

# Credit Enhancement and its Risk Factors for IPP Projects in Asia: An Analysis by Network

Abu Naser Chowdhury<sup>1</sup> and Po-Han Chen<sup>2</sup>

**Abstract:** Credit enhancement is absolutely essential for financing Independent Power Producer (IPP) projects in Asia particularly for countries whose sovereign credit rating is on non-investment grade and foreign investment is difficult to achieve. Due to nexus of agreements among various parties in IPP project, it is hard to clearly visualize the roles of these agreements. Examples are: What credit enhancement factors are most influential to minimize the associated risks of IPP projects? Why are they powerful? What are their roles? Who are less powerful and what are the obstacles that causes them less powerful? A research is conducted to identify the credit enhancement factors for IPP projects in Asia. IPP professionals validated 27 out of 28 identified credit enhancement factors, and five factor groupings were made through factor analysis. Afterwards, network theory is applied to find the unanswered questions, which by graphical and mathematical representations show that the host government's credit enhancement, MDBs, ECAs and other parties' credit enhancement are prominent and of great importance to handle the associated risks of IPP projects in Asia

**Keywords:** Credit Enhancement, Risk, Independent Power Producer, Asia, Network Theory

## I. INTRODUCTION

In Public Private Partnership (PPP) projects, selecting right credit enhancement factors is considered critical for the successful financing of a project. Though credit enhancement means a third party's assurance for payment, performance or obligations to major participants in a project on off-take, supply and completion agreement, but there are various ways to enhance the credit of a project [1]. Credit enhancement helps broaden risk mitigation to stakeholders of a PPP project, as it provides political risk coverage and also mitigates cost-overrun risk. Moreover, credit enhancement improves project's creditworthiness so a project becomes bankable at reasonable interest rates.

Independent Power Producer (IPP) projects in Asia face some challenges like demand risk, payment risk, price risk, currency parity risk and foreign exchange availability risk. To overcome these issues, the major stakeholders (i.e. the host government, sponsors, Multilateral Development Banks and Export Credit Agencies) of the projects provide some credit enhancement schemes that not only mitigate those risks but also earn better ratings of that project, thus making the project more credible though the project falls into non-investment grade. While some related studies [2, 3, 4, 5, 6] have been documented on this area, still some questions left unanswered. Examples are: What are the major credit enhancement factors for financing IPP projects in Asia? Why are they powerful? What are the minor credit enhancement factors? Why they are less influential? And what are the roles of these credit enhancement factors in addressing risks of IPP projects? This research is thus focused on trying to find the answers to these questions.

## 2. RESEARCH METHOD

The research method followed for this study includes two sections. Section 1 contents: (1) a literature review and case investigation to identify initial lists of credit

enhancement for IPP projects (i.e. content), (2) structure interviews to PPP experts to validate the credit enhancement factors identified in step (1) (i.e. content validation), (3) a questionnaire survey to IPP professionals in Asia to evaluate the importance of those factors, and (4) factor analysis for grouping of factors. Section 2 contents application of network theory using the output of section 1 with the results of risk factors.

### 2.1 Content

Preliminary 28 credit enhancement factors were identified from literature review (journals and books) that were mentioned by many researchers in their scholarly works. Subordinated loan from financial intermediaries (i.e. from International Bank for Reconstruction and Development, International Development Association, International Finance Corporation, Asian Development Bank, sovereign wealth funds etc.) acts as a form of credit enhancement in any project [2]. Credit enhancement factors can be a letter of credit from the host government, establishing an escrow agreement between special purpose vehicle (SPV) and off-taker to capture revenues from off-taker customer to support off-taker's payment obligation, and financing with political risk insurance from multilateral agencies or export credit agencies or insurance companies [7]. Among other factors escrow accounts, revolving bank guarantees and/or state guarantees for off-taker's payment obligation [6]; contingent equity and the standby letter of credit [8, 9]; credit support agreements such as central bank's guarantee as third party, and political risk guarantees by Export Credit Agencies (ECAs) [4] are widely used credit enhancement mechanism for PPP projects. It is also found that bank letter of credit facility also worked as credit enhancement in Colombian power project Termobarranquilla [10].

