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## Article

# Relationship between project success and the success factors in public-private partnership projects: A structural equation model

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## BANKING & FINANCE | RESEARCH ARTICLE

# Relationship between project success and the success factors in public–private partnership projects: A structural equation model

Usman Ahmad<sup>1</sup>, Hamid Waqas<sup>2\*</sup> and Kashif Akram<sup>3</sup>

**Abstract:** The budgetary pressures, scarcity of resources, and incessant increases in the demand for public services have driven the Malaysian government to involve the private sector in the development of infrastructure through public–private partnership (PPP) projects. Despite the benefits of PPP projects in different regions, including Malaysia, various PPP endeavours are considered unsuccessful for many reasons. However, the evaluation of the success of these projects is not robust because the definition of the PPP project's success based on its distinct nature is inadequate. Moreover, the reviewed literature has identified critical success factors (CSFs) for PPP projects, but the question remains whether these factors are real success factors. Thus, this study aimed to develop a robust definition of a PPP project success variable, to categorise the CSFs, and to examine the relationship between the CSF categories and the success of the PPP project.



Usman Ahmad

### ABOUT THE AUTHOR

Dr Usman Ahmad is Assistant Professor at DHA Suffa University. Dr Ahmad has conducted research on Malaysian Public Private Partnerships (PPP), in particular, risk management, financial management and project success of PPP projects. Dr Ahmad has profound expertise and interests in risk management, project management, fraud risk management, credit risks, public finance and international finance.

Dr. Hamid Waqas is Senior lecturer at Westminster International University in Tashkent (WIUT) Uzbekistan. He wrested expertise in Corporate Finance, Investment Risk management and Financial Management. He has diversified research interests consisting on leadership and industrial safety management practices, economic growth, capital structure, public private partnership, financial distress and portfolio diversification.

Dr. Kashif Akram is currently serving as an assistant professor at the department of Management and HRM, school of business management and administrative sciences, IUB. His research interests are strategic management, knowledge management and innovation in organizations particularly in public higher education institutions.

### PUBLIC INTEREST STATEMENT

Around the globe, various governments seek private sector involvement to meet the demand of infrastructure and public services through Public Private Partnership (PPP) projects. In Malaysia, various types of PPP (i.e., BLMT, BOT and BOOT) are employed in for the development of infrastructure and public services to meet the demand and for better service quality. However, the involvement of public and private sector in the PPP project make the project complex and different than other projects. This distinct nature and complexity increase the risks and requires robust practices. Therefore, this study describes the critical success factors associated with BLMT and BOT projects.

To achieve these objectives, this study adopted a mixed research method—specifically, an exploratory sequential research design. First, in implementing this method, interviews were conducted to develop the measurement items for the PPP project's success. Second, the study conducted a survey to collect the data for the exploratory factor analysis (EFA) of the newly developed PPP project success items and the principal component analysis (PCA) to categorise the CSFs. Third, the study conducted a second survey to examine the relationship between CSFs and PPP project success.

The findings indicated that a PPP project's success can be measured based on four dimensions: time, cost, objects, quality and stakeholders' satisfaction. Moreover, the study considered quality and stakeholders as one dimension because of the quality phenomenon. The quality phenomenon explains that the delivery of quality services satisfies all the stakeholders. Furthermore, the CSFs were categorised into five groups that significantly affected the success of PPP projects.

**Subjects: Public Finance; Operational Research / Management Science; Operations Management; Critical Management Studies**

**Keywords: critical success factors; public private partnership; Malaysian government; Exploratory Factor Analysis; Principal Component Analysis**

## 1. Introduction

The provision of public services and infrastructure is the government's responsibility; however, because of budgetary pressures, different governments tend to involve the private sector to provide public services by implementing public-private partnership (PPP) tools. These budgetary pressures, scarcity of resources, and the continuous increase in demand for public services have driven the Malaysian government to involve and direct the private sector towards providing public services through a PPP (Ismail, 2013b). Although the Malaysian government has been implementing PPP projects in many sectors since the mid-1980s (Ismail, 2013a), Soomro and Zhang (2013) reported that various PPP projects in different regions failed for many reasons. Similarly, Malaysia Beh (2010) reported on issues of patronage, cost-benefit analysis, and supervision; Markom et al. (2012) identified the problems of low cash flows and construction cost overruns in the Light Rail Transit (LRT) project; and Tan (2012) stated the reasons for the underachievement of the Water and Sanitation Services (WSS).

Although many projects have been successful, it cannot be denied that a considerable number of projects have underachieved, partly because these success evaluations are not robust (Osei-Kyei, 2017). PPP projects require massive capital investment (Yescombe, 2011), and scarce resources are required on the part of practitioners to define the PPP's robust success for high-cost projects such as those commonly found in a PPP (Ika, 2009a; Ika et al., 2012). Nevertheless, the issues concerning the criteria used to measure the success of PPPs are still unclear. Currently, researches pertaining to PPPs have focused on risk management, the identification of critical success factors (CSFs), Value for Money (VfM) calculation, governance issues, economic viability, and procurement. Nevertheless, the success criteria remain elusive (Ke, 2009; Osei-Kyei, 2017).

Although Ika et al. (2010) established and constructed the success dimensions for international development projects (IDPs), it should be noted that each PPP project is unique due to the involvement of both public and private sectors (Ahmad et al., 2018a; Ismail, 2013a). The development of a specific construct for the success of the PPP project is indispensable; Shenhar (2001) argued that the success dimensions and measures closely depend on the type of project (i.e. low, medium, or high technology) and time frame (i.e. long term or short term). Therefore, the same construct may not be appropriate for each PPP. In addition, the involvement of both the public and

private sectors and their differences in perceptions about critical issues make the project more complex (Ahmad et al., 2017).

Because of the importance of PPP projects, the literature highlights the CSF that contribute to a PPP project's success. However, all CSFs are based on the experience of managers; therefore, such factors are termed perceived success factors (Grunert & Ellegaard, 1992). The actual success factors are the result of a statistical analysis of the relationship between success factors and project success (Grunert & Ellegaard, 1992; Ika et al., 2012). Cooke-Davies (2002) termed success factors as "real success factors". In the absence of the PPP project success variable, many of the identified CSFs remain vague. Ika, 2009a, p. 9) questioned, "How can you say what the correct success factors are until you have identified the criteria?" Furthermore, prior literature (Cserháti & Szabó, 2014; Ika et al., 2012; Westerveld, 2003) strongly recommended examining the empirical effects of success factors on project success. Moreover, in Malaysia, Build-Operate-Transfer (BOT) and Build-Lease-Maintain-Transfer (BLMT) are two important types of PPP projects that are implemented in vital sectors of its economy (Ahmad et al., 2018a). Still, both types are different in nature (Ahmad et al., 2018). Therefore, this study considers the types of PPPs as a moderator in the relationship between a PPP project's success and success factors.

Thus, the objectives of this study were twofold. First, it aims to develop a construct for the success criteria of PPP projects. Second, it aims to examine the relationship between CSFs and the success of PPP projects. The results of this study may help researchers to find the real CSFs that significantly affect the success of a PPP project. These results may also help practitioners focus on those dimensions that drive success for the project.

## 2. Literature review

### 2.1. Public-private partnership

Recently, there has been a worldwide increase in efforts to seek the involvement of the private sector in the development and financing of public infrastructure and services. Many techniques are being developed to bring the public and private sectors together to share the risks and returns related to such a consolidation. The various techniques are often referred to as the "public-private partnerships" (PPPs) and range from a simple contracting out of management services to the involvement of the private sector in the financing, design, construction, operation, maintenance, and, in some cases, the ownership of major public service facilities and infrastructure (Yescombe, 2011).

According to the prime minister, the PPP Department of Malaysia defines a PPP as, "PPP is a form of cooperation between the PPP in which the standalone business is created, funded, and managed by the private sector as a package which includes the construction, management, maintenance, repair, and replacement of public sector assets including buildings, infrastructures, equipment, and facilities" ("Official Portal of Public-Private Partnership Unit", n.d.). The Malaysian PPP process comprises five phases: the pre-project planning and selection of the private partner or a special purpose vehicle (SPV) phase; planning phase; construction phase; commencement of operation phase; and finally, the transfer to the government phase (Ahmad et al., 2018a). It is worth noting that in Malaysia, different types of PPP projects are implemented in different sectors of the economy (Ahmad et al., 2018a).

### 2.2. Critical success factors (CSFs)

In the reviewed literature, the terms "critical success factors" ("CSFs") and "success factors" for projects are interchangeably used in the same context. According to Boynton et al. (1984), the identification of CSFs is not limited to project management, although its roots have been found in the field of project management. Rockart (1979, 1982) defined CSFs as "those few key areas of activity in which favourable results are necessary for a particular manager to reach his or her own goals". The importance of CSFs leads to another crucial argument, "how to find the critical success

factors (CSFs)” and “what are the real success factors” (Ika, 2009a; Ika et al., 2010, 2012). To answer the first question, Rockart (1982) proposed an interview method to identify CSFs.

