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ORIGINAL ARTICLE

Critical success factors for development of public-private-partnership airports in India

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ABSTRACT

Examining the interrelationships between critical success factors (CSFs) is of importance for the successful development of PPP airports. Many studies are available for the identification of CSFs for infrastructure projects, but very limited research have been conducted so far on investigating the interrelationships between the CSFs of PPP airports. The study is based on the institutional theory, which considers the exploration of the relationships between different institutional factors. The results show that Process Characteristics have comparatively more impact on Public Characteristics and, similarly, Cooperative Environment has more impact on Process Characteristics. However, Process Characteristics have a less significant impact on Private Characteristics. The study also revealed that to achieve high-quality services and the protection of public interest under a PPP mechanism, proper government supervision is required. Moreover, customers' satisfaction and their opinion are also responsible for the achievement of high-quality services and better value for money.

Keywords: *public-private partnership (PPP); critical success factors of PPP; airport development; structural equation modeling; institutional theory*

1. Introduction

The definition of public-private partnership (PPP) is given by many authors as a contractual arrangement formed between public and private partners, which involves the private partner financing, developing, owning and operating the facility. It is an arrangement wherein the resources of the government are combined with the resources of the private partner to deliver the social goals (Rossi and Civitillo, 2014). It is a partnership for building, operating, maintaining and then delivering a project to the government body by the private partner. There may be a number of private partners with expertise in PPPs performing different roles and responsibilities. They may be investors, lenders, designers, construction contractors, O&M contractors, etc. Similarly, along with the

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government body, there may be involvement by regulatory authorities. The structuring of a PPP is quite complex due to the involvement of a large number of parties having different interests in the same project and their multiple relationships (Yescombe, 2007). The implementation of PPP is beneficial for the private partners, as well as for the society located in the area where the PPP project is executed (Mause, 2019). Conversely, the private partner carries substantial risks, along with management responsibility, while the government body takes part as a partner or the regulator in the PPP. The private partner also provides a means of financing for the PPP infrastructure project, which helps the government in building a world-class facility. Due to the benefits of PPP and the increased level of confidence of private investors due to the guarantee by the government regarding income stream over and above the average income (Cepparulo et al., 2019), the application of PPP has begun to be used in the development of different types of infrastructures, including airports. The promotion of PPP has taken shape in the aviation sector due to the requirements of huge investments, as well as specific skills, for the development of airport infrastructures. Tolić, Vojvodić and Martinović (2012) stated that the adoption of public-private partnership in airports has resulted in a satisfactory solution for the airports. They gave the example of the Hamburg airport. The participation of private parties is made through different modes of PPP, i.e., Build-Own-Operate (BOO), Build-Operate-Transfer (BOT), Build-Own-Operate-Transfer (BOOT), etc., by keeping a certain intervention by the government. The PPP model for airports may be defined as a shareholding between the government and the private partner, which is based on a high investment for building facilities as per international standards and enhancing the capacity of airports to handle increased number of passengers and cargo (Gupta, 2015). The world is well experienced with the successes, as well as failures, of PPPs in the development of airports. However, with minimum government regulations, the profit and efficiency of PPP airports can be maximized (Singh et al., 2015). The participation of the private party in the development of public airports is debatable and thus arise management complications due to conflict in objectives and profit-making outlook of the private partner. Therefore, the relationships between PPP stakeholders are critical for the success of airport development. A good understanding of the relationships between the critical success factors (CSFs) of PPPs can assist project managers to focus on the control of key factors and allow them to make reasonable resource allocations in the project (Chen et al., 2012). The success of PPP airports depends on how the partnership between the government body and the private party meets the mutual interests. Zou et al. (2014) defined the relationship between public and private partners as a set of comprehensive strategies and processes of partnership with selected

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counterparties and stakeholders for creating a superior value for the PPP project.

CSFs are key inputs that lead directly or indirectly to a project's success. Alias et al. (2014) stated that CSFs are such conditions and characteristics that may have substantial impacts on the success of a project if they are managed properly. These success factors and their interactions may also lead to inefficiency and ineffectiveness of the project if not taken care of appropriately. The CSFs for PPPs are numerous due to the participation of dissimilar parties, and these CSFs are integrated with each other. The concept of critical success factors was introduced by John F. Rockart and the MIT Sloan School of Management in 1979. Initially, it was used from the perspective of project management and information systems (Almarri and Abu-Hijleh, 2017). Thereafter, it was applied in BOT projects by Tiong et al. (1992). Morledge and Owen (1998) defined the CSFs of a PPP as those factors that need to be conserved in order to improve the success ratio of the project so that the objectives of its stakeholders are achieved. Many researchers have identified the CSFs of PPPs, but studies wherein the interrelationships between such factors were examined are very rare. Shi et al. (2016) stated that due to the limitations of many statistical techniques, the interrelationships between the CSFs of PPPs could not be easily analyzed. Therefore, the interrelationships between CSFs are explored in the present study to have a better understanding of the influence of the mechanism and to provide an apparent comprehension for the administration of the critical success factors in the development of PPP airports in India. The objective of the study is to examine the interrelationships between the CSFs of PPPs for the successful development of PPP airports in India. Accordingly, the study contains different sections as stated hereunder.

In Section 1, the Introduction is presented. An exhaustive literature review is described in Section 2, and the theoretical framework is mentioned in Section 3. The description of data collection and research methods are explained in Section 4, wherein the interrelationships between the variables (latent and observables) were examined using the PLS-SEM method. In Section 5, a conceptual model was developed, wherein 23 CSFs were considered as indicators and five latent variables were considered as constructs in the model. The results are prescribed in Section 6, followed by discussion, implication and study limitation in Section 7, and the conclusion is presented in Section 8.