Moreover, the authors have investigated credit enhancement factors on twelve power generation projects

<sup>1</sup> Assistant Professor, Department of Civil Engineering, University of Asia Pacific, Bangladesh, Email: naserc-ce@uap-bd.edu (\*Corresponding Author)

<sup>2</sup> Professor, Department of Civil Engineering, National Taiwan University, Taiwan, Email: pohanchen@ntu.edu.tw

in India, Pakistan, China, Thailand, Bangladesh, Indonesia and Philippines. They are the Dabhol IPP project in India, the AES Lal Pir, Pat Gen and HubCo IPP projects in Pakistan, the Laibin B, Shajiao B, Meizhou Wan projects in China, the Meghnaghat and Haripur power projects in Bangladesh, the PT Paiton Energy (Paiton 1) power project in Indonesia, the BLC Power project in Thailand, and the Casecan Water and Energy project in Philippines.

## 2.2 Content Validation

After identifying credit enhancement factors, interviews were taken to the experts (all senior lawyers, consultants and academics with rich experience in PPP) to validate these factors for financing IPP projects in Asia. 27 out of 28 factors were validated by them. This is done through structured interviews. Interview has a number of unique advantages and disadvantages [11]. If well conducted, it can produce in-depth data which are likely to be obtained with a questionnaire. 9 interviewees were thus selected from Singapore, Thailand, Taiwan, Malaysia, Indonesia, India and Bangladesh who were involved in IPP projects for more than 20 years. The validated factors are the factors which five out of nine experts (majority) agreed to consider essential for IPP projects in Asia.

## 2.3 Questionnaire Survey

Finally, 27 credit enhancement factors were included in a questionnaire survey instrument that addressed wider issues involved in IPP projects in Asia. The factor ‘an unconditional financial payment obligation by the host government’ was not validated by the experts which reflects that most of the experts considered this factor might cause extra pressure to the host government and it would better be compensated by the participation of multilateral agencies such as Multilateral Investment Guarantee Agency (MIGA) based on the insured outstanding principal and any accrued and unpaid interest. The survey was done from October 2013 to March 2014 among PPP professionals who have experiences and were particularly involved in IPP projects in Asia. Respondents were asked to rate the importance/criticality of each factor on a five-point Likert rating scale ranging from 1 (least important) to 5 (most important).

The respondents were from various different organizations in countries from Bangladesh, India, Pakistan, Thailand, Taiwan, China, Singapore, Malaysia, Indonesia, Hong Kong and Vietnam. This can generalize the output from the questionnaire survey as different respondent from different countries or regions may have opposite view towards the same question. In all, 51 out of 120 distributed questionnaires were completed and returned.

## 3. DATA ANALYSIS

Statistical analyses undertaken for this research are descriptive analysis, reliability test using Cronbach’s alpha,

and factor analysis. Adequacy of sample size for factor analysis could be checked using the Kaiser-Meyer-Olkin (KMO) [12] and the value for this test is 0.712. On the other side, Cronbach alpha is 0.856. Here, both the tests (KMO and Cronbach’s alpha) suggest that the data collected for the factor analysis were reliable and appropriate [13]. Factor analysis helps to identify a relatively small number of factor groupings that can be used to represent relationships among sets of many inter-related variables [13, 14]. The analysis shows that these factors can be grouped into five principal factors (as shown in Table 1) by factor analysis and be interpreted as follows:

- Factor Grouping 1 - represents shareholders’ credit enhancement: which consists of five factors where higher loadings are associated with contingent equity support and standby credit support from the sponsors.
- Factor Grouping 2 - represents host government’s credit enhancement: which consists of four factors and all of them have higher factor loadings.
- Factor Grouping 3 - represents MDBs, ECAs, and other parties’ credit enhancement: which consists of six factors where financing with political risk insurance from MDBs or ECAs possess significantly higher loading (i.e. 0.798) among the group.
- Factor Grouping 4 - represents capital structure mechanism: which consists of five factors and debt service reserve fund possess higher loading among them.