There are two other types of CSFs: perceived key success factors and actual success factors (Grunert & Ellegaard, 1992). The perceived success factors are based on the experiences of practitioners, whereas actual success factors are the result of the statistical analysis of the relationship between success factors, cost, and objectives. The literature (Cserháti & Szabó, 2014; Ika et al., 2012; Westerveld, 2003) elucidates that actual success factors that are based on statistical analysis benefit the project more, and there is a pressing need to convert perceived success factors to actual success factors.

For different types of PPP arrangements, the literature identifies CSFs based on practitioners. Table 1 presents the success factors identified by different researchers in different regions of the globe.

### 2.3. Project success

Ika, (2009a) and Ika et al. (2012) described success as “a happy result, a success”. However, “what is the success of the projects?” In the available literature, no consensus has been reached about the means of “project success” or “failed projects” (Ika, 2009a).

Atkinson (1999) and Westerveld (2003) considered the restrictions of time, cost, and quality or “triangle: time, cost, quality” or the “iron triangle” as sufficient to describe a project’s success. Even so, it has often been observed that there have been projects that had been delivered on time, within budget, and according to the required specifications but still were considered as failures. In contrast, some projects failed to meet the requirements of time, cost, and quality, yet have been proven to be successful (Pinto & Slevin, 1988). Hazebroucq (1993) explained that projects which had been perceived as failures at one time could become symbols of success later. Conversely, some successful projects have proven to be disastrous. Hence, it is the criterion for achieving prolific objectives or stakeholders which define the level of the success of projects (Ika, 2009a).

Ika, (2009a) highlighted that, in the past, a robust explanation of project success is scant in the available literature. Over the decades, various authors have explained countless dimensions of success in different words, but they share similar concepts. Accordingly, Table 2 depicts the dimensions of project success.

### 2.4. Project success and success factors

Rockart (1982) explained that success factors are key areas affecting the success level of a project or crucial factors that need to be handled properly to achieve the success factors. In other words, success factors must have an impact on the level of success. This clearly means that a true success factor for PPP projects should have an impact on the PPP project’s success. As Ika et al. (2012) explained, the greater the impact on success, the more important the success factor is. However, the criticality of this factor cannot be gauged based on perceptions. Therefore, this study considered all of the success factors in the field of PPP that were identified as CSFs for the purpose of examining the empirical relationship between success factors and the success of establishing the actual CSFs. Thus, the hypotheses of this study are as follows:

H1: Success factors have a significant effect on the PPP project’s success.

Table 3 describes the number of PPP projects completed until 2019 and their types (Ahmad, 2019). The current literature (Ahmad et al., 2018b, 2018) suggest that different types of PPPs are diverse in nature and may result in different success factors. Therefore, this study develops another hypothesis:

**Table 1. CSFs for PPP Projects**

Sr.	Factors	Scholars of who identified the factor
1	Appropriate risk allocation and risk sharing	Qiao (2001), Grant (1996)
2	Available financial market	Akintoye (2001) Qiao (2001)
3	Clarification of contract documents	Hwang et al. (2013)
4	Clear defined responsibilities and roles	Hwang et al. (2013)
5	Commitment/responsibility of the public/private sector	Stonehouse et al. (1996)
6	Competitive procurement process	Jefferies et al. (2002) and Kopp (1997)
7	Favourable legal framework	Bennett (1998) and Boyfield (1992)
8	Good governance	Qiao (2001)
9	Government involvement by providing guarantees	Qiao (2001) and Stonehouse et al. (1996)
10	Multi-benefit objectives	Grant (1996)
11	Political support	Qiao (2001)
12	Project technical feasibility	Qiao (2001)
13	Shared authority between public and private	Stonehouse et al. (1996)
14	Sound economic policy	Li (2005)
15	Stable macro-economic environment	Qiao (2001)
16	Strong private consortium	Jefferies et al. (2002)
17	Technology transfer	Qiao (2001)
18	Thorough and realistic cost/benefit assessment	Qiao (2001)
19	Transparency in the procurement process	Jefferies et al. (2002) and Kopp (1997)
20	Well-organised public agency	Li (2005)

Source: Author's Work

H2: Certain types of PPPs have a significant moderating effect on the relationship between success factors and project success.

Thus, the discussion of the hypothesis concludes following research framework;

### 3. Methodology

This study aims to examine the relationship between success factors and PPP project success. Although the study adopts success factors from the literature (see Table 1), the construct of PPP project success needs to be developed. To achieve this objective, the study adopted a mixed method approach—specifically the exploratory sequential method—as suggested by Creswell (2017). The exploratory sequential method consisted of two phases: qualitative and quantitative. In the qualitative phase, the study developed a PPP project success construct based on interviews and the research experts' judgment (DeVellis, 2016). The construct was tested in the quantitative phase, the success factors were categorised, and the hypotheses were tested (DeVellis, 2016).

The purpose of the qualitative approach in the first phase was to assist in the development of a questionnaire on PPP project success (Creswell, 2017). This first phase was divided into three

**Table 2. Success Dimension in Literature**

Dimensions	Definition	Authors
Time	The project must achieve the goals of the timeframe	De Wit (1988), Ika, (2009aa), Pinto and Slevin (1988) and Muller and Turner (2007)
Cost	Actual cost should not increase more than the budgeted cost	Baccarini (1999) De Wit (1988) Ika, (2009a), Muller and Turner (2007), Pinto and Slevin (1988) and Shenhar (2001)
Quality	Quality of operations/services provided, or product should be according to the general thresholds	Pinto and Slevin (1988), De Wit (1988), Might and Fischer (1985), Baccarini (1999), Shenhar (2001) and Ika et al. (2010)
Achievement of Project Objectives	Main objectives/expected results other than time/cost/quality should be achieved	Might and Fischer (1985), De Wit (1988)
Stakeholder satisfaction	All stakeholders should be satisfied with the project's services	Pinto and Slevin (1988)
Preparation for future	The project should be ongoing according to the future needs of the stakeholders	Shenhar (2001) and Ika et al. (2010)

stages: interviews, development of items, and expert judgment of the items (DeVellis, 2016). Based on the qualitative interview guidelines (Sekaran & Bougie, 2016; Whiteley, 1998), this study used open-ended questions to establish the domain/definitions of PPP project success. For this phase, interviews were conducted with 28 practitioners who were involved in PPP projects from both the public and private sectors. Twenty-eight interviews were considered sufficient because of the repetition of the information.

Based on the interview findings, a large initial pool of items was generated which was shrunk into a small pool of items. Based on Lynn's method (1986), these items were listed in the form and sent to research experts in the field of PPP for content validity analysis. The experts rated the items based on Lynn's rating scale (1986). For content validity, the study consulted ten research experts to determine the content validity of the PPP project items, and five of these experts had research expertise in PPP projects.

After the items were finalised, the quantitative phase was initiated. It comprised an exploratory factor analysis (EFA) of the measurement items of PPP project success, a principal component analysis (PCA) for success factor categorisation, and structural equation modelling (SEM) for hypothesis testing. In this phase, the data were collected twice using a survey questionnaire based on simple random sampling. The first survey was conducted for an EFA and PCA to test the newly developed construct of PPP project success; correspondingly, the second survey was

**Table 3.**

Type of PPP	No. of Project
BLMT	62
BOT	56
BLT	12
LMT	1
BOO	1
Other Types	26
Total	158



conducted for the SEM to test the hypothesis. For the first survey, two questionnaires were sent for one project: one to the managers from the Ministry (public sector) and another questionnaire to the managers of an SPV (private sector). The study received 152 questionnaires out of 200 for the first survey. For the second survey, a questionnaire was sent to the directors of PPP projects from both the public and private sectors involved in the monitoring of the current PPP projects. The study received 128 out of the 200 questionnaires sent; notably, of the 128 questionnaires received, 70 belonged to the BLMT type of PPP and 58 belonged to the BOT type. Hair et al. (2016) recommend adopting partial least squares structure equation modelling (PLS-SEM) to test complex structural models with a small sample size; thus, this study adopted the PLS-SEM approach.

### 3.1. Analysis, results, and discussion

This section presents the analysis and findings of both phases. The first phase is qualitative, whereas the next phase is the quantitative method.

### 3.2. Qualitative phase analysis

This section presents the analysis of the interview data, discusses the developed items of the PPP project success, and presents the content analysis of the developed items based on the judgment of experts.