2. Literature review

The participation of the private party in airport development has become a global trend, and private participation in developing and managing airports is being done through different modes of PPP (In et al., 2017). India has also followed the trend and the government of India has developed and modernized its major airports in Delhi, Mumbai, Hyderabad, Bangalore and Cochin on PPP basis. However, private participation in airports is still highly controversial due to the involvement of complex principal-agent relationships. These relationships and the successful development of PPP airports basically depend upon different factors called critical success factors (CSFs). The theory of critical success factors was first established by Rockart and the MIT Sloan School of Management. Critical success factors of PPP airports are generally classified into macro factors and project-specific factors (Ayo-Vaughan et al., 2019). Other authors (Infrastructure Consortium for Africa, 2012; Cruz and Marques, 2011; Hussain, 2010) have conducted research into the identification of the CSFs of PPP airports and classified them into adequate risk allocation, transparent procurement procedure, financial feasibility, availability of robust concessionaire consortium/association, prevailing environment, sound regulatory and institutional frameworks, and the application of sound technical solutions. Studies on the CSFs of PPP airports are very rare, but the studies on the CSFs for different PPP infrastructures are mostly available. Emmanuel (2013) concluded that the CSFs for PPP projects in Nigeria are appropriate risk allocation, comprehensive feasibility study, commitment, government guarantee, responsibilities of the public and private sectors, a strong private consortium, realistic cost/benefit assessment, transparent and sound regulatory framework, stable macro-economic conditions and sound economic policy. Du, Wu and Xianbo (2018) identified seven critical factors that influence the capital structure of PPP projects. They listed the ability of the private sector, government support, external situation, benefit and cost as top critical factors. Alias et al. (2014) studied the CSFs of project management practices and concluded that CSFs are key inputs to project management practice that lead directly or indirectly to a project's success. They identified five CSFs: project management action, project-related factors, human factors, project procedures and external issues. Al-Saadi and Abdou (2016) identified the five most critical success factors for PPPs in the UAE infrastructure projects: proper risk allocation and sharing among project stakeholders, proper project value management systems during different project phases, clear project brief and client outcomes, comprehensive and business viability of project feasibility study, and availability and effectiveness of proper regulatory and legal frameworks for the PPPs. Hwang, Zhao and Gay (2013) examined the critical success factors for understanding the comparable significance of positive and negative factors that influence the desirability of PPP projects in Singapore. They identified the positive factors as better value for money; improved risk profile; facilitated creative, innovative and cost-effective solutions; improved quality and services; tap on private expertise; shared total project cost; and optimal resource allocation. They also listed the negative factors as long delays in negotiation, high participation costs, confusion on government objectives and criteria evaluation, lack of experience or appropriate skills, high project costs, high risk relying on the private sector and excessive restriction on the participation. Zou et al. (2014) focused on the relationship management in PPPs and identified the CSFs, in which four CSFs—defining the objective, integration of different divisions, a multidisciplinary team and commitment of senior executives—are the most important. Similarly, Shi et al. (2016) examined the interrelationships between the CSFs of PPP infrastructure projects using Structural Equation Modeling (SEM). They stated that exploring the interrelationships between the CSFs is very important for enlightening the accomplishment of PPP projects, along with sustaining the implementation of PPP projects. In their research, they revealed that in a PPP project, the relationship between the government body and the private partner is like a leader-follower relationship, wherein the responsibilities, power or resources among the partners are very unequal. Public involvement negatively affects the process of service provision. However, the connection between appropriate risk allocation and service price is a critical one. Chen et al. (2012) also examined the interrelationships between the CSFs for construction projects using SEM. They considered 62 CSFs from the literature and then refined them to 46 CSFs via expert discussions. The identified CSFs were then grouped into three categories and ten subcategories. Thereafter, they applied the SEM to explore the interrelationship between the CSFs. Many authors (Teo, 2009; de Campos et al., 2018; Rouf and Akhtaruddin, 2018; Paraschi et al., 2019; Blieck et al., 2019) applied SEM in their study to explore the interrelationships between the factors, as well as to study the effect of the factors. SEM is a multivariate technique used to estimate simultaneously a series of interrelated dependent relationships (Chen et al., 2012). Moreover, the PLS-SEM (Partial Least Squares–Structural Equation Modeling) method is suitable for validating complex models in studies, wherein predictive accuracy is most important (Blieck et al., 2019).

The identification of the critical success factors of different PPP infrastructure projects has been included in various studies. However, the identification of the CSFs of PPP airports is very rare. On the other hand, studies on examining the interrelationships between the CSFs of PPP airports are not found. Moreover, no study has been found so far on understanding the effects of CSFs on each other. Therefore, to bridge such gaps, the study was conducted. It explored the interrelationships between the CSFs of PPP airports to explain how the critical success factors affect each other, along with their intensity. It will provide assistance to industry experts in addressing the CSFs with appropriate approaches for the development of PPP airports in India. The study also contributes to the literature with the use of PLS-SEM to examine the interrelationships between the variables and to understand the implications of the CSFs in the development of PPP airports.

3. Theoretical framework

A public-private partnership is an arrangement between a government body (public sector) and private parties to participate in the development of a physical facility for the society. Under a PPP, a government institution and private parties enter into a long-term contractual agreement. These contract agreements define the risk allocations, as well as the roles and responsibilities of each partner of the PPP. Nijkamp, van der Burch and Vindigni (2002) defined PPP as an institutionalized form of cooperation between public and private sectors in working together to achieve a joint target. The public sector (being a supervisory authority) cares about the total benefits of PPP projects, including economic, social and environmental aspects, while the private sector partners pay more attention on maximizing their profits through financing, construction, operation and other activities related to project implementation (Du et al., 2018). Moreover, the public partner performs its regulatory role (Singh et al., 2015) to establish a system that ensures that the allocated resources are utilized efficiently and the partnership works effectively. The public partner also institutes an environment where the partnership with the private partners can prosper. The relationship between the public sector and private parties is influenced by many factors. These factors actually control the success of PPPs and are recognized by the institutional theory (Panayides et al., 2015). Lawrence and Shadnam (2008) stated that a theoretical framework is provided by the institutional theory to analyze the social/organization phenomena and considers the social world as significantly comprised of institutions that endure rules, practice and structures and typically focuses on sets of institutions and their relationships.

