Public private partnership approach in electrical projects – how to make a decision

Hesham A. bdelkhalek
Structure Eng. Dept., Faculty of Eng., Alexandria University, Alexandria, Egypt
Ibrahim Abullah and Abdullah Almershid
Faculty of Eng., King Saud University, Suadi Arabin

The electrical projects as infrastructure projects need huge amounts of money which the governments can not afford. The Public Private Partnership (PPP) is an approach to form a relationship between the government as public sector who have the authority and the private sector who has the resources and the technology. This study presented the PPP approach and introduced the international experience from some countries. The main aim of this study was to develop a model using the AHP theory to be used in making a decision either to select the PPP approach or select the conventional way. To develop such a model, all criteria that affect the PPP were collected and categorized into three main stages, stage one criteria for infrastructure projects, stage two criteria for electrical projects, and stage three for power generating projects. These criteria were divided into 13 main criteria and 45 secondary criteria. The relative weights or importance and then the priorities for all criteria were obtained and listed using the Expert Choice program. Two case studies were implemented. The weights for the criteria were obtained for each case study from the decision makers and then adjusted according to the weights from the developed model. Then, the summation of the last weights was calculated and compared to a certain percentage to make a decision either to select the PPP approach or not.

تعتبر مشاريع الكهرباء من مشاريع البني التحتية التي تتطلب حجم كبير من الأموال نظرا للزيادة المطردة للطلب على الكهرباء. و لا تستطيع الحكومات أن تقوم بإنشاء جميع محطات الكهرباء التي تغطي الخدمة المطلوبة. لذلك كان التفكير في الشراكة بين القطاع العام ممثلا في الحكومة ذات السيادة و بين القطاع الخاص ممثلا في الائتلافات الذي تملك الأموال والتقنية. تعرف هذه الدراسة الشراكة بين القطاعين العام والخاص و تستعرض بعض خبرات الدول المختلفة في قطاع الكهرباء. تهتم هذه الدراسة بالبنية التحتية لمشاريع توليد الكهرباء. تم استنباط المعايير التي تتحكم في علاقة الشراكة وتم تقسيم هذه المعايير إلى ثلاثة مراحل وهي: المرحلة الأولى و هي الخاصة بمعايير مشاريع البني التحتية بصفة عامة والمرحلة الثانية المعايير الخاصة بمشاريع الكهرباء (التوليد و النقل) أما المرحلة الثالثة فهي معايير خاصة بمشاريع التوليد. وهذه المعايير المستنبطة في المراحل الثلاثة قسمت الى٤٥ معيار فرعي و ١٣ معيارا أساسيا. تم استخدام نظرية التحليل الهرمي لحساب الأوزان النسبية لجميع المعايير حتى يمكن ترتيبها حسب الأهمية. وخلال نظرية التحليل الهرمي تم عمل مقارنات ثنائية - بالاستعانة بالخبراء- بين المعايير لإيجاد المتوسط الهندسي والذي استخدم في برنامج Expert Choice لحساب الأوزان. تم استخدام هذه الأوزان في حالتين دراسيتين حيث تحسب أوزان جديدة لهذه المعايير بواسطة متخذي القرار في قطاع الكهرباء وتم تعديل هذه الأوزان باستخدام النموذج أو الأوزان السابقة. وتجمع الأوزان الجديدة و تقارن بنسبة معينة (اقترحت ٧٠%) فإذا كان مجموع الأوزان مساو أو يزيد عن هذه النسبة فالقرار أن يتم التعاقد بطريقة الشراكة بين القطاعين و إذا قلت مجموع الأوزان عن نسبة أخري (اقترحت ٦٠%) فان القرار أن يتم التعاقد بالطريقة التقليدية. أما إذا كانت مجموع الأوزان بين هاتين النسبتين فالقرار يحدد بواسطة متخذي القرار.