### 3.3. Interview results

The answers to the interview questions formed the raw data of the study. To interpret the raw interview data, the study used Atlas.ti 8.0 software, which was used to generate codes (themes) and interview quotations to describe the PPP project success. Each code was based on several interview questions. Based on the codes and quotations, PPP project success can be described as:

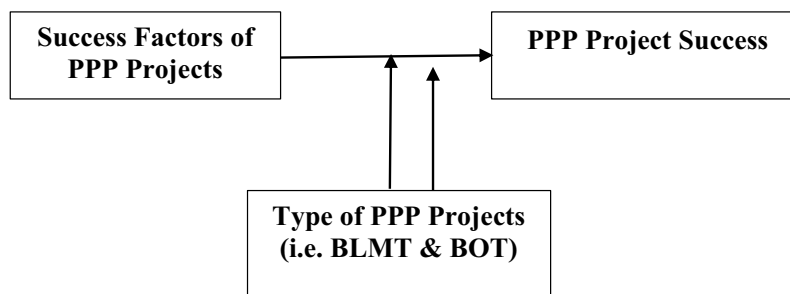
PPP project success consists of various dimensions—namely, time, cost, quality of services, profile objective, and stakeholder satisfaction. Nevertheless, preparing for the future was excluded based on expert opinions. Figure 1 depicts the dimensions of PPP project success. The letters D and G represent the density and groundedness of the code, respectively. Density refers to the attachment of a code to other dimensions and constructs. Furthermore, a density of more than 1 means that the code is attached to more than one dimension or construct. In addition, groundedness refers to the number of quotations attached to the code.

The interview results for the PPP project successfully revealed each dimension, which are discussed as follows:

### 3.4. Time

- PPP agreements are time-specific and based on certain demand forecasts. Based on the demand forecast, the government initiated the project, and the SPV would prepare a budget for a specific period. Therefore, the pressure of public demand makes time very crucial for both the government and the SPV. For instance, a road project should deliver services based on highway traffic forecasts.

Figure 1. Research Framework.



Similarly, a university hostel project of a specific number of rooms must commence its service at a scheduled time before the admissions of students.

To meet the demands of the scheduled time, suitable planning time, completion of project construction, and commencement of operations at the scheduled time are critical in a PPP project. The planning phase would normally take longer for many reasons, such as the clarity of the design concept and delays in approvals. However, proper planning is vital for the success of PPP projects. Delays in construction or installation affect the overall schedule because the constructed facility cannot be immediately enjoyed in the case of delay. After the construction, the respective public departments would inspect the facility based on the key performance indicators (KPIs) of the PPP agreement. In the case of minor or major defects, extended time is required for the necessary rectification. Therefore, the three crucial components of time are the proper planning of time, in-time construction, and commencement of operation at the schedule.

The government desires in-time construction and commencement of service delivery to avoid any public hostility. In addition, delays in commencement may incur extra costs for the provision of a substitute. Furthermore, in the case of a long delay, the government may cancel the agreement which in itself is a failure of the PPP project.

Similarly, time is crucial for an SPV because it receives a unitary charge (payment from the government) at the start of the operation, yet it must start the repayment of debt instalments at the specified time, irrespective of when the operation commenced. Therefore, for an SPV, it is vital to start operations at the scheduled time. Even so, possible delays in approvals, lengthy documentation, and excessive changes in design may increase the planning time. In addition, material availability, technological imports, and lengthy inspections may delay the construction and commencement of service delivery. Therefore, it can be concluded that PPP project time consists of three crucial timelines: suitable planning time, in-time construction, and the commencement of service delivery. Thus, this study developed three measurement items over time.

### **3.5. Cost**

- Cost plays a pivotal role in the success of the PPP project, as it affects the overall budget. The cost of the PPP project comprises the construction and operation/maintenance costs. Both these costs are associated with each other because the quality of the material used in the construction stage affects the frequency of maintenance during the operation stage. Owing to its importance, cost is crucial for both the government and the SPV.

To the government, cost is vital because, ultimately, the government must bear the cost of the project. Therefore, the cost is minimal. Based on budgeted construction and maintenance costs, the government fixes the unitary charge (rental payment). In the case of any increase in the maintenance cost, the unitary charge can be revised. However, the government does not incur any increase in construction costs.

For an SPV, any increase in cost is crucial, as it directly affects cash flows and profitability. For an SPV, the cost of a PPP project can be divided into three sections: the cost of finance, construction, and operations. Only in the case of an increase in the cost of maintenance, the government may increase the payment of unitary charges. Otherwise, the SPV would have to bear the burden of an increase in cost. Furthermore, the cost of maintenance could affect the budgeted cash flows because the cash flows of the SPV depend on the payment (inflow) from the government/public and the maintenance cost (outflow), whereas the amount and schedule of debt instalments are fixed. Therefore, low cash flows may lead to delays in debt instalment. Therefore, this study measures costs by using construction and budgeted cash flows.

### **3.6. Quality of service**

The quality of service is vital for both the government and the SPV. The quality of service must be coherent with its KPIs. The government has the purpose of seeking private sector involvement because of its investment and better quality of service. Similarly, service quality is vital for an SPV because in the case of the KPIs failing to be achieved, the unitary charges can be stopped, or penalties can be imposed that can directly affect the profit margins. Furthermore, in Malaysia, all PPP projects belong to critical public sectors, such as health, education, security, and infrastructure. Therefore, quality is crucial. In addition, the failure of the SPV in providing good quality services may affect the government directly in terms of inviting public hostility. Thus, this study suggests the need to measure the quality of services pertaining to specific KPIs mentioned in the agreement rather than comparing them with a general threshold.

### **3.7. Objectives in profile**

Ministry officials usually develop a needs statement for every PPP that states the project's objectives and profile. Generally, all these objectives are publicly announced and available on the Ministry's website. One of the main objectives is the VfM, which aims to achieve maximum service with low cost at standard quality. Technical experts of Malaysia's Public Private Partnership Unit (UKAS) defined that the VfM ratios for each project should be achieved through PPP projects—otherwise, PPP projects are not considered successful.

For all the government ministries of Malaysia, the profile objectives and the VfM are one of the main concerns, as the auditor general of Malaysia will inspect the VfM and objective profiles on a yearly basis. Moreover, it is important for the government to achieve VfM to avoid political hostility. Ika et al. (2012) and Munns and Bjeirmi (1996) postulated that the achievement of specific objectives is one of the dimensions of success. For PPP projects, the achievement of the VfM is one of the specific objectives. Therefore, this study suggests the inclusion of VfM as an item in the construct of success.

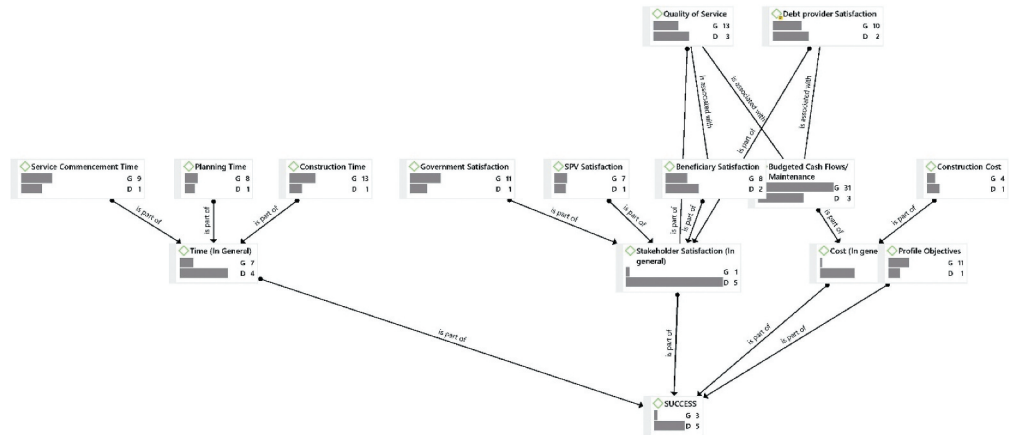
### **3.8. Stakeholder satisfaction**

Interviewees revealed four main stakeholders: the government, SPV, debt financier, and public/user. A PPP project should satisfy all of these major stakeholders. The government needs to fulfil all its objectives in the provision of a particular public service, whereas the SPV needs to achieve a budgeted profit margin. Similarly, a debt-provider requires an in-time repayment, and the public needs satisfactory service at a low cost.

