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Research paper

Assessment of factors influencing on the success of public-private partnerships infrastructure projects in Vietnam

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Abstract: The implementation of public-private partnerships has become one of the effective models of cooperation between the public and private sectors in the development of infrastructure in Vietnam. This model has been adopted in Vietnam for many years and is intended to help governments build infrastructure and provide an opportunity to reduce government debt profiles. This study aims to identify the most critical factors that could determine the success of these projects. A questionnaire was conducted based on the participants' experience in the implementation of public-private partnerships projects and a total of 216 respondents were received. A regression analysis shows that six critical success factors, including factors relevant to public sector, factors relevant to private sector, factors relevant to selected process partnerships, factors relevant to risk management systems, factors relevant to project information, and factors relevant to natural environment. The findings indicated that the most effective development projects could be carried out via PPPs if the government could focus on these important factors in the implementation process. The results will influence political development towards PPP and guide partners in developing public-private partnerships projects.

Keywords: factors, infrastructure, public-private partnerships, projects, success, Vietnam

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1. Introduction

Public-private partnerships (PPPs) are a cooperation project between two or more public sector and private sector, which are usually long-term and build on the expertise of each partner who best meet the needs of the clearly defined public needs through the appropriate sharing of resources, benefits and risks [1]. Otherwise, it is an agreement between a state institution and a company that provides better services or improves the place's ability to operate effectively [2]. This model is mainly used to provide infrastructure facilities such as the construction and equipment of schools, hospitals, transport systems, and water and sanitation systems. Also, PPPs have been highly controversial as financial instruments, mainly because of concerns that returns for the private funder is higher than the public return on investment. PPPs are directly related to privatisation and contracting out of government works and services [3]. The scarcity of a common perception of what PPPs are makes the process of assessing whether PPPs have been complex successes. For instance, evidence of PPPs' performance in terms of value for money and efficiency is mixed and often unavailable. The common themes of this model are risk sharing and innovation development [4].

According to a summarized report issued by the government of Vietnam [5], over VND 1.6 million billion from the private sector was mobilized to invest for PPP in many sectors (refer to Table 1 and Fig. 1). This shows that PPP projects bring many benefits to the country such as contributing to improving technical infrastructure and urban landscape; stabilizing energy supply; and improving the quality of life of people. In addition to the achieved results, the fact shows that when implementing the PPP project in Vietnam, there are still some shortcomings, such as slow progress, increased costs, potential conflicts between the parties involved, loss of investment capital, and selection of investors with insufficient capacity to

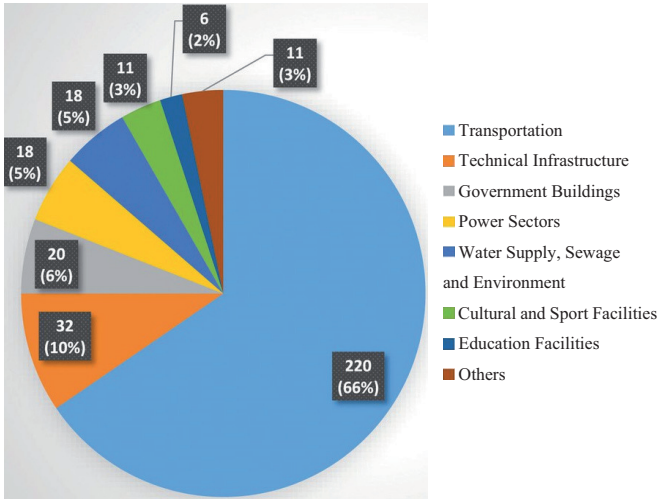

Fig. 1. Numbers of PPP Projects in Term of Investment Fields [5]

implement the project. In addition, the mechanism to monitor investors' revenue, sanctions to handle violations of investors as well as competent State agencies is insufficient and not strict. Therefore, in-depth research on the factors affecting the success of infrastructure investment projects in the form of PPP will contribute significantly to the participants in identifying important and crucial factors as projects' main successful indicators. Thus, the paper will provide effective solutions to help PPP projects achieving their initial goals.

Table 1. Investment Capital for PPP Projects

No	Fields of Investments	Capitals (billion VND)	PPP Types and Numbers
1	Transportation	672,345,000,000	BOT: 118, BOO: 2, BT: 100
2	Technical Infrastructure	39,568,000,000	BOT: 1, BT: 31
3	Government Buildings	5,125,000,000	BT: 20
4	Power Sectors	857,209,000,000	BOT: 18
5	Water Supply, Sewage and Environment	25,247,000,000	BOT: 1, BT: 15, BOO: 2
6	Cultural and Sport Facilities	4,632,000,000	BOT: 1, BT: 10
7	Education Facilities	1,285,000,000	BT: 6
8	Others	3,834,000,000	BT: 10, BOO: 1
	Total	1,609,335,000,000	BOT: 139, BT: 192, BOO: 5

(Source: [5])