Table 1 Credit enhancement factors for IPP projects in Asia

Factor Components	Component				
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
1. Contingent Equity support by the sponsors	0.8490				
2. Standby credit guarantee by the sponsors	0.8450				
3. Shareholder’s retention agreement	0.6630				
4. Ability to Exit through sales of shares from SPV					
5. Shareholders’ agreement that SPV reserves a maintenance account for O&M before making any distribution to shareholders	0.6250				
6. Claw back guarantee by the project sponsors and passive equity investors	0.5473				
7. Letter of Credit by the host government		0.8160			
8. Establishment of government funded debt reserve account if state-owned off-taker is unable to make necessary payments to the lenders		0.8030			
9. Presence of host government grants					
10. Presence of Subordinated Debt by Host Government		0.7980			
11. Presence of Equity from Government/ Government Agency		0.7930			
12. Financing with political risk insurance from Multi-lateral agencies or Export Credit agencies or insurance companies			0.798		
13. Establishment of specialized intermediary (such as Infrastructure Development Finance Company etc) with equity participation from government, domestic financial institutions.			0.677		
14. Involvement of Multilateral Agencies			0.663		
15. Involvement of Export Credit Agencies			0.648		
16. Involvement of security trustee			0.622		
17. Involvement of insurance companies (Business interruption and casualty insurance policies in place)					
18. Presence of Subordinated Debt (by Multilateral Agency)			0.573		
19. Creation of Debt Service Reserve Fund				0.719	
20. A trust that grants SPV a priority interest in portion of off-taker’s cash collection in case the off-taker defaults in payment obligation				0.646	
21. Indexation formula that adjusts the local currency tariffs for inflation and changes in tax				0.613	
22. Establish an escrow agreement between SPV and off-taker to capture revenues from off-take customer to support off-taker’s payment obligation				0.556	
23. Establish a lender managed escrow account for deposit revenues				0.508	
24. Standby letter of credit backing Contractor’s performance to fulfill its obligation					0.775
25. Senior lender’s acceptance of back-ended payment profile (i.e. flexible repayment schedule)					0.764
26. Commercial Paper from Banks					0.672
27. A subordination agreement among government, SPV and lenders for short term cash flow pressure					0.634
<b>Percentage of Variance</b>	<b>28.9%</b>	<b>18.3%</b>	<b>8.2%</b>	<b>5.9%</b>	<b>5.4%</b>

Note: Extraction Method: Principal Component Analysis  
 Rotation Method: Varimax with Kaiser Normalization  
 Rotation converged in 7 iterations.

- Factor Grouping 5 represents commercial banks' credit enhancement: which consists of four factors in a group and higher loadings are associated with standby letter of credit and lender's acceptance of backended payment profile.

Application of network theory provides thorough analysis on PPP structure and the relationships among stakeholders from a set of agreements/contracts [15]. In this view, the authors have tried to analyze credit enhancement factors and their associated risks of IPP projects by network theory to get clear understanding on - What credit enhancement factors are the most influential to minimize the associated risks of IPP projects? Why are they powerful? What are their roles? Who are less powerful and what are the obstacles that cause them less powerful? Now consider a bipartite (two-mode) graph, which represents credit enhancement factors (i.e. five factor groupings from Factor Analysis) and risk factors (where the risk factors\* are clustered into 10 groupings) [16]. A network is set based on relationships, contains a set of objects (nodes) and a mapping or description of relations between objects or nodes [17].

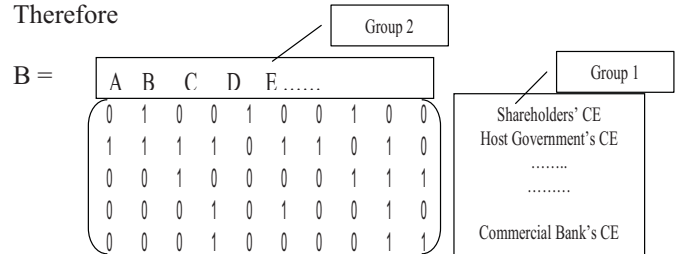
Figure 1 shows the bipartite graph of an IPP project. In this graph, the nodes are divided into two sets so that no edge connects two nodes in the same set. Group 1 is the credit enhancement factors and Group 2 is the related risk factors of IPP projects. An edge exists only when there is a relationship between risk factors and credit enhancement factors but there is no edge between two credit enhancement factors in the same set. Now, this graph can

be analysed algebraically by introducing adjacency and incidence matrices.

In the matrix notation,

$B_{ij} = 1$ , if node  $i$  from the first group links to the node  $j$  of second group;  
 $= 0$ , otherwise.