Accordingly, the underpinning theory in the present study was based on the institutional theory, which considered exploring the relationships between different institutional factors, i.e., Government Characteristics, Private Characteristics, Public Characteristics, Cooperative Environment and Process Characteristics. In the study, Government Characteristics and Cooperative Environment are independent variables and their impacts on dependent variables were examined.

4. Research method

An exhaustive literature review was adopted to identify factors that are responsible for the success of PPP projects. A total of 23 factors were considered for the study. These factors were grouped into five critical factors as per their characteristics. Accordingly, a questionnaire was developed to conduct the questionnaire survey. The questionnaire had two parts: Part A for collecting the general information of the respondents and Part B for getting the weightage for each factor.

A pilot survey was conducted to improve the content validity and reliability of the questionnaire. Initially, the questionnaire was sent to 15 industry experts who have experience of more than 15 years in PPP airport projects or airport projects. A face-to-face interview was also conducted with two experts who have work experience of more than 20 years in airport projects and are presently associated with PPP airport projects. Subsequently, the questionnaire was revised as per the feedback received. Thereafter, the final questionnaire was sent to 320 industry professionals who are/were associated with public-private-partnership projects and/or airport projects through email from December 2019 to October 2020. A total of 182 responses was received, out of which 170 responses were considered due to their completeness.

PLS-SEM (Partial Least Square–Structural Equation Modeling) and the SmartPLS software (version 3.2.2) were used to test the hypotheses and to explore the interrelationships.

4.1. Sample size

If a study has a small sample size and the models comprise many constructs, along with a large number of items, PLS-SEM is most useful (Fornell and Bookstein, 1982). Power analysis shall be considered by researchers to determine the required sample size for PLS-SEM (Hair, Risher, et al., 2019). The model's structure, the expected effect sizes and the anticipated significance level are considered in power analysis. Accordingly, power analysis was applied in the study. Faul et al. (2007) mentioned that G*Power is a free power analysis program for different statistical tests. The G*Power software (version 3.1.9.4) was adopted in the present study to find out the adequate sample size. The following steps were followed for calculating the sample size using the G*Power software in the study: (i) selecting the appropriate statistical tests for the study, (ii) choosing the type of power analysis, (iii) providing the input parameters for the analysis and (iv) calculating the sample size (Faul et al., 2007). Accordingly, inputs were provided in the software to calculate the sample size by considering the medium effect size, 5% error probability (α=0.05) and three predictors (independent variables). The minimum sample size computed was 77. However, it has been suggested by Cohen (1992) that in order to have consistent results, the sample size shall be two times to three times the minimum sample size computed from the G*Power software. Therefore, the required sample size was $77 \times 2 = 154$.

Thus, a sample size of $170 > 154$ was considered in the study. A total of 170 samples were used to run the SmartPLS software.

4.2. PLS-SEM

Structural Equation Modeling (SEM) is a second-generation multivariate technique used to estimate a series of interrelated dependence relationships through combining aspects of multiple regression and factor analysis (Fah and Sirisena, 2014). As regression lacks in handling multicollinearity, SEM was applied in the study due to its effectiveness in dealing with multicollinearity between the factors. SEM was first used in the early 1970s, but it received attention from various researchers in the 1980s. SEM is a comprehensive statistical approach to test hypotheses for examining the relationships between observed and latent variables (Hoyle, 1995). It enables the incorporation of unobservable variables measured indirectly through the indicator variable (Hair Jr. et al., 2014). There are different approaches available for SEM: Covariance-Based SEM (CB-SEM), PLS-SEM, Generalized Structured Component Analysis (GSCA), etc. However, PLS-SEM was adopted in the study due to its numerous benefits over other approaches, as well as its effectiveness in analyzing the complex model, including the formative constructs. When formative constructs are included in a structural model, PLS-SEM is the preferred approach (Hair, Sarstedt and Ringle, 2019). PLS-SEM has the ability to deal with the problems of multiple regression that occur using other approaches, i.e., a limited number of observations, numerous missing data and high correlations between predictor variables (Fah and Sirisena, 2014). Moreover, the following advantages of the PLS-SEM approach have been listed by Byrne (2016), Wong (2019) and Hwang et al. (2010), which supported the usage of PLS-SEM in the study:

- Capability of working even with small sample size.
- Ability to analyze formative constructs.
- Ability to work with fewer indicators.
- Ability to work with non-normal distribution of data.
- Goodness-of-fit of the PLS path model is not required to be evaluated.

PLS-SEM is a covariance-based structure analysis technique that is more suitable for studies with many latent variables (Vijayabanu and Arunkumar, 2018). PLS-SEM has two sub-models: structural model (inner model) and measurement model (outer model). A structural model shows the relationship between different constructs, while a measurement model describes the relationship between a construct and its indicators (Diamantopoulos et al., 2008). PLS-SEM analyzes the relationships in the structural model and the measurement model separately, not concurrently (Hair, Risher et al., 2019). The study specified the formative measurement, wherein the direction of the relationship is from its indicators to the construct, which means that the indicators cause the constructs. Indicators of formative constructs are not interchangeable and capture a specific aspect of the construct's domain (Hair Jr. et al., 2014).

The evaluation of a PLS-SEM model comprises the measurement model and the structural model. The first step is to evaluate the measurement model with reflective or formative parameters, whichever is applicable. If the measurement model meets all the required criteria, then the next step is to proceed to the assessment of the structural model (Hair, Risher et al., 2019). The structural model is evaluated by path assessment, predictive relevance and explanatory power of the model. The formative parameters for the evaluation are indicators' collinearity, statistical significance and the relevance of indicators' weights (Hair, Risher et al., 2019).

4.3. Assessment of formative measurement model

An assessment of formative measures deploys a different set of metrics: the collinearity of the indicators and the significance of the indicators' weights (Chuah et al., 2020). The VIF (variance inflation factor) should be between 3 to 5. Ideally, the VIF values should be close to 3 or lower (Hair, Risher et al., 2019).