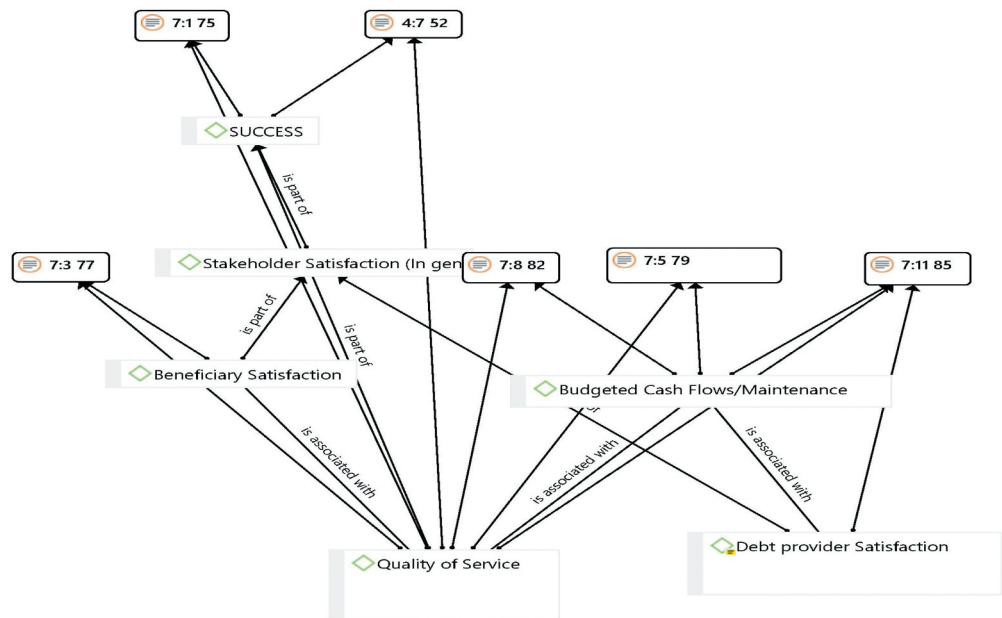
Therefore, based on the interviews, a project is considered successful if it is completed in the budgeted cost, delivers the desired services within the scheduled time, obtains all its objectives, and satisfies all the stakeholders.

Based on the interview quotations, Figure 2 explains the *quality phenomenon*. The low quality of service is associated with unsatisfied beneficiaries which in turn creates hostility. The government may stop the payment to the SPV for low-quality services or deduct some amount from the payment as a penalty. This situation reduces the cash flows of the SPV and delays the payment of debt instalments to financial institutions. In a worse situation, project operations may shut down for the non-payment of debt instalments. Furthermore, the delay in debt instalments discourages financial institutions in the market to extend debts for PPP projects. For instance, students in the case of a hostel project and the public in the Medical Equipment Enhancement Tenure (MEET) project (Ahmad et al., 2018b) may express hostility to compel the government to take action against the SPV. Similarly, the government may stop the SPV from collecting road tolls for inferior road quality. Thus, the quality of the phenomenon affects all the stakeholders (Figure 3).

**Figure 2. PPP Project Success.**



**Figure 3. Quality Phenomenon.**



### 3.9. Excluded dimension

The findings of interviews indicated the lack of usefulness of one dimension: the future preparation or expansion of the market or the fulfilment of a future need. Each PPP project was built for the specified objectives and specific demands. Based on specific demands, all budgeted statements are prepared. In PPP projects, management does not account for any budget for future marketing or expansion. In the case of extra demand or expansion, the government launched a separate project. Even if expansion is required in the current project, expansion comes under a new project because separate planning and agreement are prepared for that expansion. Nevertheless, the need statement of the government accounts for future demands and creates plans for projects that are connected. Therefore, unlike normal business projects, future preparation or market expansion is not carried out for a specific PPP project.

### 3.10. Development of items and content analysis

Based on the above description, a large pool of items has been developed for PPP project success in accordance with the guidelines proposed by DeVellis (2016). A large pool of items was presented

**Table 4. The correlation for PPP Project Success Items**

	Time 1	Time 2	Time 3	Cost 1	Cost 2	Quality	Profile Objective	Profile Objective 2	Stakeholder 1	Stakeholder 2	Stakeholder 3	Stakeholder 4
Time 1	1.000	.838	.876	.209	.182	.250	.529	.524	.271	.369	.333	.310
Time 2	.838	1.000	.886	.177	.187	.255	.495	.520	.260	.254	.189	.311
Time 3	.876	.886	1.000	.194	.132	.222	.541	.517	.234	.347	.278	.308
Cost 1	.209	.177	.194	1.000	.657	.172	.484	.468	.079	.084	.092	.096
Quality Profile	.250	.255	.222	.172	1.000	.233	.442	.457	.136	.155	.104	.090
Profile Objective	.529	.495	.541	.484	.442	1.000	.301	.390	.492	.487	.472	.515
Objective 2 Stakeholder 1	.524	.520	.517	.468	.457	.390	1.000	.869	.209	.258	.295	.374
Stakeholder 2	.271	.260	.234	.079	.136	.492	.209	.269	1.000	.690	.751	.768
Stakeholder 3	.369	.254	.347	.084	.155	.487	.258	.258	.690	1.000	.791	.714
Stakeholder 4	.333	.189	.278	.092	.104	.472	.272	.295	.751	.791	1.000	.681
	.310	.311	.308	.096	.090	.515	.278	.374	.768	.714	.681	1.000

Determinant = 5.38E-005

**Table 5. KMO and Bartlett’s Test for PPP Project Success Items**

<b>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</b>		<b>0.804</b>
<b>Bartlett’s Test of Sphericity</b>	<b>Approx. Chi-Square</b>	<b>1.437E3</b>
	<b>Df</b>	<b>66</b>
	Sig.	0.000

by the School of Economics Finance and Banking (SEFB) committee. Based on this suggestion, a small pool of items was generated. Ten research experts rated the items based on Lynn’s method (1986) by examining content validity in the form of an item-content validity index (I-CVI), construct validity index (C-CVI), and the ratio of the agreed experts to all experts. The threshold value for this study for each item (I-CVI) was 0.6 (DeVellis, 2016).

For PPP project success, after the suggested revision, all the items have at least 0.9 I-CVI, and the overall scale has 0.93 S-CVI. Likewise, the overall agreement ratio of the experts is 0.5, which means that 50% of the experts are in complete agreement to approve the scale. These results confirm that the PPP project success scale is satisfactory and can be used for quantitative research tests.

**3.11. Quantitative phase analysis**

This section presents the EFA for the PPP project success items, a PCA for the success factors, and a SEM analysis to examine the relationship between success factors and PPP project success. The details of the analysis are as follows.

**3.12. Exploratory factor analysis (EFA)**

To ensure the dimensionality of the PPP project success items that were developed in the previous section, Yong and Pearce (2013) suggested examining the patterned relationship between the items and sample adequacy of the data set before extracting the factors.

**3.13. Patterned relationship**

To ensure the suitability of the current study’s dataset for EFA, a patterned relationship through the correlation matrix is examined. The patterned relationship reveals the possibility of extracting factors from a pool of items through the correlation matrix and Bartlett’s test of sphericity. In addition, the confirmation of the patterned relationship authenticates the absence of multicollinearity among the items. This step is consistent with prior studies (Field, 2013). Furthermore, Yong and Pearce (2013) asserted that the determinant score of the correlation matrix should be higher than 0.00001, and the correlation among the variables should be less than 0.9. In addition, Bartlett’s test of sphericity determines the significance level of the patterned relationship. Consequently, Bartlett’s test of sphericity ensured that the p-value was less than 0.05. Tables 4 and 5 illustrate that the correlation values of all the items are less than 0.9, and the determinant value is 5.38E-005—which is satisfactory. Both the correlation matrix and p-value authenticate the patterned relationship.

**3.14. Sample adequacy**

After a patterned relationship, the next step in the EFA is to determine the sample adequacy. Yong and Pearce (2013) suggested that a Kaiser-Meyer-Olkin measure (KMO) and diagonals elements of the anti-correlation matrix are measures that can be used to determine sample adequacy. The value of the KMO value should be higher than 0.5, and the diagonals values should also be more than 0.5. Table 5 shows a 0.804 KMO value that is acceptable for the current study. In addition, the diagonal values of the anti-image matrix are from 0.670 to .886, which are satisfactory (Table 6). Both the KMO and anti-correlation matrix depicted also indicated the adequacy of the sample size.

**Table 6. Anti-Image Correlation**

Time 1	.886 <sup>a</sup>	-.316	-.416	-.019	-.009	.031	-.004	-.057	.047	-.077	-.181	.115
Time 2	-.316	.773 <sup>a</sup>	-.613	.131	-.158	-.105	.092	-.097	-.221	.176	.254	-.116
Time 3	-.416	-.613	.785 <sup>a</sup>	-.099	.206	.089	-.168	.054	.153	-.194	-.055	.019
Cost 1	-.019	.131	-.099	.735 <sup>a</sup>	-.564	-1.803E-5	-.133	-.024	.019	.110	-.018	-.066
Cost 2	-.009	-.158	.206	-.564	.670 <sup>a</sup>	-.057	-.027	-.144	-.085	-.213	.098	.196
Quality	.031	-.105	.089	-1.803E-5	-.057	.938 <sup>a</sup>	.068	-.178	-.070	-.142	-.062	-.092
Profile Objective	-.004	.092	-.168	-.133	-.027	.068	.780 <sup>a</sup>	-.761	.006	-.091	-.023	.129
Profile Objective 2	-.057	-.097	.054	-.024	-.144	-.178	-.761	.767 <sup>a</sup>	.066	.208	-.066	-.257
Stakeholder 1	.047	-.221	.153	.019	-.085	-.070	.006	.066	.826 <sup>a</sup>	-.042	-.427	-.435
Stakeholder 2	-.077	.176	-.194	.110	-.213	-.142	-.091	.208	-.042	.814 <sup>a</sup>	-.451	-.352
Stakeholder 3	-.181	.254	-.055	-.018	.098	-.062	-.023	-.066	-.427	-.451	.819 <sup>a</sup>	-.014
takeholder 4	.115	-.116	.019	-.066	.196	-.092	.129	-.257	-.435	-.352	-.014	.832 <sup>a</sup>





Figure 4. Scree Plot.