Keywords: PPP, AHP theory, Infrastructure projects, Electrical projects

1. Introduction

Public Private Partnership (PPP) is a new trend in the relationship between the government who has the authority and the investors who have the technology and resources to apply the required services. This relationship takes many shapes but at the end there are two main partners, the government represented in ministries, public sectors e.g. electrical sector, and the investors represented in concessionaires as consortiums. Due to the growth in demand for infrastructural services and the large amount of money required for such projects and due to the limited resources of the governments, the need for a partnership between the public sector and private sector is required. In this study the authors focused on

the electrical sector and tried to discover if the PPP approach is valid for such projects or not. Some electrical projects which applied PPP failed and some succeeded. The main reason for failure of these projects is that both partners did not have enough information and knowledge about the PPP approach and did not have mature insight or conceptual vision for this relationship. Many criteria affect this relationship and needed to be weighted.

2. Definition of PPP

It is an agreement for Partnership between the Public and Private (PPP) sectors for a long period to fulfill the mutual benefits. The famous form of these partnerships is that the public sector represented by the government buys the quality service for long time (concession period) from the private sector. The private sector is responsible for the service, maintenance, development and construction of the infrastructure [1]. There are many forms of PPP such as Lease-Purchase (LP), Build-Operate-Transfer (BOT), (Operation and Maintenance (O and M), (Build-Own-Operate-Transfer) (BOOT), Build-Own-Operate (BOO) and many other forms [2]. The PPP has the following characteristics: concentration on services; high performance; creativity; and risk mitigation [3].

3. Aim of the study

This study aims at

1. Describing the criteria that affect the decision to make a partnership between public and private sectors in electrical projects.
2. Building a model to help the decision makers to evaluate the PPP in electrical projects. Electrical projects include generating and transporting the electricity, this study concentrates on power generating projects.

4. International experience in electrical projects by PPP

PPP is used by many countries for electrical projects. The following is the experience of some countries using PPP in their electrical projects.

- Egypt: Eleven international consortiums were conformed to compete in execution Al-Nobarya Power Plant (1200 MegaWatt). North Cairo Power Plant (600 MW) with cost 300 million USD. Expected ten Power Plants with total capacity 7000 MW [4].
- China: After failing in two projects, Lebeen B Power Plant (2x350 MW and cost 600 million USD) has succeeded. Four other projects distributed allover the country have been accepted by the government [5].
- India: Two projects faced many problems from the government and society: Dabhol Power Plant (2015 MW) and Mangalor Power Plant (cost 2800 million USD) [6].
- Pakistan: Hobb Power Plant which cost 1500 million USD faced many problems between the government and the concessionaire [6].
- Oman: Manh Power Plant (180 MW) was finished in year 2000 with concession period 20 years. Three additional Plants will be executed using the PPP.

5. Description of the criteria that affect PPP

Many criteria affect the Public Private Partnership PPP in generating electricity projects. It is very essential to extract all the expected criteria. All the criteria were extracted from the references as listed in Table (1). These criteria were divided into three stages (Stage one for general infrastructure projects, stage two for electrical projects, and stage three for power generating projects). These stages were divided into 13 main criteria, and then these main criteria were divided into 45 secondary criteria.

6. Steps of the model

The developed model can be summarized in the following steps

1. Collect all criteria that affect the power generating electrical projects and then categorize them to main and secondary criteria as in table 1.
2. Measure the relative importance by Pairwise Comparison using the Analytical Hierarchical Process (AHP) as in table 2.
3. Insert the averages obtained from step B in the Expert Choice Program to calculate the