2. Literature reviews

Public-private partnerships are a long-term co-operate between a private party and a public sector to provide an asset or public service, in which the private party assumes significant risk and management tasks and the remuneration is aligned to performance. PPPs is defined as any form of investment based on a contract between a regulatory agency and an investor, a special purpose entity to build, innovate, operate and manage infrastructure and public service project [6]. The states in many countries have used a mix of private and public efforts in numerous decades. In particular, Muhammad Ali used "concessions" in the early 19th century to obtain public works in Egypt for minimal cost, whereas concessionaires' companies made most of the benefits from transportation 's road and bridge projects [7]. Much of the early infrastructure of the US was constructed by what can be considered PPPs such as the Philadelphia and Lancaster Turnpike road in Pennsylvania, which was initiated in 1792 [8], an early steamboat line between New York and New Jersey in 1808; lots of the railroads, including the nation's first railroad, were chartered in New Jersey in 1815; and most modern power grids. Robert Gillespie Reid from Newfoundland who commissioned the railway to operate for fifty years from 1898, although it was originally intended to become his property at the end of the period. Meanwhile, the end of the twentieth century and the beginning of the twentieth one century experienced an

unmistakable pattern toward states over the globe utilizing different PPP agreements [2]. This trend seems having reversed since the world's financial crisis in 2008.

The success of the project is the degree to which the established objectives have been achieved [43–45]. Project success can only be achieved if the project management process goes in the right direction. Although there is a link between project success indicators and project success factors, success indicators refer to the success metrics, while success factors represent for events that contribute to success [46, 47]. The recognized initial project success indicators, the project's Cost-Quality-Schedule triangle, are tied to the project's "hard" objective measures, including benchmarks. on schedule, cost and quality. "Soft" criteria, especially stakeholder satisfaction, are ignored in the project's Cost-Quality-Schedule triangle [48]. Through a combination of hard and soft measures, a generally accepted criterion for assessing project success is whether a project meets time, cost, and specification requirements. technique and customer satisfaction [49, 50]. In fact, customers are among the many stakeholders. It should be noted that stakeholders refer not only to the parties in the project but also to the parties that may affect or be affected by the implementation of the project [51, 52]. In other words, a project can only be recognized as successful if it meets the individual or collective expectations of the stakeholders [43].

As a construction-specific procurement approach, PPP is often applied in infrastructure projects that have a significant impact on economic or social development and are tied to the interests of stakeholders. different perspectives [53, 54]. Nisar [55] highlights the intrinsic characteristics of the PPP approach: The private sector is responsible for funding, managing assets, and charging fees in line with the asset's performance or client asset usage. customer or end user.

Clearly a PPP project initiated by the public partner and granted a concession agreement, while the private partner funds, designs, builds, operates, and maintains the project in strict compliance with the contract. franchise. The final output of the project is used by end users. Accordingly, the main stakeholders in this study include three components, namely public partners, private partners and end users.

Rockart (1982) [9] defined Critical Success Factors (CSFs) as follows: "those few key areas where favorable results are essential for a manager to achieve their objectives". The method of CSFs is a procedure that seeks to make explicit the most important areas that are essential for successful management (Boynton, et al., 1984) [10]. This method has been used as an impact measure since the 1970s in financial services (Boynton, et al, 1984) [10], information systems Rockart (1982) [9], and within the manufacturing industry (Mohr, et al., 1994) [11]. In the past, there were some studies apply this method in the field of construction control (Yeo, 1991; Sanvido, et al., 1992) [12, 13]. Jefferies, et al., (2002) [14] shown that three major factors identified for Australia's PPP projects, including solid consortium with great experience, considerable experience, high profile, and a good reputation; an efficient approval process that supports stakeholders during a very tight timeframe; and innovation in consortium financing methods. In India, Gupta, et al., (2013) [15] identified the dealership agreement, short construction time and debt repayment as PPP success factors, whereas Tang, (2013) [16] displayed five factors as identification

of customer/owner requirements; clear and precise information documents; feedback from completed projects; and a deep understanding of customer/owner requirements.

Minnie (2011) [17] identified providing a public service and achieving the objectives of the partnership for South Africa, while, Cheung, et al., 2012) [18] shown that the most important success factors for China's PPP projects are a stable macroeconomic situation, favourable legal framework; sound economic policy; available financial market; and multi-benefit goals. Besides in Malaysia, Ismail (2013) [19] recognized 5 success factors for the implementation of PPP projects, including good leadership, commitment or responsibility of the public or private sectors, low-cost legal framework; sound economic policy, and financial market available. Meanwhile, in Indonesia, the key factors identified for the success of PPP projects are a solid legal basis. an irrevocable contract; sensible and manageable risk-sharing arrangements; reality described coordination mechanisms; and strong political help (Wibowo, 2014) [20]. Besides, Jacobson (2018) [21] identified the involvement and shared vision, open communication, and trust, and collaboration are the three main success factors of the USA's PPP projects. Bing, et al., (2012) [22] shown that five key PPP projects success factors as: strong private consortium; adequate risk allocation and risk sharing; available financial market; commitment/ responsibility of the public/private sectors; and accurate and realistic cost /benefit assessment. Ameyan, et al., (2015) [23] also identified government engagement, adequate funding, public acceptance/support, private partner strong and competent private partner, and effective legal and regulatory structures.