The indicators' weights, statistical significance and relevance are checked by applying bootstrapping. If the BCa bootstrap confidence interval of an indicator's weight does not include zero, this means that the indicator's weight is statistically significant (Hair, Risher et al., 2019).

After assessing the statistical significance of the indicators' weights, the indicator's relevance is evaluated. The standard values of indicators' weights are between –1 and +1; however, on rare occasions, the values lower or higher than the standard values are also acceptable. An indicator's weight close to +1/–1 represents a strong positive/negative relationship, whereas a value close to 0 indicates a weak relationship (Hair, Risher et al., 2019).

4.4. Assessment of structural model

The statistical significance and relevance of path coefficients (β-value), collinearity (VIF), coefficient of determination (R^2) and a model's predictive relevance ($Q^2_{predict}$) can be evaluated using the PLSpredict software (Samani, 2016). PLSpredict is a suitable and direct approach to assess the out-of-sample predictive capabilities of a PLS path model.

The collinearity of the constructs must be examined before assessing the structural relationships (Hair, Risher et al., 2019). It is similar to assessing the collinearity of the formative measurement models but the only difference is that the scores of latent variables of the predictor constructs are used to calculate the VIF values. The values of the VIF should be between 3 to 5. Ideally, the VIF values, as suggested by Hair, Risher et al. (2019), should be close to 3 and lower.

Path coefficients are assessed for obtaining the structural model's relationships, which represent the hypothesized relationships between the constructs. The standard values of path coefficients are between –1 to +1. However, path coefficients close to +1 represent strong positive relationships, and *vice versa* for negative values (Hair Jr. et al., 2014). The significance of a coefficient depends on its standard error, which is estimated by means of bootstrapping. The bootstrap standard error enables the computation of the empirical *t*-value and *p*-value for all structural path coefficients. For a significance level of 5% using the two-tailed tests, the t-value should be more than 1.96 and the *p*-value must be smaller than 0.05 (Hair Jr. et al., 2014).

The higher the value of the coefficient of determination (R^2), the greater is the model's explanatory power. The value of R^2 above 0.25 is acceptable, while a value above 0.50 is most preferable (Paraschi et al., 2019). The R^2 values of 0.75, 0.50 and 0.25 represent substantial, moderate and weak explanatory power of a model (Hair, Risher et al., 2019). The coefficient denotes the amount of variance in the endogenous constructs as explained by all of the exogenous constructs linked to it (Hair Jr. et al., 2014).

To evaluate the impact of a specified exogenous construct if omitted from the model, the value of f^2 (effect size) is measured. The values of f^2 of 0.02, 0.15 and 0.35 represent small, medium and high effects, respectively, of an exogenous latent variable, and there is no effect considered if the value of f^2 is less than 0.02 (Hair Jr. et al., 2014).

If the value of $Q^2_{predict}$ for all indicators calculated by PLSpredict is greater than zero ($Q^2_{predict} > 0$), then the MAE/RMSE values are compared with the native LM benchmark (Shmueli et al., 2019). If, PLS-SEM < LM for a majority/all of the indicators in PLS-SEM, the model has predictive relevance.

5. Building of hypothesized model

Five latent variables and 23 observable variables were identified from the literature and

Table 1. Constructs and indicators

Construct	Indicators
SF1–Government Characteristics	G1–Supervision G2–Willingness G3–Cooperation G4–Contract Enforcement G5–Contract Administration
SF2–Private Characteristics	P1–Contract Implementation P2–Financial Abilities P3–Correct Information P4–Project Experience P5–Profit Expectation
SF3–Public Characteristics	Pu1–Opinion Pu2–Satisfaction Pu3–Recognition
SF4–Cooperative Environment	C1–Favorable Legal Framework C2–Economic Policy C3–Financial Capital Market C4–Commercial Viabilities C5–Political Support
SF5–Process Characteristics	Pr1–Project Details Pr2–Project Complexity Pr3–Procurement Pr4–Risk Allocation Pr5–Project Management

Source: Literature review and author's compilation

considered in the study. These latent variables were SF1–Government Characteristics, SF2–Private Characteristics, SF3–Public Characteristics, SF4–Cooperative Environment and SF5–Process Characteristics.

On the basis of an extensive literature review and a detailed discussion with three industry experts who have experience in the field of public-private-partnership airports, hypotheses were developed.

The government has numerous roles and responsibilities in a PPP airport project, especially in protecting social goals. The government is also involved in the effective supervision of the project, together with the contract enforcement and administration. The government's monitoring and supervision are essential to protect the public interest. Generally, the government helps to create such an environment wherein public participation can be augmented in PPP projects (Shi et al., 2016). The government's strategies and prerequisite actions towards the development of PPP airports help the public in building its opinion. Government policies, goals and cooperation have a direct impact on the procurement process of PPP airport projects.

Hence, the following hypotheses were constructed:

H1: SF1 → SF3 (Government Characteristics have a direct influence on Public Characteristics)

H2: SF1 → SF5 (Government Characteristics have a direct influence on Process Characteristics)

Public interest is protected by the government. The public is not directly involved in any PPP contracts; even so, the public is an imperative stakeholder. Public opinion towards a PPP airport project is essential for the success or failure of the project. The public is an end user who provides feedback in many senses. Therefore, Public Recognition, Opinion and Satisfaction directly affect Private Characteristics, which are the key elements in forming and maintaining the relationship with other stakeholders of the project.

Hence, the following hypothesis was constructed:

H3: SF3 → SF2 (Public Characteristics have a direct influence on Private Characteristics)

It is the government's responsibility to create a cooperative environment (Li et al., 2005) in which the fear of the private party to participate in the PPP project can be eradicated (Zhang, 2005; Shi et al., 2016). Such a healthy environment encourages the private party to take part in PPP airport projects and it also comforts the public in building its opinion. Economic policies, legal framework, capital market and appropriate political support provide assistance in maintaining the partnership as sustainable and encourage the private partner for the delivery of high-quality services. Moreover, as recommended by Shi et al. (2016) in their study, we explored the relationship between Cooperative Environment and Private Characteristics.