Table 1
Criteria that affect PPP-developed from the references

Stage	Main criteria	Secondary criteria	References
First Stage - Criteria for General Infrastructure	Project economy	Financing	[8-11]
		Concession period	[5, 10-12]
		Easy accounting	[5]
		Market needs	[9-10, 13-14]
		Project cost	[8, 13, 15]
		Follow-up the project stages	[16]
		Fast benefits	[8, 17]
	Technical	Complexity of the project	[8, 10, 15]
		V.F.M.	[10, 16]
		Experience of consortium	[14, 18, 19], 20]
	Social	Social support	[21, 22]
		Work safety	[13, 23, 24]
		Security problems	[8]
		Environmental safety	[8, 11, 25-26]
	Law	Complete set of PPP rules	[21, 22]
		Local laws matching and stability	[9, 27]
		End of Concession by Government	[5]
		Fair Competition	[5, 27]
		Owner's equity /debit for investors	[10]
		Less risk and disputes	[17]
	Managerial	Owner experience in PPP	[16, 21,25]
		Fast approval and cash	[5, 22].
		Managerial flexibility and defined responsibility.	[15, 16, 17]
		Less governmental interference	[16, 28]
	Country economy	Power of country economy	[8, 13, 29]
		Inflation and taxes	[5, 8]
		Governmental share in the project	[5, 10, 14]
		General debit	[3]
		Political and security stability	[13, 14, 27]
Second Stage – Criteria for Electricity Sector	Electricity economy	Sell price	[8, 11, 14, 19]
		Investments attraction	[10, 22, 27]
		Clarity of selling policy	[5-6]
		Growth of demand	[5, 13, 22, 27]
	Technical	Consortium includes the manufacturer	[5, 11]
		Unity of electrical specs.	[11]
		Precise of long-term studies	[10, 26-7]
	Managerial	Consortium commitment	[14, 16]
		Special organization for electrical sector	[3, 5]
		Clear criteria for project submittals	[11, 27]
Third Stage – Criteria for Power Generating	Plant type	Power plant type	[26]
	Fuel	Fuel type and transportation cost	[23, 26-27]
		Fuel prices	[5]
	Location of plant	Close to fuel source	[26]
		Close to water source	[26]
	Electrical link	Electrical link	[26]

weight for each criterion and then rearrange the criteria according to its weight.

For any case study, evaluate the criteria from the decision makers (scale of 10) and calculate the corresponding weights according to the model e.g. if a decision maker gives a criterion 7 out of 10 and the weight of this criterion is 2, then its new weight will be 0.7*2=1.4. Sum all the new weights for all the criteria and compare it with a certain percentage. If the sum is more than or equals this percentage, then the decision is select the PPP and vice versa. This certain percentage can be assumed as 70% or any other percentage depending on the decision makers.

7. Pairwise comparison between the criteria

The Analytical Hierarchal Process (AHP) is a Multiple Criteria Decision Making process (MCDM). The Pairwise comparison for the main and secondary criteria is the main step in the AHP, then a consistency test is used to judge the Pairwise Comparison [30]. The Pairwise Comparison is carried out through experts' opinions while the consistency test is carried out by computer program called Expert Choice 2000. In this study, the Pairwise Comparison was carried out by taking opinions of 21 experts (17 experts from the electrical sector, two from academia in the economy and energy management discipline, and two from ministry of defense).

In pair-wise experts give weights for the importance (priorities) of one criterion compared to the second criterion. These weights are of scale 1 to 9: where, 1 for the least importance (priority) while, 9 for the highest importance (priority). Then the averages are calculated using the following eq. (1) according to the AHP technique. These averages are calculated and listed in table 2 for secondary criteria, table 3 for main criteria, and table 4 for stages.

Averages of values

$$(x_1, x_2, x_3\ldots, x_n)=[(x_1, x_2, x_3\ldots, x_n)]^{(1/n)}. \quad (1)$$

Where:

$x_1, x_2, x_3\ldots, x_n$ are the values given by experts 1,2,3..., n

8. Outputs of AHP

After making the Pairwise comparison, the averages are inserted in the Expert Choice 2000 (EC) Program to obtain the relative weights for all criteria and stages [31]. EC will arrange the priorities (importance) for all the criteria according to the Pairwise comparison inserted. Table 5 shows the outputs for the three stages. Tables 6- 8 show the weights for the items (criteria) for each stage listed in table 5.

9. Case study

A user interface program was built using the model to link the used criteria with a decision of selecting from two alternatives; either to follow the PPP approach or select the conventional way of contract. The program was built using Microsoft Excel with Visual Basic application. The model was implemented in the third stage for Al-Shaeeba Power Generating Plant on Red Sea coast to produce 900 MW with total cost 1200 million USD. The second project was extensions of the Ninth Power Generating Plant in Riyadh (480 MW and cost 222 million USD). The outputs for these case studies (summation of all weights of criteria) were 73.85% for case one and 59.51 for case two. As mentioned previously in subtitle 6 -steps of the model- point D, and if the results were compared to 70%, the decision in case one is select the PPP approach and for case two is select the conventional contracting.