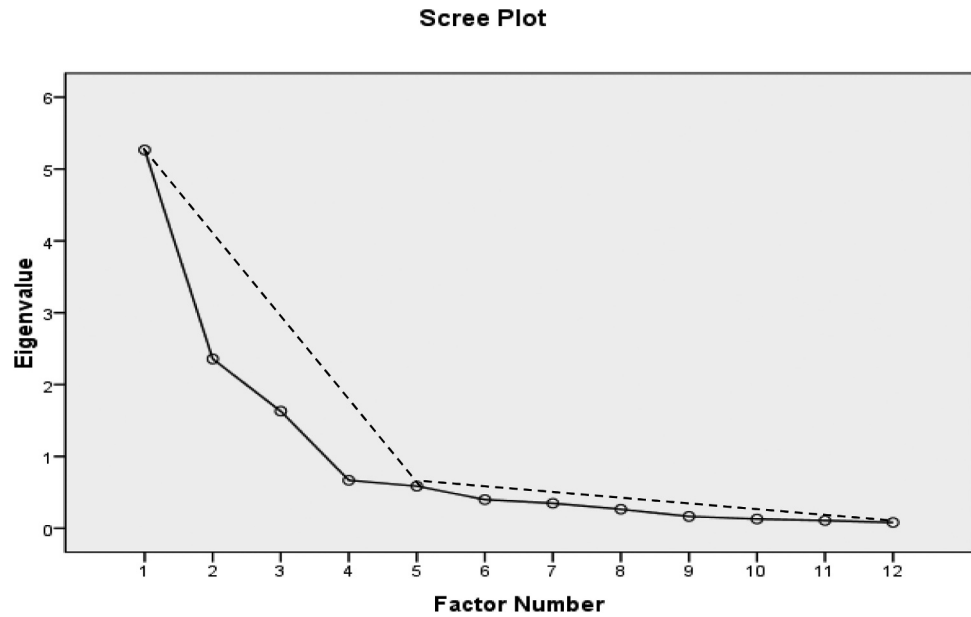
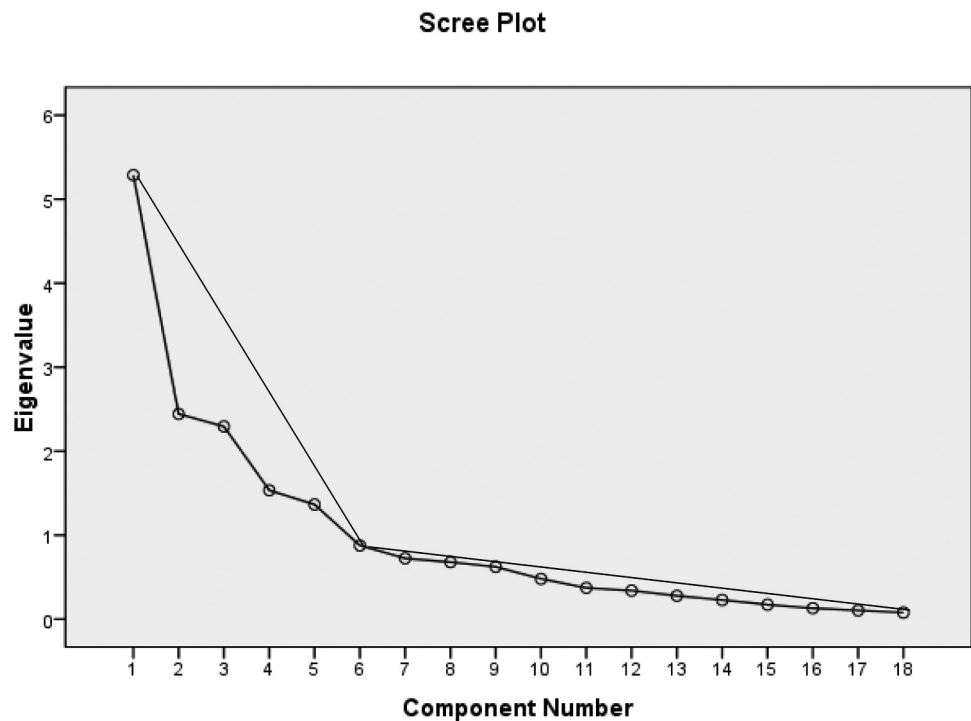


Figure 5. Scree Plot.



### 3.15. Factor extraction and rotation

In the last step of the extraction of factors, the decision about the extraction method and rotation is crucial. The principle axis method was selected along with a varimax rotation because it intends to find the dimensions (latent structure) (Conway & Huffcutt, 2003). After the decision of the

**Table 8. Factor Matrix**

	Factors				
	1	2	3	4	5
Profile Objective 2	0.763			-0.409	
Time 1	0.748		-0.404		
Time 3	0.744		-0.476		
Time 2	0.723		-0.463		
Profile Objective	0.709	0.402			
Stakeholder 4	0.682	-0.515			
Stakeholder 2	0.674	-0.532			
Stakeholder 3	0.662	-0.579			
Stakeholder 1	0.638	-0.576			
Quality	0.535				
Cost 2	0.405		0.637		
Cost 1			0.507		

Extraction Method: Principal Axis Factoring.

a. Attempted to extract five factors. More than 25 iterations are required. (Convergence = .005). Extraction was terminated.

extraction method and rotation, the Kaiser criterion and scree plot method were utilised to determine the number of factors retained (Conway & Huffcutt, 2003; Yong & Pearce, 2013). In the Kaiser criterion, the rotated sum of the extracted eigenvalues should be greater than 1. Furthermore, the scree plot involves the graph of the eigenvalues to determine a number of factors by observing the bend or break point in the data curve. Table 7 shows that the Rotated Sums of Squared Loadings for the first four factors was more than 1. Moreover, the scree plot shows a bend at Factor 5 (Figure 4 and 5). Thus, for the 12 items of success, there were four factors. The factor matrix and rotated factors illustrate the items for each factor.

### 3.16. Factor 1

This factor (Tables 7, 8, and 9) consists of five items in which four are the stakeholders' satisfaction items; one of them is a quality item. All factors have factor loadings of more than 0.5, which is the benchmark (Yong & Pearce, 2013). The quality phenomenon in qualitative findings is confirmed in the factor analysis in that the quality and stakeholder satisfaction are associated. Therefore, this study named Factor 1, "Quality and Stakeholder Satisfaction".

### 3.17. Factor 2

This factor consists of all three items of time that show the importance of all-time items and their common variance. Consequently, Factor 2 is named "Time" and the items in it are related to planning, construction, and operations. This factor is consistent with the prior literature (Ika et al., 2012), but it separately includes items of planning, construction, and operation.

### 3.18. Factor 3

This factor consists of both cost items: construction cost and budgeted cash flows (maintenance cost). Therefore, Factor 3 is named "Cost" and it is consistent with prior literature (Ika et al., 2012) but contains two items.

### 3.19. Factor 4

This factor consists of two items related to profile objectives. However, these two items have a good contribution in Factor 1 and Factor 2, but their distinct nature and high values in Factor 4 allow us to consider them in Factor 4, which is named, "Profile Objective".

**Table 9. Rotated Factor Matrix**

	Factors				
	1	2	3	4	5
Stakeholder 3	0.86				
Stakeholder 1	0.859				
Stakeholder 4	0.836				
Stakeholder 2	0.834				
Quality	0.545				
Time 2		0.92			
Time 3		0.916			
Time 1		0.858			
Cost 2			0.887		
Cost 1			0.69		
Profile Objective 2				0.834	
Profile Objective				0.721	

Extraction Method: Principal Axis Factoring

**Table 10. KMO and Bartlett's Test for PPP Success Factors**

<b>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</b>		<b>0.758</b>
<b>Bartlett's Test of Sphericity</b>	<b>Approx. Chi-Square</b>	<b>1.642E3</b>
	<b>Df</b>	<b>153</b>
	Sig.	0.000

### 3.20. Principal component analysis (PCA) for success factors

The second objective is to assess the underlying relationships between success factors through categorisation of factors. Field (2013) suggested a PCA for component extractions in success factor categorisation because prior knowledge is scant about the factor structure. The PCA is divided into a preliminary analysis and a factor extraction.

### 3.21. Preliminary analysis

For a PCA, the assessment of patterned relationships, sample adequacy of the data set, and singularity of the correlation matrix is vital before extracting the component (Field, 2013; Yong & Pearce, 2013).