Based on previous studies and consideration of the implementation of the PPP infrastructure projects in Vietnam, the study identified 45 factors that impact on the success of the PPP projects and classified them into seven categories as shown in Table 2.

Table 2. Success Factors Affecting the Implementation of PPP Infrastructure Projects

Latent Factors	Observable Variables		Related Sources
Factors Relevant to Public Sector (PB)	Predictable and reasonable legal framework	PB1	Ameyan, et al., (2015) [23]; Cheung, et al., (2012) [18]; Wibowo, et al., (2014) [20]; Toan, N. Q. et al. (2022) [24];
	Favorable PPP's legal framework	PB2	Ameyan, et al., (2015) [23]; Wibowo, et al., (2014) [20]; Toan, N.Q. et al. (2022) [24]; Ali (2019) [25]; Ismail (2013) [19]
	Promising economy	PB3	Ismail (2013) [19]
	Stable political system	PB4	Ameyan, et al., (2015) [23]; Cheung, et al., (2012) [18]; Toan, N.Q. et al. (2022) [24]; Ali (2019) [25]; Ismail (2013) [19]
	Strong government support	PB5	Ameyan, et al., (2015) [23]; Toan, N.Q. et al. (2022) [24]; Ali (2019) [25]; Ismail (2013) [19]; Bao, et al., [26]

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Table 2 – *Continued from previous page*

Latent Factors	Observable Variables		Related Sources
	Favorable economic system	PB6	Cheung, et al., (2012) [18]; Toan, N.Q. et al. (2022) [24]; Ali (2019) [25];
	Governmental project management	PB7	Toan, N.Q. et al. (2022) [24]; Ali (2019) [25]
	Good governance	PB8	Bao, et al., (2016) [26]; Qiao, et al., (2001) [27]; Badshah (1998) [29]
Factors Relevant to Private Sector (PV)	Sound financial analysis	PV1	Ali (2019) [25]; Cheung, et al., (2012) [18]; Toan, N.Q. et al. (2022) [24];
	Human resources competence	PV2	Ali (2019) [25]; Jefferies, et al., (2002) [14]; Ng, et al., (2012) [30]
	Quantities, conditions and ownership of plants and equipment	PV3	Ameyan, et al., (2015) [23]; Ali (2019) [25]; Ismail (2013) [19]; Jefferies, et al., (2002) [14]; Li, et al., (2005) [31]
	Financial competence	PV4	Bao, et al., (2016) [26]; Ameyan, et al., (2015) [23]; Toan, N.Q. et al. (2022) [24]; Ismail (2013) [19]; Li, et al., (2005) [31]
	Qualification and experience implemented same previous projects	PV5	Ali (2019) [25]; Toan, N.Q. et al. (2022) [24];
	Using different capital investment	PV6	The authors proposed
	Appropriate toll/tariff levels	PV7	The authors proposed
	Abilities to deal with fluctuations in interest/exchange rates	PV8	Ali (2019) [25]; Toan, N.Q. et al. (2022) [24];
	Effective of project management	PV9	Bao, et al., (2016) [26]
	Competencies subcontractors	PV10	The authors proposed
	Benefits of privates	PV11	Ameyan, et al., (2015) [23]
Factors Relevant to Seleceted Process Partnerships (PP)	Competitive procurement process	PP1	Ameyan, et al., (2015) [23]; Jefferies, et al., (2002) [14]; Kopp (1997) [32]
	Competitive process of selected sub-contractors	PP2	The authors proposed
	Transparency in the procurement process	PP3	Jefferies, et al., (2002) [14]; Kopp (1997) [32]; Gentry, et al., (1997) [33]

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Table 2 – *Continued from previous page*

Latent Factors	Observable Variables		Related Sources
	Transparency process of selected sub-contractors	PP4	The authors proposed
	Appropriate evaluation standards	PP5	Minnie (2011) [17]
	An efficient privates approval process	PP6	The authors proposed
	An efficient subcontractors approval process	PP7	The authors proposed
Factors Relevant to Risk Management Systems (RM)	Predictable risk scenarios	RM1	Bao, et al., (2016) [26]; Wibowo (2014) [20]
	Appropriate risk sharing for stakeholders	RM2	Wibowo (2014) [20]; Jefferies, et al., (2002) [14];
	Appropriate risk allocation for stakeholders	RM3	The authors proposed
	Effective of risk management	RM4	Jefferies, et al., (2002) [14]; Ali (2019) [25]
Factors Relevant to Project Informations (PI)	Project scales	PI1	The authors proposed
	Project types	PI2	The authors proposed
	Project complex	PI3	The authors proposed
	Construction methods and technologies	PI4	Toan, N.Q. et al. (2022) [24];
	Sufficient profitability of the project to attract investors	PI5	Ali (2019) [25]; Grant (1996) [34]
	Benefits for communities	PI6	The authors proposed
	Clear and precise briefing documents	PI7	Qiao, et al., (2001) [27]; Brodie (1995) [35]; Hambros (1999) [36]
	Financial feasibility of the project	PI8	Bao, et al., (2016) [26]
	Project places	PI9	The authors proposed
	Similar projects	PI10	The authors proposed
Factors Relevant to Natural Environment (NE)	Weather conditions	NE1	Enshassi, A., et al., (2007) [37]
	Geological and hydorlogical conditions	NE2	The authors proposed
PPP Successful Infrastructure Projects (PS)	Project quality	PS1	Heizer, et al (1990) [38]
	Project duration	PS2	Hanna, et al. (2005) [39]
	Project cost	PS3	Kazaz, A, et al. (2008) [40]