Table 2
Average values for the importance of one criterion compared to the other –secondary criteria

Main criteria	No.	Pairwise comparison for secondary criteria		Importa-nce of 1st criterion compared to the 2nd	Importa-nce of 2nd criterion compared to the 1st.
		First criterion	Second criterion		
Project economy criteria	1	Financing	Concession period	2.650	
	2	Financing	Easy accounting	2.321	
	3	Financing	Market needs		2.21
	4	Financing	Project cost		1.70
	5	Financing	Fast benefits	1.253	
	6	Financing	Follow-up the project	3.378	
	7	Concession period	Easy accounting		1.13
	8	Concession period	Market needs		3.72
	9	Concession period	Project cost		2.77
	10	Concession period	Fast benefits		1.84
	11	Concession period	Follow-up the project	2.203	
	12	Easy accounting	Market needs		3.66
	13	Easy accounting	Project cost		2.68
	14	Easy accounting	Fast benefits		1.07
	15	Easy accounting	Follow-up the project	1.899	
	16	Market needs	Project cost	1.991	
	17	Market needs	Fast benefits	2.919	
	18	Market needs	Follow-up the project	4.948	
	19	Project cost	Follow-up the project	4.494	
	20	Project cost	Fast benefits	2.091	
	21	Follow-up the project	Fast benefits		2.76
Technical	22	Complexity of the project	V.F.M.		2.28
	23	Complexity of the project	V.F.M.		3.02
	24	V.F.M.	Complexity of the project		1.30
Social	25	Social support	Work safety		1.94
	26	Social support	Security problems		1.13
	27	Social support	Environmental safety		1.08
	28	Work safety	Security problems	1.662	
	29	Work safety	Environmental safety	1.816	
	30	Security problems	Environmental safety	1..248	
Law criteria	31	Complete set of PPP rules	Laws match. and stability	2.091	
	32	Complete set of PPP rules	End of concession by Gov.	3.178	
	33	Complete set of PPP rules	Fair competition	2.185	
	34	Complete set of PPP rules	Owner's equity /debit	2.955	

	35	Complete set of PPP rules	Less risk and disputes	1.831	
	36	Laws match. and stability	End of concession by Gov.	1.629	
	37	Laws match. and stability	Fair competition	1.615	
	38	Laws match. and stability	Owner's equity /debit	2.661	
	39	Laws match. and stability	Less risk and disputes	1.386	
	40	End of Concession by Gov.	Fair competition		1.45
	41	End of Concession by Gov.	Owner's equity /debit	1.403	
	42	End of Concession by Gov.	Less risk and disputes		1.30
	43	Fair competition	Owner's equity /debit	2.379	
	44	Fair competition	Less risk and disputes	1.0554	
	45	Owner's equity /debit	Less risk and disputes		2.65
Managerial Criteria	46	Owner experience in PPP	Fast approval and cash	1.628	
	47	owner Experience in PPP	Manag. flex. and def. resp.	1.533	
	48	Owner experience in PPP	Government interference		1.06
	49	Fast approval and Cash	Manag. flex. and def. resp.	1.437	
	50	Fast approval and Cash	Government interference		1.34
	51	Manag. flex. and def. resp.	Government interference		1.76
Country Economy Criteria	52	Power of country economy	Inflation and taxes	1.913	
	53	Power of country economy	Gov. share in the project	2.049	
	54	Power of country economy	General debit	1.496	
	55	Power of country economy	Political and security stability		1.47
	56	Inflation and taxes	Gov. share in the project	1.392	
	57	Inflation and taxes	General debit		1.25
	58	Inflation and taxes	Political and security stability		3.11
	59	Gov. Share in the project	General debit		1.48
	60	Gov. Share in the project	Political and security stability		3.51
	61	General Debit	Political and security stability		2.86
Economical – Electricity	62	Sell Price	Investments attraction	2.091	
	63	Sell Price	Clarity of selling policy	1.268	
	64	Sell Price	Growth of demand		1.12
	65	Investments attraction	Clarity of selling policy		1.91
	66	Investments attraction	Growth of demand		2.16
	67	Clarity of selling policy	Growth of demand		1.08
Tech. (Elec.)	68	Manuf. is in consortium	Unity of electrical specs.		1.18
	69	Manuf. is in consortium	Precise of long-term studies		1.44
	70	Unity of electrical specs.	Precise of long-term studies		1.35
Mang. (Elec.)	71	Special organization	Clear criteria in proj. submit.	2.620	
	72	Special organization	Consortium commitment	1.238	
	73	Clear criteria in proj. submit.	Consortium commitment		2.29
Fuel	74	Fuel type and tran. cost	Fuel prices		1.13
Loc.	75	Close to fuel source	Close to water source	1.194	