Hence, the following hypotheses were constructed:

H4: SF4 → SF2 (Cooperative Environment has a direct impact on Private Characteristics)

H5: SF4 → SF3 (Cooperative Environment has a direct impact on Public Characteristics)

H6: SF4 → SF5 (Cooperative Environment has a direct impact on Process Characteristics)

The participation of the private party in PPP airport projects is inspired by government policies and actions. These participations are made through a specific process of PPPs, which is finalized by the government and regulatory authorities. The decision made by the government leads to the success or failure of the project. The types of project risk, risk allocation among the parties, project details that are to be shared publicly and the procurement methods are fixed by the government after considering many other aspects of the project. These aspects directly affect the private party. Consequently, the private party decides on whether to participate in the project. The government's decisions and actions for private participation in airport projects affect public interest. This helps the public in building its opinion and then its satisfaction level.

Hence, the following hypotheses were constructed:

H7: SF5 → SF2 (Process Characteristics have a direct influence on Private Characteristics)

H8: SF5 → SF3 (Process Characteristics have a direct influence on Public Characteristics)

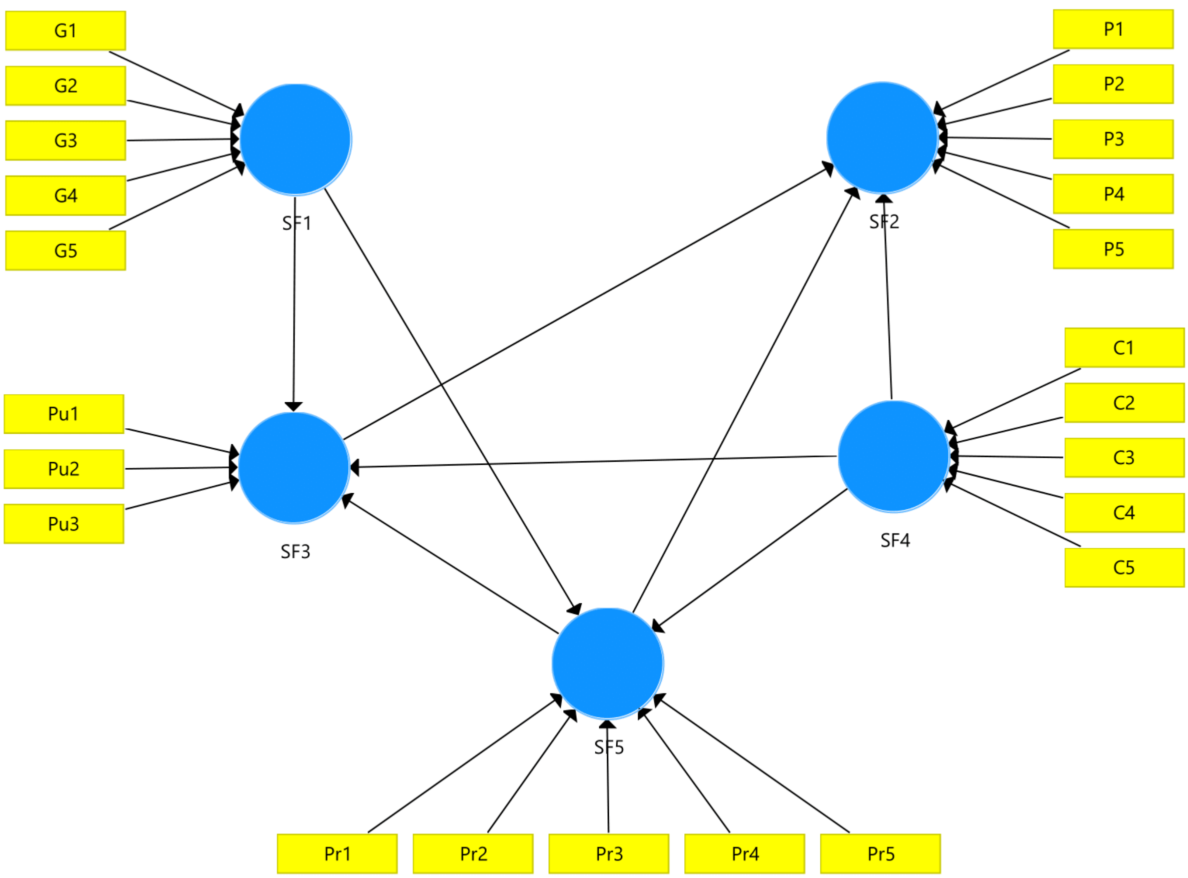


Figure 1. Hypothesized model

6. Results

6.1. Assessment of measurement model

The first step of the analysis was to evaluate the measurement model. The results of the assessment of the measurement model are shown in **Table 2**.

The formative measurement model was checked for collinearity issues (VIF values). The VIF values of all the indicators are uniformly below the conservative threshold of 3. Therefore, we concluded that the collinearity is under the critical level and it is free from collinearity issues.

The significance and relevance of the indicator were evaluated using complete bootstrapping of 5000 subsamples with Bias-Corrected and Accelerated (BCa) Bootstrap for two-tailed tests with a 95% significance level. The outer weights for all the indicators are significant except for indicators C2, G2, P3 and Pr4. As the outer weights of these indicators are not significant, the outer loadings of these indicators were checked. The outer loadings of these indicators are more than 0.50, which shows that these indicators are absolutely important to their constructs. In this situation, these indicators were retained in the model.

The outer weights of indicators Pu2, C4, Pr5 and P5 are close to +1, which shows a strong relationship between these indicators and their respective constructs, i.e., SF3, SF4, SF5 and SF2.

