due consideration should be given to the selection of the operator in PPP healthcare projects.

Jefferies et al. (2002) considered *financial capability and credibility of the investors* as a separate success factor in their studies. Correspondingly to this, in the semi-structured

interviews conducted for this study, the critical importance of strong investors for these projects was especially emphasized by the experts. High credit rating of the investors was considered to be critical to provide the required loan for these projects. *Provision of adequate government guarantees* was another factor that ranked among the top critical factors in studies conducted by Qiao et al. (2001), Li et al. (2005) and Zhang (2005), parallel to the results of this study. Similarly, *comprehensive and clear final contract documentation* was also revealed with a high ranking in studies carried out by Qiao et al. (2001) and Hwang et al. (2013).

The factor covering scope definition prior to the tender process conducted with the proper integration of end users' needs, inputs of operational staff, healthcare experts, relevant institutions, non-governmental organizations and all other interest groups early on in the process was assigned a high importance weight in the model. Akintoye and Chinyio (2005) also emphasized that employees (doctors, nurses, caterers, etc.) and consultants in the medical field should be participated in preparation of project brief and defining project requirements. Robinson and Scott (2009); Abdou and Al Zarooni (2011); and Tang et al. (2013) pointed out the proper integration of public and customer/end users' needs in this process. *Clear project brief and client outcomes* was included among the CSFs of Al-Saadi and Abdou (2016) and ranked third in their survey analysis.

According to the results, establishment of an efficient system for controlling project changes and resolving disputes, which was the second-ranked factor in the study conducted by Osei-Kyei et al. 2017, was revealed with the highest weight among the *Project Management* factors. The factor added by the experts during the interviews, which was concerned with the contractor's preparation with the conduct of technical and financial analysis and further work on the feasibility study subsequent to the signing of the contract, also revealed a significant importance weight according to the results.

Design, construction and operation integration was an emphasized point in studies of Edum-

Fotwe et al. (2003) and Javed et al. (2013) for healthcare PPPs. Providing the flexibility of design was mentioned by these authors as a necessity for healthcare PPPs. Providing the integration of design, construction and operation processes and ensuring maximum design performance and flexibility was included as a CSF in this study and ranked third among the DCO factors.

According to the results of the analysis, factors of the *Project Management* and *Design, Construction and Operation Processes* clusters attained relatively lower importance weights. It was mentioned by the experts that having the *Project Stakeholders*, *Financial Characteristics*, *Planning, Tender and Contracting Processes* and *External Environment* factors in the upper ranks is reasonable, since these clusters mostly involve the predominant factors for the project, influencing the other clusters. Moreover, it was inferred that factors mainly under the control of a single party were deemed to be more manageable by the experts and attached a lower importance. The factors related to public sector stakeholders' characteristics and the processes undertaken by them, factors that require an integrated contribution of both public and private sectors, and also the factors related to the external environment and financial characteristics were regarded as the sources of risk/uncertainty threatening the successful planning and delivery of the project by the experts and attached significant importance. The findings also point out the criticality of the project preparation phase, planning efforts and stakeholder assemble for project success.

Although focused on distinct project types and involved different dimensions, there are some similar points between this study and the study carried out by Wang (2018), which also explored CSFs for PPPs and took the factor interrelations into account. In their study, Wang (2018) mentioned that their results pointed out responsibility integration, passing of risk and an incomplete contract as important items for a PPP project, as well as profitability. These findings are consistent with the results of this study, with factors P4, concerned with comprehensive and

clear final contract documentation; PM2, related to active stakeholder involvement and communication; and F1, concerned with project finance and profitability, having high importance weights in the model.