The correlation determinant score helps to examine the patterned relationship, which should be more than 0.00001 (Yong & Pearce, 2013). The determinant score for the correlation was < 0.00001. However, Yong and Pearce (2013) suggested deleting low correlation values. Therefore, the study deleted the SF10 (political support) and SF15 (good governance) which resulted in a determinant score of 1.13E-005—which is acceptable. Moreover, the Kaiser-Meyer-Olkin (KMO) test and the diagonal values of anti-image correlation are measures of sample adequacy (Ameyaw & Chan, 2016; Field, 2013). The KMO value should be larger than 0.5, and the diagonal of the anti-image matrix should be reasonably high (> 0.5) for a good factor analysis (Field, 2013). The current study has a KMO value of 0.758 (Table 10), and all diagonal values of anti-image-correlation were 0.551 to 0.888.

**Table 11. Total Variance Explained for Success Factors**

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.287	29.372	29.372	5.287	29.372	29.372	3.579	19.884	19.884
2	2.442	13.568	42.94	2.442	13.568	42.94	3.275	18.196	38.079
3	2.294	12.746	55.686	2.294	12.746	55.686	2.353	13.072	51.152
4	1.534	8.52	64.205	1.534	8.52	64.205	2.182	12.12	63.272
5	1.365	7.581	71.786	1.365	7.581	71.786	1.533	8.514	71.786
6	0.877	4.87	76.656						

Extraction Method: Principal Component Analysis.

**Table 12. Component Matrix**

Success Factors	Component				
	1	2	3	4	5
Transparency in the procurement process	0.755				
Multi-benefit objectives	0.743	-0.429			
Strong private consortium	0.731				
Competitive procurement process	0.715		0.496		
Thorough and realistic cost/benefit assessment	0.701	-0.466			
Shared authority between public and private	0.691	0.447			
Technology transfer	0.668	0.436			
Government involvement by providing guarantees	0.656	0.418	-0.424		
Project technical feasibility	0.637	0.478			
Commitment/responsibility of public/private sector	0.606				
Well-organized public agency		-0.554			
Stable macro-economic environment		0.463	0.602		
Favourable legal framework			0.542		
Available financial market		0.412	0.515		
Sound economic policy			0.492		
Clarification of contract documents				0.475	-0.627
Clear defined responsibilities and roles				0.538	-0.590
Appropriate risk allocation and risk sharing	0.410	-0.419		0.457	0.459

Extraction Method: Principal Component Analysis.

a. 5 components extracted.

**Table 13. Rotated Factor Matrix**

Success Factors	Component				
	1	2	3	4	5
Government involvement by providing guarantees	0.880				
Project technical feasibility	0.873				
Technology transfer	0.868				
Shared authority between public and private	0.848				
Commitment/responsibility of public/private sector	0.618				
Strong private consortium		0.937			
Competitive procurement process		0.904			
Transparency in the procurement process		0.900			
Appropriate risk allocation and risk sharing			0.870		
Well-organized public agency			0.840		
Thorough and realistic cost/benefit assessment		0.564	0.627		
Multi-benefit objectives		0.543	0.617		
Stable macro-economic environment				0.817	
Available financial market				0.729	
Sound economic policy				0.679	
Favourable legal framework				0.652	
Clear defined responsibilities and roles					0.837
Clarification of contract documents					0.805

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

**Table 14. Outer Loadings, Composite Reliability and Average Variance Extracted for SEM**

Variables	Dimensions	Items	Outer Loading	Composite Reliability (CR)	Average Variance Extracted (AVE)
Success	Time	T1	0.895	0.944	0.680
		T2	0.911		
		T3	0.901		
	Cost	C1	0.931		
		C2	0.928		
	Objective	O1	0.923		
		O2	0.931		
	Quality & Stakeholder Satisfaction	Q	0.846		
		S1	0.881		
		S2	0.818		
S3		0.834			
Technology Transfer and Commitment of Partners	C1	SF12	0.835	0.883	0.605
		SF13	0.677		
		SF14	0.658		
		SF7	0.828		
		SF9	0.866		
Procurement Factors	C2	SF3	0.903	0.934	0.824
		SF2	0.918		
		SF1	0.903		
Public agency and Planning stage factors	C3	SF16	0.897	0.786	0.719
		SF20	-0.668		
		SF4	0.915		
		SF8	0.887		
Macro-Economic Factors	C4	SF17	0.906	0.952	0.831
		SF18	0.911		
		SF19	0.907		
		SF5	0.920		
Agreement Factors	C5	SF11	0.816	0.752	0.603
		SF6	0.734		

Moreover, the value of Bartlett's test of sphericity explains whether the correlation matrix is significantly different from the identity matrix. This significant difference means that the correlations between variables are (overall) significantly different from zero, and a PCA can be conducted. This study has a significant value ( $p = 000$ ) for Bartlett's test of sphericity. The values of the correlation matrix determinant, the KMO test, diagonal values of anti-image, and Bartlett's test of sphericity met the threshold criteria. Thus, this study can extract these factors.

### 3.22. Factor extraction and rotation

The PCA can extract the factor by using the principle component method, and this study used a varimax rotation to find components (Conway & Huffcutt, 2003). After the selection of extraction method and rotation, this study adopted the Kaiser criterion and scree plot method to decide the number of factors retained (Ameyaw & Chan, 2016; Conway & Huffcutt, 2003; Field, 2013). Table 11

**Table 15. Fornell and Lacker's criterion**

Variables	C1	C2	C3	C4	C5	PPP Project Success
C1	0.778					
C2	0.629	0.908				
C3	0.554	0.737	0.848			
C4	0.609	0.750	0.686	0.911		
C5	0.303	0.515	0.604	0.482	0.776	
PPP Project Success	0.629	0.796	0.807	0.742	0.623	0.824

**Table 16. Cross Loadings**

	Time	Cost	Obj	Q&S	C1	C2	C3	C4	C5
T1	0.895	0.705	0.727	0.739	0.532	0.722	0.691	0.700	0.630
T2	0.911	0.686	0.695	0.770	0.474	0.731	0.656	0.648	0.495
T3	0.901	0.646	0.713	0.741	0.520	0.651	0.607	0.674	0.566
C1	0.648	0.931	0.779	0.727	0.543	0.700	0.692	0.591	0.493
C2	0.752	0.928	0.737	0.738	0.474	0.741	0.710	0.597	0.571
O1	0.737	0.743	0.923	0.735	0.612	0.657	0.715	0.630	0.512
O2	0.726	0.769	0.931	0.740	0.550	0.707	0.710	0.666	0.496
Q	0.650	0.627	0.689	0.846	0.467	0.569	0.606	0.487	0.432
S1	0.748	0.689	0.640	0.881	0.488	0.636	0.669	0.554	0.563
S2	0.732	0.698	0.719	0.818	0.479	0.684	0.698	0.608	0.430
S3	0.705	0.634	0.679	0.834	0.563	0.570	0.644	0.601	0.490
S4	0.696	0.702	0.658	0.874	0.523	0.676	0.647	0.589	0.514
SF12	0.596	0.552	0.550	0.598	0.835	0.640	0.528	0.600	0.356
SF13	0.290	0.286	0.429	0.331	0.677	0.316	0.259	0.364	0.134
SF14	0.185	0.181	0.246	0.274	0.658	0.208	0.133	0.263	0.002
SF7	0.451	0.461	0.487	0.434	0.828	0.552	0.480	0.504	0.240
SF9	0.506	0.497	0.610	0.543	0.866	0.553	0.565	0.520	0.291
SF3	0.743	0.712	0.680	0.678	0.556	0.903	0.677	0.689	0.486
SF2	0.695	0.693	0.656	0.655	0.513	0.918	0.638	0.657	0.497
SF1	0.677	0.706	0.669	0.674	0.644	0.903	0.692	0.695	0.420
SF16	0.646	0.675	0.673	0.690	0.491	0.672	0.897	0.609	0.465
SF20	-0.474	-0.452	-0.480	-0.452	-0.230	-0.423	-0.668	-0.443	-0.545
SF4	0.681	0.708	0.714	0.736	0.596	0.718	0.915	0.662	0.539
SF8	0.628	0.688	0.709	0.688	0.499	0.644	0.887	0.588	0.529
SF17	0.692	0.573	0.640	0.615	0.513	0.620	0.617	0.906	0.460
SF18	0.689	0.638	0.637	0.627	0.546	0.746	0.672	0.911	0.475
SF19	0.669	0.541	0.632	0.580	0.561	0.701	0.569	0.907	0.351
SF5	0.674	0.575	0.642	0.609	0.603	0.667	0.638	0.920	0.467
SF11	0.540	0.494	0.433	0.461	0.147	0.416	0.470	0.365	0.816
SF6	0.424	0.388	0.412	0.426	0.341	0.384	0.471	0.387	0.734



**Table 17. Assessment of Inner Model**

Hypothesis	Relationship	Path Coefficient	Significance (t-value)	P Values	Decision
H1a	C1 -> PPP Project Success	0.134**	1.837	0.066	Supported
H1b	C2 -> PPP Project Success	0.269*	2.185	0.029	Supported
H1c	C3 -> PPP Project Success	0.326*	2.861	0.004	Supported
H1d	C4 -> PPP Project Success	0.151**	1.714	0.087	Supported
H1e	C5 -> PPP Project Success	0.173*	3.138	0.002	Supported

depicts the Rotated Sums of Squared Loadings for the first five factors are more than 1. Moreover, the scree plot shows the bend at Factor 6. Thus, for 18 success factors, there are five components/categories. The factor matrix and rotated factors illustrate the items in each category (Tables 12 and 13).