Table 2. Results of measurement model

Indicator	VIF	Outer weight	*p*-value	95% confidence interval	Outer loading
C1	1.338	0.242	0.003	[0.109, 0.368]	0.629
C2	1.577	0.039	0.707	[–0.135, 0.195]	0.619
C3	1.568	0.234	0.016	[0.081, 0.400]	0.705
C4	1.385	0.559	0.000	[0.417, 0.702]	0.832
C5	1.407	0.286	0.001	[0.161, 0.429]	0.676
G1	1.554	0.319	0.029	[0.076, 0.553]	0.756
G2	1.789	0.003	0.982	[–0.202, 0.215]	0.654
G3	1.657	0.426	0.001	[0.211, 0.616]	0.806
G4	1.974	0.266	0.005	[0.123, 0.436]	0.795
G5	1.639	0.277	0.025	[0.079, 0.483]	0.728
P1	1.478	0.369	0.004	[0.168, 0.594]	0.77
P2	1.323	0.274	0.003	[0.138, 0.434]	0.67
P3	1.613	0.065	0.568	[–0.128, 0.247]	0.594
P4	1.571	0.202	0.089	[0.007, 0.396]	0.642
P5	1.325	0.458	0.000	[0.304, 0.612]	0.793
Pr1	1.635	0.268	0.003	[0.114,0.418]	0.703
Pr2	1.695	0.193	0.034	[0.051, 0.349]	0.609
Pr3	1.612	0.312	0.001	[0.147, 0.450]	0.751
Pr4	1.787	0.084	0.360	[–0.068, 0.235]	0.686
Pr5	1.766	0.492	0.000	[0.324, 0.653]	0.817
Pu1	1.506	0.178	0.062	[0.016, 0.326]	0.692
Pu2	1.469	0.592	0.000	[0.444, 0.735]	0.882
Pu3	1.376	0.447	0.000	[0.300, 0.595]	0.793

Source: Author's compilation

6.2. Assessment of structural model

After the successful assessment of the measurement model, the structural model was first evaluated for collinearity (VIF). The VIF values of the structural model are shown in **Table 3**. The minimum VIF value is 1.739 and the maximum VIF value is 2.864 for constructs SF3 and SF5, respectively. The VIF values are lower than the conservative threshold of 3. Therefore, it is concluded that collinearity is not an issue.

In the next step, the structural model relationships were evaluated using path coefficients, which represent the hypothesized relationships between the constructs. The significance and relevance of the path coefficients were evaluated using the bootstrapping procedure. The results of the complete bootstrapping of 5000 subsamples with Bias-Corrected and Accelerated (BCa) Bootstrap for two-tailed tests with a 95% significance level are presented in Table 3. The results show that all of the structural model relationships are significant except for hypothesis H1 (SF1→SF3). The t-value of path SF1→SF3 is 0.287, which is less than 1.96, and also the path's 95% confidence interval contains zero, i.e., [–0.253, 0.122]. The results of its t-value and 95% confidence interval show that the relationship is not significant and, hence, Government Characteristics (SF1) do not affect Public Characteristics (SF3). Therefore, hypothesis H1 is not supported.

The t-values ($t < 1.96$), 95% confidence intervals and p-values ($p < 0.05$) for hypotheses H2 (SF1→SF5), H3 (SF3→SF2), H4 (SF4→SF2), H5 (SF4→SF3), H6 (SF4→SF5), H7 (SF5→SF2) and H8 (SF5→SF3) are presented in Table 3. The results show that the paths are significant and the hypotheses are supported. The result of the hypothesis testing is shown in **Table 4**.

Furthermore, the model was tested for coefficient of determination (R^2) and the result is shown in **Table 5**. Constructs SF1 and SF4 jointly explained 42.5%, 51% and 65% of the variance in constructs SF3, SF2 and SF5, respectively, thus indicating a moderate explanation power.

The effect size (f^2) was also calculated and its result is shown in **Table 6**. The values of f^2 show that SF1 and SF4 have a large effect size on SF5. However, there is zero effect size shown of SF1 on SF3 and SF2.

Table 3. Assessment of structural model

Hypothesized path	β	*t*-value	*p*-value	95% confidence interval	VIF
SF1 → SF3	–0.032	0.287	0.774	[–0.253, 0.122]	2.325
SF1 → SF5	0.441	6.286	0.000*	[0.324, 0.551]	1.768
SF3 → SF2	0.259	2.301	0.021**	[0.065, 0.434]	1.739
SF4 → SF2	0.311	2.446	0.014**	[0.096, 0.511]	2.284
SF4 → SF3	0.256	2.005	0.045**	[0.050, 0.471]	2.334
SF4 → SF5	0.445	6.119	0.000*	[0.312, 0.552]	1.788
SF5 → SF2	0.246	2.004	0.045**	[0.033, 0.434]	2.526
SF5 → SF3	0.465	3.641	0.000*	[0.249, 0.664]	2.864

*Note: *p<0.01, **p<0.05*
Source: Author's compilation

Table 4. Result of hypothesis testing

No.	Path	Hypothesis	Result
H1	SF1 → SF3	Government Characteristics have direct influence on Public Characteristics	Not Supported
H2	SF1 → SF5	Government Characteristics have direct influence on Process Characteristics	Supported
H3	SF3 → SF2	Public Characteristics have direct influence on Private Characteristics	Supported
H4	SF4 → SF2	Cooperative Environment has direct impact on Private Characteristics	Supported
H5	SF4 → SF3	Cooperative Environment has direct impact on Public Characteristics	Supported
H6	SF4 → SF5	Cooperative Environment has direct impact on Process Characteristics	Supported
H7	SF5 → SF2	Process Characteristics have direct influence on Private Characteristics	Supported
H8	SF5 → SF3	Process Characteristics have direct influence on Public Characteristics	Supported

Source: Author's compilation

Table 5. Result of R^2

Construct	R^2	R^2 Adjusted
SF2	0.510	0.502
SF3	0.425	0.415
SF5	0.651	0.647

Source: Author's compilation

Table 6. Result of f^2 effect size

Construct	SF2	SF3	SF5
SF1	-	*0.001*	0.315
SF3	0.079	-	-
SF4	0.087	0.049	0.320
SF5	0.049	0.131	-