In the developed model network, the factor PS3, namely "Contractor's experience, technical and management competencies, resource adequacy, sufficient knowledge and experience in healthcare projects and the BLT model" is the leading factor in terms of the number of factors it affects. The factor interacts with many factors from the *Financial Characteristics*, *Planning, Tender and Contracting Processes*, *Project Management* and *Design, Construction and Operation Processes* groups. This interaction also enhanced the weight of the factor in the model. F3, namely "Inclusion of investors and sponsors with sufficient financial strength in the project", ranks first in terms of the number of factors it affects in the network structure. F3 is also under the influence of many factors from the *External Environment*, *Financial Characteristics*, *Project Stakeholders* and *Planning, Tender and Contracting Processes* groups. Similar to PS3, PS1 also stands out with the multitude of factors it affects. In the network, provision of adequate government guarantees (F2) influences the inclusion of investors and sponsors with sufficient financial strength in the project (F3). The fact that it affects F3, which is a strong factor, has increased the weight of F2 in the model. The same applies to PS5, since it also has an influence on F3. PS5 also affects multiple *Project Management* and *Design, Construction and Operation Processes* factors in the model. P4 is under the influence of PS1 and PS3, since the preparation of a comprehensive and realistic pre-tender feasibility study depends on the competence and experience of the public agency and the contractor. P4 also influences F3, PM1 and multiple *Design, Construction and Operation Processes* factors.

As mentioned in this section, according to the findings, factors such as PS3, PS1 and F2 stood out in terms of their contribution to PPP healthcare project success, which is a result also shown in previously conducted studies on PPP project success. The same applies to the factors E1, E2,

F1, E3, P3, P2 and PM5, which are the factors revealed with high importance weights according to the results of this study. On the other hand, the findings of this study show that factors F3 and P4 have a critical importance for PPP healthcare project success, which is a unique finding of this study. This can be attributed to the inclusion of interactions between factors in the model, since F3 and P4 have multiple connections in the network. In the same vein, factors PS5, PS2, PS6, and PS4 were revealed with high importance weights in the model thanks to their impact on critical factors. From this point of view, it is believed that considering the interrelationships between the factors contributed to a more realistic and elaborated analysis of project success.

Managerial implications of findings and the model

The proposed model can assist in performance improvement by setting forth the strengths and weaknesses of the project and pointing the factors that are the most sensitive ones to improve the project's success rating. Considering the most critical parameters revealed by the proposed model, decision-makers can develop possible strategies to enhance project success. For instance, since the factor DCO3 was revealed to be critical for the performance of Project 1, the decision maker may consider improvement strategies such as making a design effort through strong collaboration of the design firm, technical consultants, healthcare planner, contractor, operator and subcontractors so that design efficiencies can be maximized; enhancement of the construction process through constructability and value engineering reviews performed during the design phase; review and assessment of the design from operability, maintainability and serviceability point of view by the operator; and provision of sufficient detailing and timely finalization of the design documents.

The proposed model can be used to predict a performance rating for a given project and this rating can be tracked through the implementation of improvement strategies/corrective actions. In other words, the decision-maker can assign a rating to each given factor by evaluating the project context, project characteristics, host country conditions and characteristics of the

stakeholders involved and find an overall project success rating. Alternative scenarios can be generated for the project and their potential contribution to the project performance rating can be assessed. Besides providing a snapshot of the project's performance and assisting to build a roadmap for the improvement of performance through the project's life cycle, it was also anticipated that the model may contribute to organizational learning and continuous improvement by virtue of its use in different stages of a project's life cycle and on various projects of the company by means of creating a performance benchmark.

Conclusions

PPP has become a widely used approach for the delivery of healthcare projects throughout the world in the recent two decades. A gap was determined in the literature with respect to the assessment of PPP healthcare project success, with a holistic approach considering the interrelationships between the CSFs and integrating project performance assessment and improvement. In this paper, a PPP healthcare project success framework comprised of 33 CSFs organized in six groups was proposed. Based on the collective judgment of experts from the private sector, PPP healthcare project success was modeled using the ANP. The model was tested via the assessment of two real projects' performance by the experts and the findings were reported.