### 3.23. Category 1

The first factor consists of the following five success factors: government involvement by providing guarantees, project technical feasibility, technology transfer, shared authority between public and private, and the commitment and responsibility of the public/private sector. The study names this factor as “Technology and Relationship Factors”.

### 3.24. Category 2

This factor consists of the following three items: strong private consortium, competitive procurement process, and transparency in the procurement process. All of these factors are associated with the selection of an SPV in the preplanning stage (Ahmad et al., 2018a), and are thus termed procurement factors. This category is consistent with the findings of Chan (2010), who emphasised the transparent procurement process.

### 3.25. Category 3

This includes factors such as appropriate risk allocation and risk sharing, well-organised public agency, thorough and realistic cost/benefit assessment, and multi-benefit objectives. All of these factors are related to the planning phase of the PPP project, whereas organised public agency is an

**Table 18. Assessment of Inner Model**

Relationship	Path Coefficients-difference (  BOT—BLMT  )	t-Value (BOT vs BLMT)	p-Value (BOT vs BLMT)
C1 -> PPP Project Success	0.269**	1.648	0.100
C2 -> PPP Project Success	0.050	0.234	0.820
C3 -> PPP Project Success	0.361*	1.960	0.050
C4 -> PPP Project Success	0.261	1.267	0.210
C5 -> PPP Project Success	0.099	0.912	0.360

important success factor. Thus, the study names this category as “Organised Public Agency and Planning Phase Factors”.

### **3.26. Category 4**

The fourth factor consists of the following four CSFs: stable macroeconomic environment, available financial market, sound economic policy, and favourable legal framework. All of these factors are related to the economy; thus, the study terms this category as “Macroeconomic Factors”, which are also consistent with Chan’s (2010) findings.

### **3.27. Category 5**

Factor Five consists of the following two CSFs: clearly defined responsibilities and roles, and clarification of contract documents. Therefore, the study names this category as “Agreement Factors”. The separate grouping of these two factors confirms the argument of Ahmad et al. (2018) that agreement plays a crucial role in a PPP project’s success.

As the success factors are categorised into five categories, the study divides H1 into five sub-hypotheses:

H1a: Technology and relationship factors have a significant effect on a PPP project’s success.

H1b: Procurement factors have a significant effect on a PPP project’s success.

H1c: Organised public agency and planning phase factors have a significant effect on a PPP project’s success.

H1d: Macroeconomic factors have a significant effect on a PPP project’s success.

H1e: Agreement factors have a significant effect on a PPP project’s success.

### **3.28. Structural equation modelling (SEM)**

PLS-SEM divides the model into the following sub-models for assessment: measurement model/outer model and structural model/inner model. The outer model assessment was conducted to examine the underlying assumptions of internal consistency and the validity of the model, while the structural model examined the research hypothesis. The detailed analysis is as follows:

#### **3.29. Assessment of the outer-model**

Ramayah, Cheah, Chuah, Ting, and Memon (2018) suggested three criteria for the assessment of the reflective model: internal consistency, convergent validity, and discriminant validity.

For internal consistency, the composite reliability (CR) should be more than 0.6, and is not desirable if more than 0.95 (Ramayah, 2018). Table 14 shows that all the variables meet the threshold value of the CR.

In the PLS model assessment, the convergent and discriminant validity are measures of the construct’s validity (Hair et al., 2016). The convergent validity is measured using the outer loadings of the items and the average variance extracted (AVE) of the variables. The outer loadings of the construct should be more than 0.7 while the AVE should be more than 0.5 (Hair et al., 2016). The values of the outer loading and AVE meet the threshold values recommended in the literature (Hair et al., 2016; Ramayah, 2018), hence, ensuring the convergent validity (see Table 14).

Moreover, discriminant validity is an important criterion for evaluating the validity of the construct. The PLS provides two criteria, namely Fornell and Lacker’s criterion, cross-loading criterion, and heterotrait–monotrait (HTMT) criterion for ascertaining discriminant validity (Hair et al., 2016;

Ramayah, 2018). Table 15 indicates that the diagonal value of each construct is greater than its value correlated with the other constructs.

Another criterion to examine the discriminant validity is cross-loadings, which means that an indicator's loadings on the associated construct should be greater than any of its cross-loadings on other constructs (Hair et al., 2016). Table 16 shows that the items of each construct load are higher on its respective construct than on other constructs. Moreover, the HTMT ratio of correlation is less than 0.9 which satisfies the HTMT threshold values. Therefore, the discriminant validity of the construct was established.

The above discussion of internal consistency, convergent validity, and discriminant validity confirms that the model is fit for assessment. Specifically, the newly developed variables such as PPP project success, along with their dimensions, satisfy the criteria of reliability and validity. After determining the outer model, it is possible to examine the outer model/structural model to test the hypothesis.

### 3.30. Assessment of the inner-model

The inner model was used to test the hypothesis. The assessment of each inner-model/structural model comprises four steps: hypothesis testing/path coefficient,  $R^2$ ,  $f^2$ , and  $Q^2$ .

The most important step was to test this hypothesis. All the hypotheses in the inner model require an examination of the direct relationships between the independent and dependent variables. This hypothesis was examined based on the path coefficients and level of significance. The bootstrapping procedure allowed for the determination of path coefficients and their significance in SmartPLS 3.0 software. This study's bootstrapping procedure was conducted based on two-tailed t-tests, and a path coefficient was considered significant if the t-value was greater than 1.96, with the p-value being less than 0.05, or the t-value greater than 1.645 with a p-value less than 0.01 (Ramayah, 2018). Table 17 shows the results of bootstrapping

In addition, it is important to evaluate the predictive accuracy of the model through the coefficient of determination ( $R^2$ ) score. Hair et al. (2016) suggested reporting the adjusted  $R^2$  as well. Hair et al. (2016) described  $R^2$  values 0.75, 0.5, and 0.25 as substantial, moderate, and weak levels of predictive accuracy. The current study has  $R^2$  and the adjusted  $R^2$  values as 0.782 and 0.773, respectively.

Moreover, after assessing the predictive accuracy, it is vital to evaluate the effect size of the predictors using  $f^2$  (Hair et al., 2016) because  $f^2$  assesses the relative importance of a predictor construct on an endogenous construct. Specifically, it gauges how strongly one exogenous construct contributes to explaining certain endogenous constructs in terms of  $R^2$ . Cohen (1988) considered the  $f^2$  values of 0.35, 0.15, and 0.02 as large, medium, and small effect sizes, respectively. The  $f^2$  of C1, C2, C3, C4, and C5 are 0.045, 0.105, 0.174, 0.039, and 0.084, respectively. The values of  $f^2$  imply that C3 has a large effect on the PPP project, whereas all the other factors have a low effect on PPP project success.

The predictive relevance ( $Q^2$ ) of the model was examined using the blindfolding procedure through cross-validated redundancy (CVR) and cross-validated communality (CVC). If the  $Q^2$  value is larger than 0, the model has predictive relevance for the endogenous construct (Hair et al., 2016). The blindfolding procedure for the current study produces values of both CVR (0.492) and CVC (0.561) which are greater than zero and are acceptable. Thus, the success categories show the predictive relevance of the path model.

### 3.31. Multi-group analysis

To test H2, the effect of the types of PPP on the relationship between the success factor categories and PPP project success, a multi-group analysis (MGA) was adopted based on Hair et al. (2016).

Established by Hair et al. (2016), the parametric approach of the MGA was adopted as the study received a response from two types of PPP projects: BLMT and BOT. In this approach, the difference in path coefficients was calculated, and their significance was tested. The results in (Table 18) reveal that C3 (at p-value = 0.5) and C1 (at p-value = 0.10) categories have significant differences in path coefficients.

#### 4. Discussion

This study aimed to develop a construct for a PPP project's success, categorise success factors, and examine the relationship between success factor categories and PPP project success. Therefore, the discussion of the results can be divided into the following three main sections.