Source: Author's compilation

Table 7. Result of PLSpredict

Indicator	PLS MAE	LM MAE	Difference MAE	PLS $Q^2_{predict}$
P1	0.469	0.470	–0.001	0.275
P2	0.544	0.545	–0.001	0.165
P3	0.586	0.611	–0.025	0.109
P4	0.635	0.646	–0.011	0.101
P5	0.522	0.534	–0.012	0.240
Pr1	0.587	0.589	–0.002	0.207
Pr2	0.624	0.602	0.022	0.134
Pr3	0.459	0.467	–0.008	0.357
Pr4	0.498	0.490	0.008	0.367
Pr5	0.367	0.349	0.018	0.486
Pu1	0.583	0.598	–0.015	0.143
Pu2	0.530	0.533	–0.003	0.214
Pu3	0.505	0.483	0.022	0.234

Source: Author's compilation

The predictive relevance of the model was analyzed using PLSpredict and its result is shown in **Table 7**. The $Q^2_{predict}$ values for all the indicators of a measurement model were found to be more than zero ($Q^2_{predict} > 0$). Then, the prediction errors were checked on whether they are symmetrically distributed. As stated by Shmueli et al. (2019), in the case of a highly non-symmetric distribution of the prediction errors, the consideration of MAE values is more appropriate for prediction statistics. Therefore, the MAE (Mean Absolute Error) values with the native LM benchmark were used.

All the Q^2 values of the indicators are greater than zero and the majority of MAE values of the PLS-SEM model are less than MAE values of LM, i.e., the model generated lower errors for all the indicators. Therefore the model has predictive relevance.

7. Analysis and discussion

The final SEM model was proposed, as shown in **Figure 2**, which represents two types of relationships: a) the relationships between the CSFs and their indicators and b) the relationships between the CSFs. The results of the assessment of the measurement model show that Public Satisfaction (Pu2) shares a strong relationship with Public Characteristics (SF3) as compared with its other indicators, i.e., Public Opinion (Pu1) and Public Recognition (Pu3). Similarly, Commercial Viabilities (C4), Project Management (Pr5), Profit Expectation (P5) and Government Cooperation (G3) share strong relationships with Cooperative Environment (SF4), Process Characteristics (SF5), Private Characteristics (SF2) and Government Characteristics (SF1), respectively.

The results of the assessment of the structural model are discussed hereunder.

7.1. Government Characteristics

Government Characteristics positively influence Process Characteristics (H2) (path coefficient: 0.441). The result is also supported by the study by Shi et al. (2016). Proper government supervision ensures the delivery of high-quality services and the protection of the public interest. A government's strong willingness towards the development of PPP airports improves the satisfaction of the partners. A government's decision-making ability affects risk allocation among the parties, procurement process and project management, which are critical for the successful development of PPP airports. In addition, government policies, regulations and guidelines on PPPs have consequences on Process Characteristics.

The results also show that Government Characteristics do not influence Public Characteristics (H1) (path coefficient: –0.032). In a PPP airport, the government's role and responsibilities are very limited as compared with a private partner. Therefore, the government's characteristics are not directly perceptible to the public. Moreover, there is a lack of a system in which the government (as a regulator) collects and evaluates public/customers' feedback.

7.2. Private Characteristics

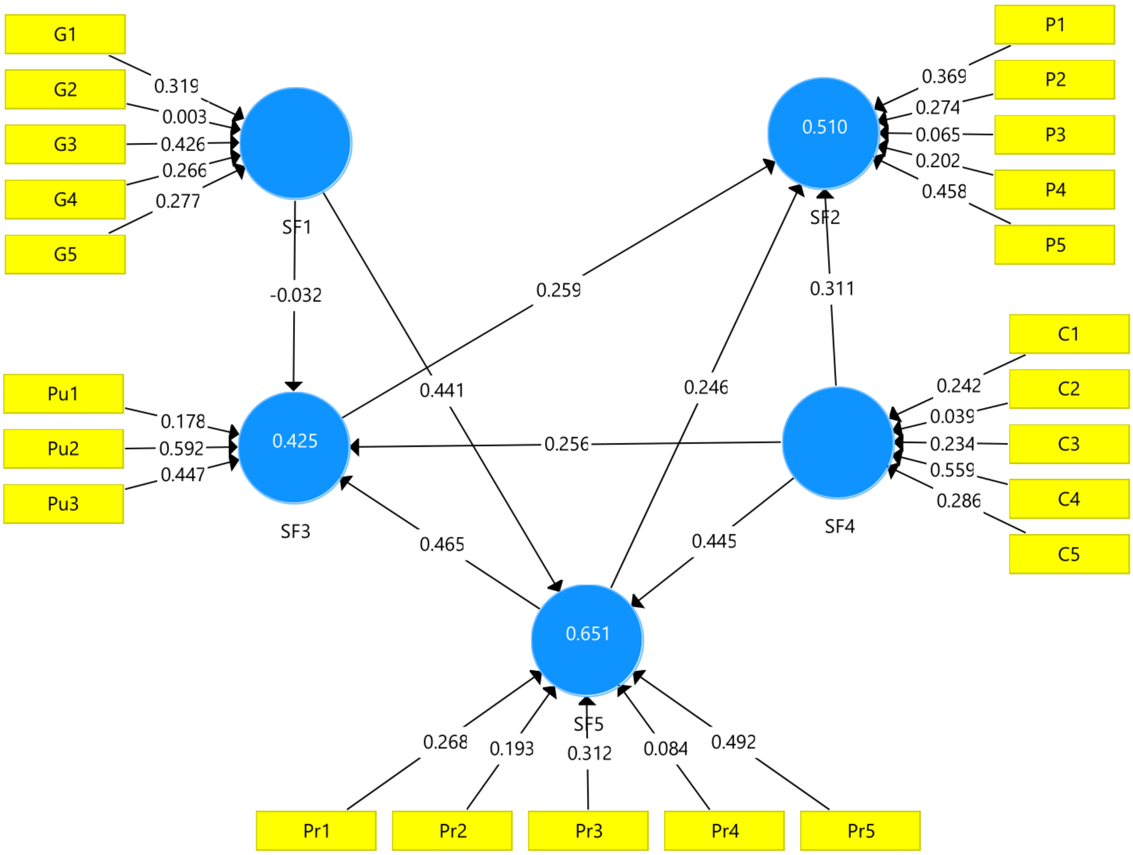
The private partner plays a vital role in the successful development of PPP airports. The roles and responsibilities are huge for the private partner, as the critical risks are borne by the private partner. Private Characteristics are positively influenced by Public Characteristics (H3), Cooperative Environment (H4) and Process Characteristics (H7). Cooperative Environment has more impact on Private Characteristics (path coefficient 0.311) as compared with Public Characteristics (path coefficient: 0.259) and Process Characteristics (path coefficient: 0.246).