When evaluated as a whole, the experience and competencies of the major stakeholders; inclusion of strong project sponsors and controlling major financial risks; provision of adequate government guarantees; comprehensive and clear final contract documentation; strong government support and favorable political and economic conditions; and sophistication of project requirements and scope prior to the tender process were revealed as the most important determinants of PPP healthcare project success. Some common points between this study and some previous studies indicate that *a strong private consortium* and *a well-organized and committed public agency* are among the most significant factors for PPP project success and

also for PPP healthcare projects. Moreover, it was shown in this study that *inclusion of investors and sponsors with sufficient financial strength in the project* and *operator's experience, competence, resource adequacy, sufficient knowledge and experience in healthcare projects and the BLT model* are the factors that have critical importance for PPP healthcare project success. The experience and competence of the public agency consultants, design firm and contractor's consultants were included as CSFs individually and revealed high importance weights in the model. According to the results, establishment of an efficient system for controlling project changes and resolving disputes was the top-ranked factor in the *Project Management* cluster. Further development of the pre-tender feasibility study and preparation of a detailed technical and financial analysis early on in the design-construction phase with the contribution of the private sector stakeholders ranked the first among the DCO factors.

One of the major contributions of this paper can be given as the provision of a holistic framework for PPP healthcare project success, encompassing external project environment, financial characteristics of the project, project stakeholders, project management and project processes. Second, this paper provides a model of the interrelationships between the critical success factors for PPP healthcare projects and by that means, provides an in-depth analysis of the problem under consideration. From a practical perspective, the model can assist a construction company to assess the success potential of the project, identify the project's strengths and weaknesses and develop project performance improvement strategies accordingly, and also promote continuous monitoring and control of project performance and organizational learning.

It has to be noted that despite the experts' experience and the extensive PPP project portfolio that they had been engaged with, conclusions of this study are not generic and represent only the subjective assessment of the expert team participated in the study. One of the critical issues was to ensure consistency between the experts' evaluations. Considering the scope of this study,

using consensus decision making approach was favored to using a geometric mean of the experts' evaluations for the comparison of the elements in the system. It was believed that the brainstorming within the sessions was beneficial in terms of preventing misunderstandings on the relevant issues. Furthermore, for ensuring consistency in the evaluations, hosting a collective session provided practicality. It is believed that findings are reliable and consistent within the context of this study. On the other hand, since all of the experts were selected from a single company, the findings reflect the approach, culture and experiences of the company involved. In future studies, experts from different companies can be included to enhance the external validity of the findings and the results can be interpreted together. The ANP method can also be used in conjunction with a large-scale survey research to provide the generalizability of the findings. On the other hand, it has to be noted that the aim of this study was not to arrive to generic findings, rather it was aimed to demonstrate how a network-based holistic performance assessment method can be developed based on expert opinions. It is believed that similar models can be developed in other companies from different countries using the method and approach proposed in this paper. Although the factors were extracted with an extensive literature review, the gathered data and relative importance of CSFs are mostly valid for the PPP healthcare projects executed in Turkey. On the other hand, it is believed that the model provides a strong basis and can be customized to meet any organization's expectations. By adding and removing factors and re-evaluating the factor importance weights, project-specific or company-specific models can be obtained.

As mentioned previously, there are many studies in the literature that investigated PPP project success and related CSFs based on the experiences of different countries such as China, Australia, Singapore, the UAE, Ghana, Ethiopia and the UK. These studies can enable countries to learn from the best practices and problems of each other. This paper contributes to the literature by presenting Turkey's experience in this respect, on the basis of PPP healthcare

projects. Findings may have implications for companies involved in PPP projects in other countries that are similar to Turkey in terms of macro conditions and regulations. The model can be adapted to other cases in different countries as well as to other types of PPP projects. It may be of value if stakeholder-specific models are constructed, as the expectations and perceptions of each stakeholder with regards to project performance may vary.

The novelty of this study and its contribution to the existing literature lay in the effort to form an inclusive and thorough framework for PPP healthcare projects, which also explores the interrelationships among the CSFs of the framework as a first attempt in this area. Finally, it should be noted that this study is part of a research work that aimed to develop a decision support system (DSS) as a guidance tool for the construction companies, to be used for performance assessment and improvement of PPP healthcare projects. The proposed ANP model may form a basis for decision support tools and assist decision-makers in developing strategies for performance improvement in PPP healthcare projects.

Disclosure statement

No potential conflict of interest was reported by the authors.

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