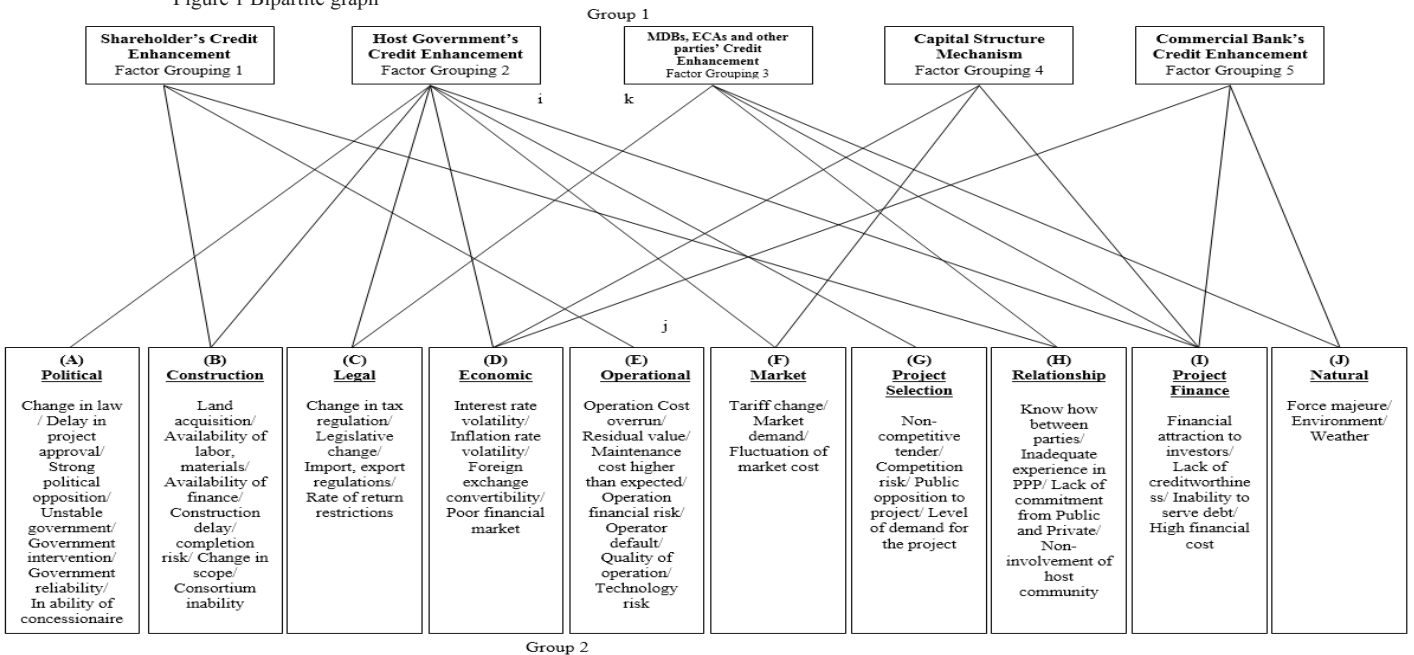
Therefore



In this matrix, each row represents the credit enhancement factor grouping of Group 1 and the columns represent the underlying risks associated with that credit enhancement factor. For example, row 1 represents factor grouping-1 (i.e. Shareholders' credit enhancement) and its risks in IPP project. Similarly, row 2 represents factor grouping-2 (i.e. Host government's credit enhancement) and its risks in IPP project. Thus, adjacency matrix  $B$  is a binary matrix. It is neither square nor symmetric in general.

$i$  and  $k$  are linked if both of them are linked to  $j$  (as shown in Figure 2).  $A_{ik} = \sum_j B_{ij} B_{kj}$ ; thus collapsing a two-mode network into a one-mode network.  $A = BB^T$ ; transposition of a matrix swaps  $B_{xy}$  and  $B_{yx}$ , if  $B$  is a  $m$ -by- $n$  matrix  $B^T$  is  $n$ -by- $m$  matrix.

Figure 1 Bipartite graph



\* The risk factors were generated from extensive literature reviews and were clustered into 10 groups namely: Political, construction, legal, economic, operation, market, project finance, project selection, relationship and natural factors [16].

Therefore  $B^T =$

$$\begin{pmatrix} 0 & 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 \end{pmatrix}$$

The general formula for matrix multiplication is -

$$Z_{ij} = \sum_k X_{ik} Y_{kj}$$

Therefore  $A =$

$$\begin{pmatrix} 3 & 1 & 1 & 0 & 0 \\ 1 & 7 & 2 & 3 & 2 \\ 1 & 2 & 4 & 2 & 2 \\ 0 & 3 & 1 & 3 & 2 \\ 0 & 2 & 2 & 2 & 3 \end{pmatrix}$$

Here, A is the product of B and B<sup>T</sup>.

The diagonal entities of A give the number of risk factor groupings in which each credit enhancement factor grouping is involved. For example, credit enhancement factor grouping-2 (i.e. Host government's credit enhancement) is involved in seven risk factor groupings; similarly shareholders' credit enhancement is involved in three risk factor groupings. Off-diagonal elements of A give the number of risk factor groupings in which both credit enhancement factors are involved. For example, there are three risk factor groupings between host government's credit enhancement and capital structure mechanism. Similarly, there is no risk factor grouping between shareholder's credit enhancement and capital structure mechanism and also with commercial bank's credit enhancement.