7.3. Public Characteristics

Public Characteristics have a positive impact on Private Characteristics (H3) (path coefficient: 0.259). Although the impact is not much stronger, customers' satisfaction and their opinion contribute to achieving high-quality services and better value for money. Similar findings were shown in the study by Jamali (2007). Public recognition and satisfaction are essential for the private partner. Similarly, Boyer et al. (2015) concluded that public involvement has a positive impact on a PPP project in the long run.

7.4. Cooperative Environment

Cooperative Environment has a comparatively more positive impact on Process Characteristics (H6) (path coefficient: 0.445) than Private Characteristics (H4) (path coefficient: 0.311) and Public Characteristics (H5) (path coefficient: 0.256). A favorable legal framework, political support,



Source: Author's compilation

Figure 2. Final SEM Model

economic policies, available financial capital market and commercial viabilities play a vital role for the private partner in partnering with the government to develop a PPP airport. A favorable legal framework always welcomes private partners to participate with the government. These factors are also the deciding criteria for risk allocation, procurement process and project management for the development of PPP airports. Government regulations and policies also affect the private partner's decision in sharing the correct information with the government.

7.5. Process Characteristics

Process Characteristics have positively more impact on Public Characteristics (H7) (path coefficient: 0.465) and comparatively less impact on Private Characteristics (H8) (path coefficient: 0.246). However, Process Characteristics are influenced by Cooperative Environment (0.445) and Government Characteristics (0.441).

The project's details, including project complexity, shared by the government (as a regulator) with private partners during the procurement process are noticeable by the public and a transparent procurement process makes a big impression on the public. An adequate risk allocation is very essential for the successful partnership between the government and the private partners. The arrangement of financial resources and the profit expectation by the private partners depend on the amount of critical-risk sharing by the private partners.

8. Conclusion and policy implication

The interrelationships between the critical success factors for the development of PPP airports have not yet been analyzed in the Indian context. To fill this gap, the study was conducted to examine the interrelationships between the critical success factors for the successful development of PPP airports in India. Accordingly, Partial Least Square (PLS), a form of Structural Equation Modelling (SEM), was adopted to explore the interrelationships between the critical success factors. The study was based on the institutional theory, which considers exploring the relationships between different institutional factors, i.e., Government Characteristics, Private Characteristics, Public Characteristics, Cooperative Environment and Process Characteristics. In the study, Government Characteristics and Cooperative Environment were the dependent variables and their impacts on Private, Public and Process Characteristics were examined. The results show that Process Characteristics have comparatively more impact on Public Characteristics (0.465) and, similarly, Cooperative Environment has more impact on Process Characteristics (0.445). However, Process Characteristics have a less significant impact on Private Characteristics (0.246). The study also revealed that to achieve high-quality services and the protection of public interest under a PPP mechanism, a proper government supervision is required. Moreover, customers' satisfaction and their opinion are also responsible for the achievement of high-quality services and better value for money.

The study has contributions to the existing literature and practice. The theoretical uniqueness of the study is the relationships explored between the critical success factors of PPP airports (in the Indian context). The study explained the importance of public opinion and satisfaction in PPP airports. It elaborated on the direct impact of Government Characteristics and Cooperative Environment on Process and Private Characteristics of PPP airports. As the study focused on the institutional factors of PPPs, policy makers are mainly expected to be the beneficiaries. Policy makers should definitely consider the impact of a cooperative environment and accordingly design a favorable legal framework, commercial viabilities and sound economic policies for the successful private participation in PPP airports.

The study will help practitioners/managers who are associated with PPPs or PPP airport projects. The study highlighted the strong and weak relationships between the CSFs. The interrelationships between the CSFs were explored to have a better understanding of the influence of the mechanism and to provide an apparent comprehension for the administration of the critical success factors in the development of PPP airports. The study provided a reference for the administration of the CSFs, as well as assistance to industry experts in addressing the CSFs with appropriate approaches for the development of PPP airports.

The study also has methodological contributions. Although PLS-SEM has been extensively used in social sciences and many business disciplines, its usage in the infrastructure sector is very rare. In the literature of PLS-SEM, the reflective-reflective, reflective-formative, formative-reflective, and formative-formative combination of models are available (Becker, 2012). This study built a formative-formative model using a novel methodology, i.e., the Partial Least Square–Structural Equation Modeling (PLS-SEM), for exploring the interrelationships between the institutional factors (critical success factors of PPPs). This model can also be used to predict Private Characteristics, Public Characteristics and Process Characteristics sufficiently well.

This is a unique study, so far, on examining the interrelationships between the CSFs for the successful development of PPP airports in India using PLS-SEM. However, it is accompanied by some limitations. The direct impact of Government Characteristics on Private Characteristics was not examined and the impact of regulatory intervention on PPP airports was not analyzed. Therefore, future research may be conducted on the same.

Data Availability

We collected primary data, which may be available on request.

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