Table 3
Average values for the importance of one main criterion compared to the other - main criteria

Stage	No.	Pairwise comparison for main criteria		Importa-nce of 1st criterion compared to the 2nd	Importance of 2nd criterion compared to the 1st.
		First Main Criterion	Second main criterion		
1st Stage Criteria	1	Project economical criteria	Technical criteria	1.838	
	2	Project economical criteria	Social criteria	2.980	
	3	Project economical criteria	Law criteria	2.257	
	4	Project economical criteria	Managerial criteria	3.029	
	5	Project economical criteria	Country economy criteria	2.943	
	6	Technical criteria	Social criteria	1.867	
	7	Technical criteria	Law criteria	1.138	
	8	Technical criteria	Managerial criteria	1.751	
	9	Technical criteria	Country economy criteria	1.532	
	10	Social criteria	Law criteria		1.35
	11	Social criteria	Managerial criteria		1.04
	12	Social criteria	Country economy criteria	1.029	
	13	Law criteria	Managerial criteria	1.357	
	14	Legal criteria	Country economy criteria	1.682	
	15	Managerial criteria	Country economy criteria		1.01
2nd Stage Criteria	16	Economical criteria for elect.	Technical criteria for elect.	2.476	
	17	Economical criteria for elect.	Mang. criteria for elect. sect.	1.829	
	18	Technical criteria for elect.	Mang. criteria for elect. sect.		1.28
3rd Stage Criteria	19	Plant type, generating unit	Fuel	2.073	
	20	Plant type, generating unit	Electrical link	1.891	
	21	Plant type, generating unit	Location	1.111	
	22	Fuel	Electrical link	1.156	
	23	Fuel	Location		1.34
	24	Location of the plant	Electrical link	1.497	

Table 4
Average values for the importance of criteria for one stage compared to the other (stages)

Stage	No.	Pairwise comparison for stages		Importa-nce of stage A compared to stage B	Importa-nce of stage B compared to stage A.
		Stage A	Stage B		
Three Stages	1	General criteria for infrastructure projects	General criteria for electrical projects	1.151	
	2	General criteria for infrastructure projects	Criteria for power generating Projects	1.316	
	3	General criteria for electrical projects	Criteria for power generating projects	1.289	

Table 5
Weights of stages in the model level

Stage	Effect on the stage %
First (criteria for infrastructure projects)	38
Second (criteria for electricity projects)	34.3
Third (criteria for power generating projects)	27.7

Table 6
Importance of criteria on the first stage (infrastructure projects)

Criteria	Effect on stage level	Effect on model level
Project economy	*33.3*	*12.6*
Market needs	31.4	4
Project cost	21.3	2.7
Financing	15.7	2
Fast benefits	11.2	1.4
Easy accounting	8.4	1.1
Concession Period	7.5	0.9
Follow-up the project stages	4.5	0.6
Project technical criteria	*18.4*	*7*
Experience of consortium	47.7	3.3
V.F.M.	36.4	2.5
Complexity of the project	15.9	1.1
Social criteria	*10.8*	*4.1*
Work safety	37.5	1.5
security problems	23.1	1
Environmental safety	20	0.8
social support	19.4	0.8
Law criteria	*15.7*	*6*
Complete set of PPP rules	31.4	1.9
Local laws matching and stability	19.5	1.2
Less risk and disputes	15.7	0.9
Fair competition	15.1	0.9
End of concession by Government	10.8	0.6
Owner's equity /debit for investors	7.5	0.4
Managerial criteria	*11*	*4.2*
Less governmental Interference	30.5	1.3
Owner experience in PPP	30.2	1.3
Fast approval and Cash	22	0.9
Managerial flexibility and defined responsibility.	17.3	0.7
Country economy	*10.8*	*4.1*
Political and security stability	38.3	1.6
Power of country economy	23.5	1
General debit	15.1	0.6
Inflation and Taxes	12.7	0.5
Governmental share in the project	10.4	0.4