3. Research methodology

3.1. Research hypothesis

Linear regression is a data analysis technique that predicts the value of unknown data using another known and related data value. Linear regression models are relatively simple and provide an easy to interpret mathematical formula for making predictions. Linear regression is a long-used statistical technique and is readily applicable to software and computation. Scientists in many fields, including biology and the behavioral, environmental, and social sciences, use linear regression to conduct preliminary data analysis and predict future trends. future. Many data science methods, such as machine learning and artificial intelligence, use linear regression to solve complex problems.

In this research, a Linear Regression modeling approach, suitable for the purpose of the study (quantifying the impact of factors affecting the success of PPP infrastructure projects in Vietnam) was applied for data analysis. This technique has been widely used in many previous studies, especially in determining the relationship between correlation effects. The study used the linear regression model to evaluate the influence of factors to the success of implementation process of the PPP infrastructure projects in the case of Vietnam through an equation that shows the correlation relationship between particular impact factors (independent variables) and PPP infrastructure projects successful (dependent variable) has a form shown in Eq. (3.1) below:

$$\text{PS} = \beta_0 + \beta_1 \cdot \text{PB} + \beta_2 \cdot \text{PV} + \beta_3 \cdot \text{PP} + \beta_4 \cdot \text{RM} + \beta_5 \cdot \text{PI} + \beta_6 \cdot \text{NE} \tag{3.1}$$

where: PS – dependent variable (the success of implementation of the PPP infrastructure projects), β_0 – free coefficient, $\beta_1, \beta_2, \beta_3, \ldots, \beta_{10}$ – recurrent coefficients, PB; PV; PP; RM; PI; NE – independent variables (effected factors): PB – the factors relevant to public sector, PV – the factors relevant to private sector, PP – the factors relevant to selected process partnerships, RM – the factors relevant to risk management systems, PI – the factors relevant to project information, NE – the factors relevant to natural environment.

3.2. Data collection

This research applied a mixed method (combining quantitative and qualitative methods), which is suitable for many studies on this topic to achieve the main objectives. First (qualitative approach), previous studies on this topic have been systematically reviewed to identify 45 factors that influence the success of PPP projects and categorize them into seven groups. These factors were tabulated in a questionnaire consisting of two main parts. Part 1 deals with the general demographic information of respondents (i.e. gender, age, education level, experience, job location and organizational involvement) and project characteristics (i.e. project type, capital type, contract type). The main purpose of this section is to describe the participants to ensure reliability and reinforce the study results. Part 2 includes a list of factors that influence the success of PPP projects. Participants were selected for the survey based on their prior involvement or direct implementation of PPP projects in Vietnam. Based on their experience, they were asked to rate the influence of factors affecting the

success of PPP projects on a 5-point Likert scale (i.e. 1, very low influence; 2, image). low influence; 3, moderate influence; 4, high influence; 5, very high influence).

Prior to distribution of questionnaires, a pilot study based on interviews was conducted by submitting draft questionnaires to five experts. The selection criteria for professionals are: (i) having at least ten years of work experience in the construction sector; (ii) academic qualification of Bachelor's degree or higher; and (iii) at least three years of experience in PPP projects or have been involved in at least three PPP projects. They assessed language appropriateness, content validity, survey structure, sequence and completeness of questionnaires, and provided constructive feedback.

In order to obtain data for this research, the authors designed a questionnaire to survey the opinions of construction industry operators with roles as construction governors; project managers; construction researchers; contractors; site supervisors; consultants. Respondents were selected for interviews based on their previous participation in or directly implementing infrastructure investment projects in the form of PPP. Based on their experience, they will evaluate the degree of influence of the factors on the success of the infrastructure construction investment project in the form of PPP in Vietnam. It is critical to determine the measurement of samples in conducting quantitative analysis. According to Hair el at. (1998) [41], experience formula which is often used to calculate the size of samples for regression analysis as follows: $n \geq 50 + 8 \cdot p$ (n is the size of samples, p is the figures for independent variables in this model). Therefore, the indispensable size of samples is: $n \geq 50 + 8 \cdot p = 50 + 8 \cdot 6 = 98$. The total amount of sent survey forms is 250, the number of received and validated was 216, which is higher than the necessary number so collected data is reaching the qualification requirement. Data is synthesizing in the following Table 3.