##### 4.1. Construct of PPP project success

The first objective of this study was to construct the measures/items for PPP project success. The study conducted interviews and described the results based on the interview quotations. The results illustrated that a PPP project's success depends on time, cost, quality, profile objective, and stakeholder satisfaction. Still, this study did not consider the preparation of the future as a dimension of PPP project success. The dimensions are consistent with the findings of prior literature (Ika et al., 2012; Shenhar, 2001; Shenhar et al., 1997).

The first dimension of a PPP project's success is "time", which is consistent with prior literature, as Shenhar et al. (1997) explained that time is a measure of efficiency, and they introduced an item known as the "meeting time goal". Most of the authors (Chandra, 2015; Ika et al., 2012) used this item to measure the efficiency of the project. A few PPP project success indices (Osei-Kyei & Chan, 2018) utilised one item, which was "Adherence to time". However, this study has developed three items for time because the interview findings indicated that time delays occur at the planning stage, construction, and commencement of the project which is consistent with prior literature (Ahmad et al., 2018a).

Sufficient planning time is vital for PPP projects, but lengthy planning leads to the cancellation of a project. In this way, Soomro and Zhang (2013) reported a few projects around the world that were cancelled at the planning stage. Therefore, this study used one item, particularly for the planning time. Similarly, construction is an essential phase of a PPP project for both public and private partners (Ahmad et al., 2018a). Abdul-Aziz and Jahn Kassim (2011) reported the construction delay in housing projects and considered it to be one of the major reasons for failure. Thus, this study considered separate measurement items for the construction and commencement of the project.

The second dimension of success is cost, which plays a pivotal role in the success of the PPP project as it affects the overall budget. The cost of a PPP project is comprised of construction and operation costs/maintenance costs. Both of these costs are associated with each other, as the quality of the material used in the construction stage affects the frequency of maintenance at the operation stage. Owing to its importance, the cost is crucial for both the government and the SPV. The cost is the dimension of success which is consistent with the literature (Baccarini, 1999; Pinto & Slevin, 1988; Shenhar, 2001; De Wit, 1988). However, these studies measure cost using one item which is "Meeting the budget goals" (Cserhádi & Szabó, 2014; Ika et al., 2012). Osei-Kyei and Chan (2018) suggested one item, which was "Adherence to budget".

Nevertheless, the interview findings suggest that construction cost overruns, and operational cash flows affect the budget of the PPP project. This finding is consistent with a study conducted by Markom et al. (2012), who reported the case of LRT where the SPV failed to achieve the budgeted goals due to high maintenance costs and low cash inflows. Similarly, Mohamad, Ismail, and Said (2018) ranked operational cost and construction cost as the first two most important performance indicators and suggested that strategies to achieve budgeted operational and construction costs

should be developed. Thus, this study measured costs using construction costs and budgeted cash flows.

The third dimension of a PPP project profile is the objective. Generally, PPP projects are developed for specific objectives, and the experts state these objectives in the needs statement (Ahmad et al., 2018a). The findings suggest that one of the main objectives is the VfM, which aims to achieve maximum service with low cost at standard quality. The technical experts of UKAS define the VfM ratios for each project that should be achieved through PPP projects. Otherwise, the PPP projects were not considered successful. Therefore, this study develops two items to inquire about profile objectives. Thomas and Fernández (2008) considered one item—meeting project objectives—to measure the objectives, but PPP projects have specific objectives and VfM ratios to meet. Ika, (2009a) Munns and Bjeirmi (1996) postulated that the achievement of specific objectives is one of the dimensions of the success. The findings illustrate that the achievement of VfM is one of the specific objectives for PPP projects, which is consistent with the findings of Li (2003). Therefore, in the measurements of PPP project success, this study includes one extra item to inquire about the VfM ratio.

The last dimension is “quality and stakeholder satisfaction”. Previous literature considers quality and stakeholders as two different dimensions. However, the EFA results of the current study combine the items “the quality and the stakeholder” because of the quality phenomenon. Accordingly, the quality phenomenon states that if the quality of service is low, unsatisfied beneficiaries create hostility—that is, students in the case of the hostel project and the public in the MEET project. The government halts or deducts the rental payments that affect SPV cash inflows. Low cash inflows tend to make the SPV delay debt instalment payments. In a worse situation, project operations may be shut down. Thus, the quality phenomena affect all stakeholders. Markom et al. (2012) described that a PPP project is successful if it offers a fair deal for all, which means that it satisfies all stakeholders.

Furthermore, interviewees revealed four main stakeholders: the government, an SPV, debt financier, and the public/user, which are consistent with the findings of Fischer (2010). A PPP project should and is likely to satisfy all major stakeholders. Shenhar (2001) considered a project to be successful if it satisfied all the stakeholders. Therefore, this study developed four separate items to examine the satisfaction of each stakeholder.

Despite “Time”, “Time”, “Objectives”, “Quality” and “Stakeholder Satisfaction”, Shenhar (2001) revealed that the “preparation for the future” as another dimension that contributes to the success and argued that a project may create a new product line, new technology, and a new market to survive in the future. However, the findings of the interviews highlighted the lack of usefulness of this dimension as one PPP project was built to attain specific objectives and meet specific demands. Furthermore, the project management group of a PPP does not account for any budget for future marketing or expansion to meet market demand. In the case of extra demand or expansion, the government launched a separate project, even if expansion was required in the current project. For future expansions in the operational project, separate planning was conducted, and a separate agreement was prepared. Nevertheless, the government needs to account for future demand and create future plans for projects that are connected. Therefore, unlike normal business projects, future preparation or market expansion is not carried out for a specific PPP project. This finding is consistent with the characteristics of a PPP project in a study conducted by Peters (1998), who explained that every PPP project is a one-off transaction and for a defined period. However, the period of agreement may vary depending on the type of PPP project.

Based on the above discussion, a project is considered successful if it is completed within the budgeted cost, within the scheduled time, delivers the desired services, obtains all its objectives, and satisfies all the stakeholders.

#### **4.2. The Relationship between the success factors and the PPP project's success**

The first category, technology and relationship factors (path coefficient = 0.134, t-value = 1.837, p-value = 0.1) have a significantly strong positive effect on a PPP project's success. This implies that, for PPP project success, the commitment of the partners plays a vital role. This result is consistent with the argument made by Villani et al. (2017) that for value creation in the PPP project, a long-term technology commitment and commitment among the partners are necessary.

The second category, the procurement factors, includes factors such as strong private consortium, competitive procurement process, and transparency in the procurement process. The selection of an SPV (path coefficient = 0.123, t-value = 2.185, p-value = 0.05) has a significant positive effect on a PPP project's success, which implies the vital role of the selection of strong SPV in a PPP project's success. The combination of the three factors in the second category and their significant impact on PPP project success suggests that the selection of a strong SPV is the result of the competitive procurement process and transparency in the procurement process. Moreover, this result is consistent with Chan's (2010) findings that recommend a transparent and competitive procurement process, which results in a strong SPV. Thus, procurement factors are imperative to achieve PPP project success.

The third category is the organised public agency and planning phase factors, which comprise appropriate risk allocation and risk sharing, well-organised public agency, thorough and realistic cost/benefit assessment, and multi-benefit objectives that significantly positively affect (path coefficient = 0.326, t-value = 2.861, under p-value = 0.05) the PPP project's success. The significance of the planning phase factor is in line with Soomro and Zhang (2013), who reported the failure of many PPP projects in the planning stage. Ahmad et al. (2018a) also considered the planning stage to be essential for PPP project success.

The fourth category, macroeconomic factors, has a positive significant effect (path coefficient = 0.151, t-value = 1.714, under p-value = 0.1) on PPP project success. This result supports the argument of Li (2005) that the government can help the PPP project by creating and maintaining a stable macroeconomic environment by manipulating economic policies to ensure stable prices.

The fifth category is agreement factors that include factors such as clearly defined responsibilities and roles along with the clarification of contract documents. They have highly significant (path coefficient = 0.173, t-value = 3.138, under p-value = 0.05) positive effects on PPP project success.

#### **4.3. Moderating effect of the type of PPP project**

The significant differences in the path coefficients of C3 (organised public agency and planning phase factors) and C1 (technology and relationship factors) reveal that both of these categories have a different impact on PPP project success for each type. This result strengthens the findings of Ahmad et al. (2018) that the BLMT projects are different from other types of PPP projects.

### **5. Conclusion**

The study concludes that PPP project success is different from the project success of other projects found in project management and requires additional measurement items to measure its dimensions. In a PPP project's success, the quality phenomenon plays a vital role because the satisfaction of the stakeholder is based on service quality.

The study categorises the success factor into five categories, and each category of success factor has a significant impact on the PPP project. Based on the path coefficients, the study concludes that the public agency and planning phase factors have the highest impact, and the related factors have the least effect on a PPP project's success. Moreover, agreement factors have a significant effect on PPP projects.

Although each category affects PPP project success, the effect of a few factors depends on the type of PPP factor. The study concludes that the effect of the relationship and planning factor depends on the type of PPP project because each type is different in nature. Thus, the planning and relationship of public and private partners differ depending on the type of PPP project.

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