Table 7
Importance of criteria in the second stage (electrical projects)

Criteria	Effect on stage level	Effect on model level
Economical factors for electricity sector	51.3	17.6
Growth of demand	30.4	5.4
Sell price	29.7	5.2
Clarity of selling policy	26	4.6
Investments attraction	13.9	2.5
Technical factors	21.1	7.2
Precise of long-term studies	41.1	3
Unity of electrical specs.	31.4	2.3
Consortium includes the manufacturer	27.5	2
Managerial and organizational factors for electricity sector	27.5	9.5
Special organization for electrical sector	45.4	4.3
Consortium commitment	37.7	3.6
Clear criteria for project submittals	16.9	1.6

Table 8
Importance of criteria in the third stage (power generating projects)

Criteria	Effect on stage level	Effect on model level
Plant type and generating units	34.8	9.7
Fuel	19.4	5.3
Fuel price	53.1	2.8
Fuel Type	46.9	2.5
Location of the plant	*27.9*	*7.7*
Close to fuel source	54.4	4.2
Close to water source	45.6	3.5
Electrical link	*17.9*	*5*

10. Conclusions

The Public Private Partnership is a new shape of the relationship that fills the gap between the government who has the authority and needs the infrastructure services for its people and the private sector who has the resources and the know-how. This paper was concerned about the electrical power projects as infrastructure projects. The criteria that affect PPP were divided into three main stages: stage one for general infrastructure projects; stage two for electrical projects (generating and transportation); and stage three for power generating plants. The criteria for each stage were extracted and developed and then divided into 13 main criteria which –in turn- were divided into 45 Secondary criteria. A model that helps the decision makers to make their decision either to select PPP alternative or not was developed using AHP theory and user interface program using (Microsoft Excel). This model was developed by inserting the Pairwise Comparison results between all the criteria for all stages in the Expert Choice Program to get the relative weights for all criteria. The study showed that the importance of the 1st stage is 38% compared to the 2nd stage (34.3%) and finally, 3rd stage (27.7%). The weights (importance) for different criteria were calculated and listed in the paper. Two case studies were implemented using the model which calculates the summation of the weights of each case. These weights were obtained from the decision makers in each case and adjusted using the model. The summation of these weights is used to compare either to select the PPP alternative or select the conventional contract. The authors suggested that, if this summation is 70% or higher, then select the PPP alternative, if it is 60% or less select the conventional contract, and if it is between 60% and 70%, the decision has to be made by the decision makers.

References

[1] S.R. Crubb, "The Private Finance Initiative Public Private Partnerships", Civil Engineering, (126), pp. 133-140 August (1998).

[2] Ministry of Municipal Affairs, "PPP A Guide for Local Government", British Colombia, May (1999).

[3] Hm Treasury, "Public Private Partnership", the Government Approach, London the Stationary Office (2000).

[4] مركز المعلومات و دعم القرار "فاعلية نظام البوت في تمويل المشروعات العامة في مصر- المخرج الاول" يونيو (٢٠٠١).

[5] S.Q Wang and L.K. Tiong, "Case Study of Government Initiatives for Prc's BOT Power Plant Project", International Journal of Project Management (18), pp. 69-78 (2000).

[6] Y.H. Kwak, "Analyzing Asian Infrastructure Development Privatization Market", Journal of Construction Engineering and Management, Vol. 128 (ASCE) (2002).

[7] طاهر محمد سجواني "خصخصة قطاع الكهرباء و المياه المحلاة المرتبطة به في سلطنة عمان" ندوة توفير و تمويل المرافق العامة، الرياض (٢٠٠٢).

[8] M.K. Lewis and D. Grimsey, "Evaluating the Risk of Public Private Partnership For infrastructure Projects", International Journal of Project Management, (20), pp. 107-118 (2002).

[9] A. Al-Twajri, "Challenges of Electricity Power Supply in Saudi Arabia", Arriyadh Development Authority Symposium of Infrastructures Financing and Provision, Riyadh (2002).