Table 3. Descriptive Analysis of Surveyors' Information

	Information	Total Number	Percentage (%)
Gender	Male	146	67.6%
	Female	70	32.4%
Age	Below 30	49	22.7%
	Above 30	167	77.3%
Job position	Construction governors	46	21.3%
	Project managers	33	15.3%
	Contractors	82	38.0%
	Construction researchers	12	5.6%
	Site supervisors	27	12.5%
	Consultants	16	7.4%
Experience	Below 3 years	38	17.6%
	3 5 years	61	28.2%
	5 10 years	74	34.3%
	Above 10 years	43	19.9%

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Table 3 – continue

	Information	Total Number	Percentage (%)
Project types	Civil Engineering	48	22.2%
	Transport building	142	65.7%
	Infrastructure	85	39.4%
	Others	38	17.6%
Capital types	State capital	97	44.9%
	Private capital	203	94.0%
	Foreign capital	8	3.7%
	Others capital	21	9.7%
Contract forms	Build-Operate-Transfer (BOT)	154	71.3%
	Build-Transfer-Operate (BTO)	27	12.5%
	Build-Transfer (BT)	85	39.4%
	Build-Own-Operate (BOO)	12	5.6%
	Others	26	12.0%

4. Results and discussions

4.1. Reliability of measured sale

Cronbach's Alpha Testing

This stage was carried out by Cronbach's Alpha value α, ρc composite reliability, and ρvc variance extracted. The study of Hair, et al. (1998) [41] indicated that the standard evaluation of the applicable levels of the model, which is demonstrated by fail-safety of scale, is $\alpha \geq 0.6$; $\rho c > 0,5$ or $\rho vc > 0.5$ [42]. Cronbach's Alpha value is adopted to explain whether the factor included in the quantitative research has influenced the latent variable. In 6-group, Table 4 shown that Cronbach's Alpha > 0.7, so reliability is acceptable.

Table 4. Reliability Statistics

Latent factors	Observable variables		Corrected Item-Total Correlation	Factor loading	Cronbach's alpha
Factors Relevant to Public Sector (PB)	Predictable and reasonable legal framework	PB1	0.517	0.551	0.836
	Favorable PPP's legal framework	PB2	0.524	0.584	
	Promising economy	PB3	0.542	0.645	
	Stable political system	PB4	0.608	0.733	

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Table 4 – *Continued from previous page*

Latent factors	Observable variables		Corrected Item-Total Correlation	Factor loading	Cronbach's alpha
Factors Relevant to Public Sector (PB)	Strong government support	PB5	0.500	0.570	0.836
	Favorable economic system	PB6	0.594	0.693	
	Governmental project management	PB7	0.666	0.767	
	Good governance	PB8	0.580	0.680	
Factors Relevant to Private Sector (PV)	Sound financial analysis	PV1	0.776	0.827	0.940
	Human resources competence	PV2	0.718	0.749	
	Quantities, conditions, and ownership of plants and equipment	PV3	0.684	0.702	
	Financial competence	PV4	0.731	0.750	
	Qualification and experience have implemented the same previous projects	PV5	0.812	0.856	
	Using different capital investment	PV6	0.726	0.745	
	Appropriate toll/tariff levels	PV7	0.820	0.856	
	Abilities to deal with fluctuations in interest/exchange rates	PV8	0.786	0.809	
	Effective project management	PV9	0.744	0.773	
	Competencies subcontractors	PV10	0.708	0.726	
	Benefits of privates	PV11	0.677	0.712	
Factors Relevant to Selected Process Partnerships (PP)	Competitive procurement process	PP1	0.646	0.718	0.888
	Competitive process of selected sub-contractors	PP2	0.724	0.808	
	Transparency in the procurement process	PP3	0.678	0.722	
	Transparency process of selected sub-contractors	PP4	0.624	0.683	
	Appropriate evaluation standards	PP5	0.660	0.751	

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Table 4 – *Continued from previous page*

Latent factors	Observable variables		Corrected Item-Total Correlation	Factor loading	Cronbach's alpha
	An efficient privates approval process	PP6	0.742	0.785	
	An efficient subcontractors approval process	PP7	0.701	0.768	
Factors Relevant to Risk Management Systems (RM)	Predictable risk scenarios	RM1	0.823	0.905	0.872
	Appropriate risk-sharing for stakeholders	RM2	0.747	0.857	
	Appropriate risk allocation for stakeholders	RM3	0.726	0.835	
	Effective of risk management	RM4	0.620	0.778	
Factors Relevant to Project Informations (PI)	Project scales	PI1	0.665	0.736	0.900
	Project types	PI2	0.778	0.834	
	Project complex	PI3	0.714	0.734	
	Construction technologies and methods	PI4	0.722	0.769	
	Sufficient profitability of the project to attract investors	PI5	0.593	0.628	
	Benefits for communities	PI6	0.633	0.675	
	Clear and precise briefing documents	PI7	0.633	0.706	
	Financial feasibility of the project	PI8	0.601	0.650	
	Project places	PI9	0.623	0.686	
	Similar projects	PI10	0.559	0.637	
Factors Relevant to Natural Environment (NE)	Weather conditions	NE1	0.671	0.881	0.803
	Geological and hydrological conditions	NE2	0.671	0.830	

Item-total correlation is a coefficient that shows the level of association between observed variables and others. The standard to evaluate whether a coefficient contributes is that the item-total correlation must be higher than 0.3. If observed variables have an item-total correlation smaller than 0.3, they are weed out of the evaluated factors. Influenced factors have Cronbach's Alpha if the item deleted > 0.3 (Table 3), so is closely related to other factors in the model, influence factors should be retained in the research model.