Software for social network analysis (computer package UCINET 6.0) is used to draw the network diagram of credit enhancement factors for IPP projects. The package incorporates models for detecting core-periphery structures in network data [18]. The components of matrix A are now being inserted into the data spreadsheets matrix of UCINET 6.0 and then the network diagram is visualized with NetDraw. Figure 2 shows the network diagram generated by NetDraw (UCINET 6.0). The drawing by NetDraw helps to better understand how a particular credit enhancement factor is embedded in its neighbourhood and in the larger graph. It gives a sense of the structural constraints and opportunities that a credit enhancement factor faces and also makes it possible to understand the role that a credit enhancement factor plays in an IPP structure.

In order to explain the location of each credit enhancement in terms of how close they are to the centre of action in an IPP structure, it is necessary to analyse degree centrality, closeness centrality and betweenness centrality indices.

Figure 2 Structure of Credit Enhancement Factors in IPP Projects by NetDraw

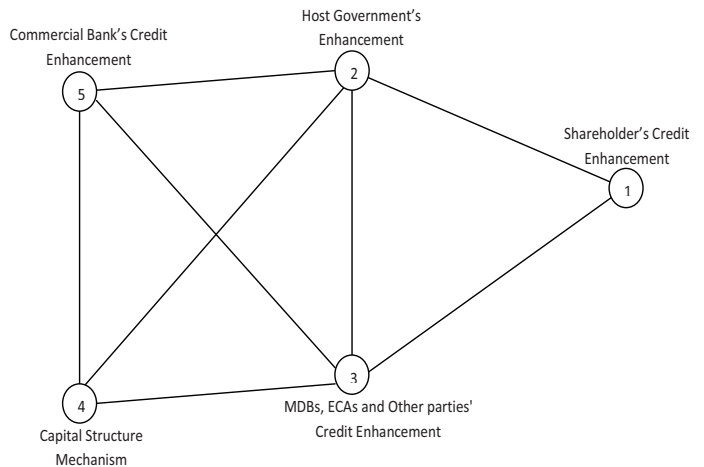


Table 2 shows graph centralization index of all credit enhancement factors involved in the structuring of IPP project agreements.

Table 2 Centralization Index

Credit enhancement factors grouping	ID	Degree	Betweenness	Closeness
Shareholders' credit enhancement	1	2	0	66.7
Host government's credit enhancement	2	8	2	100
MDBs, ECAs and other parties credit enhancement	3	7	2	100
Capital structure mechanism	4	7	0	80
Commercial bank's credit enhancement	5	6	0	80

A credit enhancement factor is said to be most important if it has the most ties. The factor is also being considered important if it is relatively close to other factors. In addition to that, the credit enhancement factor that lies on the communication paths can control the flow of communication, and is thus important.

#### 4. FINDINGS AND CONCLUSION

From the analysis of indices (as shown in Table 3) and network diagram (as shown in Figure 2), it is found that host government's credit enhancement (i.e. ID #2) and MDBs, ECAs and other parties' credit enhancement (i.e. ID #3) are the influential one in the IPP project structure. All the other credit enhancement factors are surrounded by them. Host government's credit enhancement has the highest degree, closeness and betweenness centralization indices and deals with numerous risk factors grouping agreements in the structure. It implies that host government's credit enhancement is a cohesive core actor in the IPP structure. This actor is more influential, has greater access to information and can communicate with others more effectively. The second most influential one



is – Multilateral Development Banks (MDBs), Export Credit Agencies (ECAs) and other parties' credit enhancement factor. The third most powerful credit enhancement factor is capital structure mechanism. On the other hand, shareholder's credit enhancement (i.e. ID #1) and commercial bank's credit enhancement (i.e. ID #5) are the peripheral one in the IPP structure. However, the most peripheral one is shareholder's credit enhancement (i.e. ID #1) as its degree and closeness centrality is the lowest among all others. This factor is the most remote one and has less connectivity (only with ID#1 and ID#3) compared with other factors. It is also seen that Shareholders' credit enhancement factor grouping can only address construction, operational and relationship risks which is reflected in Figure 1 as well.

Therefore, the policy makers and other stakeholders of IPP projects should shift their focus from shareholder's credit enhancement and pay more attention towards host government's credit enhancement, and MDBs, ECAs and other parties' credit enhancement as the analysis shows that these two factor groupings are of great importance to handle most of the risks of an IPP project. Presence of these two factor groupings in IPP project not only ensure creditworthiness but also better financing of the project in Asia.

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