[10] L.K. Tiong, Yeo Khim-Teck and S.C. Mccarthy, "Critical Success Factors in Winning BOT Contracts", Journal of Construction Engineering and Management, Vol. 118 (2) (1992).
[11] A.M. Abdel-Aziz and A.D. Russell, "A Structure for Government Requirements in Public-Private Partnerships", NRC, Canada, Civil Eng., Vol. 28, pp. 891-909 (2001).
[12] L. Ngee, R.L. Toing and J. Alum "Automated Approach to Negotiation of BOT Contracts", Journal of Construction Engineering and Management, Vol. 11 (2), ASCE (1997).
[13] RL.K Tiong, C.H. Keong and J. Alum, "Conditions for Successful Privately Initiated Infrastructure Projects", Proc. Insten. Civil Engineering, pp. 59-65 Paper (11139) (1997).
[14] C.M. Tam "Build-Operate-Transfer Model for Infrastructure Developments in Asia-Reasons for Successes and Failures", International Journal of Project Management, Vol. 17 (6), pp. 377-382, (1999).
[15] T. Alhazmi and R. Mccaffer, "Project Procurement System Selection Model", Journal of Construction Engineering and Management, Vol. 126 (3), ASCE (2000).
[16] J.W.E. Masterman and R.N. Games on, "Client Characteristics and Needs in Relation to their Selection of Building Procurement Systems", University of Manchester, Institute of Science and Technology –UMIST, England (1995).
[17] P.E. Love, M. Skitmore and G. Earl, "Selecting A Suitable Procurement Method for a Building Project", Journal of Management and Economics, Vol. 16, pp. 221-233 (1998).
[18] J.M. Beck, Highway 407 Etr. Express Toll Route, Highway 104 Western Alignment, "Innovative Highway Development Through Public Private Partnerships", Proceedings of the Annual Conference of The Canadian Society for Civil Engineers, pp. 89-96 (1997).
[19] J.D. Pine, "Public Private Partnership", Project Financing and Development" Proceeding of the 1st Structure Specially Conference of the Canadian Society for Civil Engineering, pp. 17-31 (1996).
[20] S.Q. Wing, et al., "Evaluation and Competitive Tendering of BOT Power Plant Project in China", Journal of Construction Engineering and Management, Vol. 124 (4), ASCE (1998).
[21] X.Q. Zhang and M.M. Kumaraswamy, "Procurement Protocols Public-Private Partnered Projects", Journal of Construction Engineering and Management ASCE, Vol. 127, pp. 351-358 (2001).
[22] C. Pahiman, "Build-Operate-Transfer (BOT) Private Investment in Public Projects or Just More Public Subsides for the Private Sector? In: Watershed", Vol. 2, Bangkok, Towards Ecological Recovery and Regional Alliance (TERRA), (1996).
[23] جمال الدين نصار تنفيذ مشروعات البنية التحتية باستخدام نظام البوت ، الجمعية المصرية للمهندسين الاستشاريين(أسكون) (٢٠٠٠).
[24] R.L. Toing and J. Alum, "Evaluation of Proposal for BOT Projects" International Journal of Project Management, Vol. 15 (2), pp. 67-72 (1997).
[25] Y.H. Kwak, "Analyzing Asian Infrastructure Development Privatization Market", Journal of Construction Engineering and Management, Vol. 1228 (2) ASCE (2002).
[26] الشعلان ،عبد الله بن عبد الله بن محمد ، تطور قطاع الكهرباء في عهد خادم الحرمين الشريفين – جامعة الملك سعود، الرياض. (٢٠٠٢).
[27] M., Kumaraswamy and D.A. Morris, "Build- Operate- Transfer-Type Procurement in Asian Mega-projects", Journal of Construction Engineering and Management, Vol. 128 (2), ASCE (2002).
[28] L. Tories and V. Pina, "Public-Private Partnership and Private Finance Initiatives in the UK and Spanish Local Governments", The European Accounting Review, 10:3, pp. 601-619 (2001).
[29] A. Lzaguirre Karin, "Private Participation in Energy, Public Policy for The Private Sector", World Bank (2000).
[30] S.T. Saaty, "Fundamentals of Decision Making and Priority Theory with the Analytical Hierarchy Process", Vol. VI, RWS Publications, Pittsburgh, USA (1994).
[31] Expert Choice, "Quick Start Guide and Tutorials", Advanced Decision Support System, Pittsburg, Pa, USA (2000).

Received February 16, 2008
Accepted March 31. 2008