Factors that influence after meeting Cronbach's Alpha requirements at a significant level, are subjected to an exploratory factor analysis to obtain a component matrix. Factor loading denotes the correlation between variables and factors used to assess the scope of the EFA. According to Hair, et al., (1998) [41], factor loading > 0.3 is considered to be the minimum; factor loading > 0.4 is considered important; factor loading > 0.5 is considered to have practical meanings. According to Table 3, 42 factors have factor loading > 0.5, so the data ensure convergence between variables in a factor.

4.1.1. Exploratory Factor Analysis (EFA)

Bartlett's Test of Sphericity and Kaiser-Meyer-Olkin Measure of Sampling Adequacy (Kaiser-Mayer-Olkin) are used to assess the suitability of EFA. Thereby, the hypothesis that variables are not interrelated in general is rejected. As a result, the EFA is considered appropriate if $0.5 \leq \text{KMO} \leq 1$ and $\text{Sig} < 0.05$. If $\text{KMO} < 0.5$, showing that the analyzed factors are not suitable for data [42]. Table 5 shown that Kaiser-Meyer-Olkin Measure of Sampling Adequacy $\text{KMO} = 0.853 > 0.5$, so meaningful analysis of factors with high relevance. In addition, Bartlett's Test of Sphericity with $\text{Sig} = 0.00 < 0.05$, therefore, the observed variables have an overall correlation with each other.

Table 5. Results of EFA for Independent Variables

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.675
Bartlett's Test of Sphericity	Approx. Chi-Square	122.595
	df	15
	Sig.	.000

The standard extraction factors include index Eigenvalue and index cumulative. Variables have Eigenvalue less than 1 which does not have a better characteristic in summarizing information than original variables. Hence, factors were extracted when Eigenvalue more than 1 and was explained if ρvc more than 50 percentage [42]. As demonstrated in Table 6, the Total Variance Explained = 52.732% > 50%, thus, the variation of observed variables is expressed as acceptable.

The following rotated component matrix to study the number of samples required 216 samples, and the load factor loading was found to be 0.5. At the component matrix, the observed variables with factor loading were less than 0.5, therefore, observed variables were uploaded to two groups of factors, and the coefficient difference at less than 0.3 was removed. It is clear that (Table 6) the variables PB; PV; PP; RM; PI; NE are variables with factor loadings of each observed variable greater than 0.5, there were excluded from the research model.

Table 6. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
PB	1.995	33.253	33.253	1.995	33.253	33.253	1.866	31.095	31.095
PV	1.169	19.479	52.732	1.169	19.479	52.732	1.298	21.637	52.732
PP	0.889	14.819	67.551						
RM	0.718	11.971	79.522			–			
PI	0.639	10.654	90.176						
NE	0.589	9.824	100.000						

Extraction Method: Principal Component Analysis .

Table 7. Result of Rotated Component Matrix

Rotated Component Matrix[a]		
	Component	
	1	2
PB	0.676	–
PV	0.671	–
PP	0.620	–
RM	–	0.729
PI	0.735	–
NE	–	0.773

Extraction Method – Principal Component Analysis.
Rotation Method – Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

4.2. Regression analysis

This stage aims to indicate that affect levels of independent variables to the dependent variable via coefficient β (β value between –1 and +1). The higher β indicated that factor has an important influence on the dependent factor. In the present study, there were 6 independent variables, including PB, PV, PP, RM, PI, and NE which have an effect on a dependent variable (PS). The results of the regression analysis were shown in Table 8.

Table 8. Model's Coefficients

Coefficients[a]							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Constant	–0.720	0.290	–	–2.459	0.138	–	–
PB	0.189	0.032	0.313	5.966	0.000	0.947	1.056
PV	0.253	0.032	0.409	7.828	0.000	0.958	1.043
PP	0.252	0.038	0.347	6.674	0.000	0.965	1.036
RM	0.158	0.034	0.248	4.693	0.000	0.935	1.070
PI	0.207	0.030	0.361	6.789	0.000	0.924	1.082
NE	0.140	0.031	0.239	4.492	0.000	0.921	1.086

a. Dependent Variable: PS

As demonstrated in Table 7, with multiple values of $\beta > 0$ show that all the independent variables are correlated with the dependent variable. Also, collinearity statistics with Tolerance > 0.1 and inflation factor of variance VIF < 2, thus indicating that the influencing factors are independent of each other. The phenomenon of multicollinearity between the independent variables has no significant influence on the regression model. The results of multiple regression analyses were applied to the regression equation to ensure statistical significance. The value of the independent variable in the model with Sig <0.05. It was observed that variables in the code were statistically significant at 5% significance. Hence, the independent variables in this model are aligned to dependencies. The regression results show that both having 8 independent variables that affect the dependent variable coefficients by Sig's 6 turns were below 0.05. Based on the standardized regression coefficient, regression equations determine the extent of the influence of each factor to the success of the implementation of PPP infrastructure projects in Vietnam which is identified in Eq. (4.1) as:

$$\text{PS} = 0.313 \cdot \text{PB} + 0.409 \cdot \text{PV} + 0.347 \cdot \text{PP} + 0.248 \cdot \text{RM} + 0.361 \cdot \text{PI} + 0.239 \cdot \text{NE} \tag{4.1}$$

where:

PS – dependent variable (the success of implementation),

PB; PV; PP; RM; PI; NE – independent variables (effected factors):

PB – the factors relevant to public sector,

PV – the factors relevant to private sector,

PP – the factors relevant to seleceted process partnerships,

RM – the factors relevant to risk management systems,

PI – the factors relevant to project informations,

NE – the factors relevant to natural environment.

Here, in formula (4.1), there is 1 dependent variable (the success of implementation of the PPP infrastructure projects) and 6 independent variables. In Table 2, the names and details of these 6 independent variables are given, and in Table 4, it is shown how to calculate the values of these 6 independent variables.

4.3. Testing conformity of regression model

By testing the suitability of the model by adjusted R^2 and testing analysis of variance (ANOVA), regression results are shown in Table 8 and Table 9. It is clear that the adjustment coefficient R^2 in this model (Table 8), which is $0.812 > 0.5$, affirms that impact factors determined by the model of the research are appropriate. This shows that there is an 81.2% variation in the success of the implementation of the PPP infrastructure projects in Vietnam (PS) which is explained, in general, by the above-defined 8 variables. The analysis of variance results (Table 9), shows that parameter F has Sig. = 0, which proved to be a recurring design model to be appropriate for the collected data. Figure 2 shows the histogram of the residuals for the developed model. The histogram demonstrated that the residuals are normally distributed. This is because, a standard distribution curve overlaps the frequency graph, which is a bell-shaped form, consistent with the shape of the standard distribution graph. Additionally, the value of Mean was approximately 0; the standard deviation was 0.986 (approximately 1). Therefore, the assumption of homoscedasticity or equal variances is fulfilled.

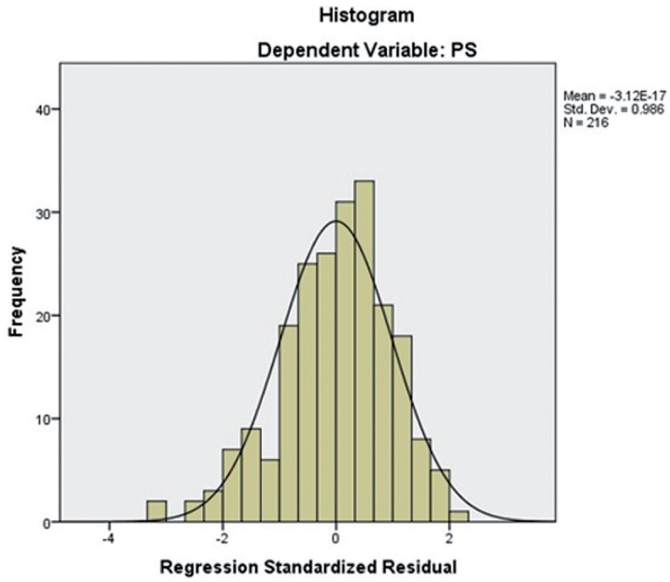

Fig. 2. Histogram of Residuals for the Regression Model

Table 9. Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.904[a]	0.817	0.812	0.3765

a. Predictors: (Constant), PB; PV; PP; RM; PI; NE

Table 10. Analysis of variance (ANOVA) results

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	132.333	6	22.055	155.595	0.000[b]
	Residual	29.626	209	0.142	–	–
	Total	161.958	215	–	–	–

a. Dependent Variable: PS; b. Predictors: (Constant), PB; PV; PP; RM; PI; NE

4.4. Ranking of the level influence of factors

As indicated in Table 11, with $\beta = 0.409$, "The factors relevant to private sector" has the most impact on the success of implementation of the PPP infrastructure projects in Vietnam, followed by "The factors relevant to project information" ($\beta = 0.219$), which were 2nd in terms of their impact on the success of implementation of the PPP infrastructure projects in Vietnam. "The factors relevant to selected process partnerships" and "the factors relevant to public sector" have a positive effect on the success of implementation of the PPP infrastructure projects in Vietnam (β are 0.347 and 0.313 respectively). "The factors relevant to risk management systems" and "the factors relevant to natural environment" have a medium impact on the success of implementation of the PPP infrastructure projects in Vietnam with almost the same coefficients β (0.248 and 0.239, in turn).

Table 11. Ranking of Influence Levels of Factors

No	Factors	Impact Index	Ranking
1	The factors relevant to private sector	0.409	1
2	The factors relevant to project information	0.361	2
3	The factors relevant to selected process partnerships	0.347	3
4	The factors relevant to public sector	0.313	4
5	The factors relevant to risk management systems	0.248	5
6	The factors relevant to natural environment	0.239	6

Research results show that, out of a total of 6 groups of factors affecting the success of PPP infrastructure projects in Vietnam, the group of factors related to the private sector has a great impact. best. The private sector helps access to finance, advanced technology, effective management, timely completion of works and the most effective exploitation of works, Besides, private investors will contribute to shifting the payment burden from taxpayers to consumers because their purpose is revenue and offset costs, At the same time, private participation in infrastructure investment will also contribute to wasteful corruption, because private capital is always strictly managed to bring the highest efficiency. In this group, the component factors all have a great influence. This result is consistent with the studies of Bing Li et al (2012) [22]; Cheung, E. et al. (2012) [18] when it is said that the capacity of the investor plays a very important role in the success of the PPP project.

The group of factors related to project information ranked second. Determining the size, type, location of the project, and the quality of the documentation has a huge impact on the cost, time, and quality of an infrastructure PPP project. Sufficient information will help stakeholders determine toll rates, location of toll booths, toll collection time. The profitability of the project is not only determined on the investor's profit factor, *the PPP project will ensure mutual benefits for both the State and the private sector*.

The success of a PPP project also depends heavily on the choice of a private partner [56]. When participating in a PPP project, the private sector is responsible for financing, designing, constructing, operating, maintaining, and providing services until the end of the PPP project implementation period. Therefore, the State needs to ensure the selection of investors with sufficient capacity and professional experience. Investor selection through a transparent and competitive bidding process. Therefore, the State needs to use scientific assessment methods and develop a set of evaluation criteria in line with the State's objectives [26].

In order to achieve success when implementing PPP projects, the State plays a very important role in the development and management of these projects [26]. Government support is needed especially for developing countries to ensure that private participation can be attracted and that people's needs are satisfied [57, 58]. This result is appropriate, because a complete and transparent regulatory framework is a prerequisite for the success of the PPP. Based on that legal framework, the State solves problems arising during the implementation of PPP projects, ensures the harmony of interests between the parties, thereby increasing the confidence of private investors, ensuring ensure effective projects, appropriate risk allocation and avoid potential risks [26].

Not only for PPP projects, most construction projects are constructed in the natural outer space, where the direct influence of weather factors, the weather does not favor or sometimes becomes difficult. should be harsh, it will significantly affect the quality, cost and construction progress, which directly affects the success of the project. The survey results show that the role of natural conditions in the project implementation process is objective and undeniable. In order for the project to achieve its planned goals, stakeholders need to anticipate. difficulties arising due to natural environmental conditions to limit risks in the production process. The group of factors related to the natural environment has the

lowest level of impact. This is also understandable, because these are objective factors, relatively fixed, with little annual change, although recently the issue of climate change has received much attention.

5. Conclusions and recommendations

This study was conducted to assess factors influencing the success of the implementation of the PPP infrastructure projects in Vietnam. Throughout the literature review, categories of six factors were identified and listed that affected the success of the implementation of PPP infrastructure projects in Vietnam. They are factors relevant to public sector, factors relevant to private sector, factors relevant to selected process partnerships, factors relevant to risk management systems, factors relevant to project information, and factors relevant to natural environment. From 216 questionnaires were collected through the survey, this study used a linear regression analysis method to access and rank the impact levels of these factor groups. The findings indicated that the factors relevant to the private sector has the most significant impact on the success of the implementation of the PPP infrastructure projects in Vietnam, followed by the factors relevant to project information, the factors relevant to selected process partnerships, and the factors relevant to public sector.

To rely on the researching results, in the case of Vietnam, this study highlighted the key role of private sector on the success of the implementation of PPP infrastructure projects. In other words, the competencies of the private sector have a significant contribution to the success of implementing PPP infrastructure projects. Besides, the information about PPP projects must be fully and transparently provided throughout the process of these project implementation. Also, the state should focus on establishing appropriate procedures for the selection of the private sector and subcontractors with appropriate evaluation standards to improve the transparency of the procurement process leading to the success of PPP infrastructure projects. Because of descriptive study, the paper has limitation that only describes actual status of factors influencing on the success of PPP infrastructure projects in Vietnam. These factor are general not speficic, but not for only Vietnam.

The degree of influence of factors on the success of PPP infrastructure projects varies from project to project, from country to country and even within the same project, depending on the circumstances, the degree of impact. This is also subject to change. Although many researchers have conducted factor studies on the success of PPP infrastructure project implementation in many countries from different continents and the results have different validity. drawn from these studies, it seems quite modest compared to a large number of countries and construction projects in the world.

Many factors affecting the success of PPP infrastructure project implementation have been identified and evaluated in previous studies to date, thereby providing a comprehensive picture of this topic. Therefore, the main factors (6 groups of factors with 45 components) need to be considered more deeply in future empirical studies.

Furthermore, the majority of research in this area to date has only been carried out on the basis of public or private sector perceptions. Future directions should consider the

perceptions of project stakeholders to identify and assess the importance of success or failure factors for PPP infrastructure projects. Further studies are needed on the determinants of the implementation of different types of PPP projects or different forms of PPP contracts.

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