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Success Factors for Build Operate Transfer (BOT) Power Plant Projects in Iran

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Abstract: *Iranian electric power industry has adopted Build Operate Transfer (BOT) approach in a number of projects as an alternative to utilize private sector investment. Therefore, some power plant projects have been successfully implemented through BOT such as South Isfahan power plant as a first BOT power plant; in contrast, some of them have been failed in the procurement process. Thus, there is a need for improving procurement approaches for future BOT projects. This study identifies and analysis various success factors in BOT power plant projects in Iran. The research methodology that has been utilized including literature review, and survey questionnaire have distributed to BOT experts. Hence, this research establishes success factors for BOT power plant project in Iran comprise of 33 factors. All 33 success factors are considered as important factors in BOT infrastructure projects; moreover, there is a good agreement in significance of success factors between government organization, consultants, and concessionaires.*

Keywords: *Success Factors, Power Plant, BOT, Iran*

I. INTRODUCTION

The desire to attain the sustainability, in terms of economic, social and environmental demands the innovative project undertaking. The innovative approach involves private sector especially in funding the project. In 80th decade, many Asian countries started privatization of infrastructure to improve public facilities and increase the life level [1], [2], [3], [4], [5]. The attractiveness of Build Operate and Transfer (BOT) approach has increased in developing countries due to the advantages offered by the approach. The main advantage is the chances of government to utilize private sector's investment, management, and technology. Previous studies have assessed the market potential for producing the power, absorbing foreign and local investment engaged in BOT procurement.

On the other hand, some BOT infrastructure projects have been failed around the world. Therefore, government and promoters should notice to the l success factors in these projects. There are some existing researches in CSFs of BOT projects around the world such as [6], [7], [8]. These studies have been done in CSFs of BOT projects only in China while it needs to identify CSFs in other countries that have utilized BOT approach in their infrastructure projects. Therefore, since there is no study to date in CSFs in BOT power plant projects in Iran, the research in this area will help both government organization and concessionaire. This paper identifies critical success factors (CSFs) in BOT power plant projects in Iran.

II. BOT POWER PLANT IN IRAN

After changing economic trends in Iran, and with particular attention to the utilization of non-government sector resources, Iran's Ministry of Energy started to attract local and foreign investment by BOT and BOO methods to implement infrastructure projects in power industry. The first power plant project proposed for private sector investment in construction of power plant was in Kerman province in 1995. However it was dropped after the withdrawal of investor. Then, in 1999, Parehsar power plant project in Gilan province proposed as an international tender was selected to be an international consortium; however, the project was stopped due to the structural problems in the implementation process. Since cancellation of that project, many projects came into negotiation but none of them reached to the stage of implementation.

Thus, the authorities in charge of the Iranian power industry and MAPNA Company initiated to remove the existing impediments in the way of the execution of such plans by creating a new project [9]. Until now, South Isfahan Power Plant has been identified as a pioneer and first Iranian IPP project. Given the nature of the project, the direct-negotiation-procedure was selected for the assignment of works. The South Isfahan BOT project was thus launched. This project is the first BOT Power Plant project that has been put into operation in the Iranian power industry. In this regard, a pre-agreement was signed between Iran Power Development Corporation (IPDC) and MAPNA International Company in 2002. The period of time specified for construction period was 3 years, and 20 years for the commercial operation period following the Commercial Operation Date (COD) of the power plant. Recently, the government has decided to transfer the majority of the power plant to the private sector; therefore, the government encourages the private sector to utilize Build Own Operate (BOO) approach in power plant project. BOO is similar to BOT but without transferring to government, commonly used in Australia at the beginning [10]. Table I illustrates BOT and BOO power plant projects in Iran.

Table I: A list of power projects via BOT and BOO approaches in Iran

Project Name	*Type of Power*	*Method of Investment*	*Capacity (MW)*	*Project Investment Value (million €)*	*Concession Period*	*Status*
South Isfahan	Gas	BOT	954	320	20	In Operation
Fars	Gas	BOT	972	550	20	In Operation
Parehsar	Combined Cycle	BOT	968	550	20	In Construction
South Isfahan	Steam	BOT	480	-----	20	In Planning
Mianeh	Combined Cycle	BOT	1000	-----	20	In Planning
Rafsanjan	Combined Cycle	BOT	1000	----	20	In Planning
Rudeshur	Gas	BOO	2000	700	----	In Operation
Asaluyeh2	Gas	BOO	1000	350	----	In Operation
Ferdos	Gas	BOO	1000	350	----	In Operation
Kahnuj2	Combined Cycle	BOO	50	31	----	In Operation
Noshahr	Combined Cycle	BOO	50	31	----	In Operation
Ali Abad	Gas	BOO	1000	350	----	In Operation
Khoramshar	Gas	BOO	1500	525	----	In Construction
Genaveh	Combined Cycle	BOO	500	310	----	In Construction
Khoram	Combined Cycle	BOO	1000	620	----	In Construction
Kahnuj1	Combined Cycle	BOO	1000	620	----	In Construction
Islam Abad	Combined Cycle	BOO	500	310	----	In Construction
Yazd2	Combined Cycle	BOO	500	310	----	In Construction
Isfahan2	Combined Cycle	BOO	500	310	----	In Construction

III. RESEARCH METHODOLOGY

3.1. The procedure

The quantitative research methodology was employed in this research. Therefore, the research methodology was considered for this study in two stages:

- The first stage was a widespread literature review and interview with BOT experts to identify the success factors in BOT projects. The most significant reviewed pervious researches included [11], [6], [12], [13], [14], [7], [15], [16], [17], [8], [18]. The CSFs related to BOT projects were identified and recognized success factors with the most agreement by these researchers as a benchmark for further researches. Hence, 33 success factors were identified in BOT infrastructure projects.
- The second stage was a survey questionnaire to government organizations, consultants, and concessionaires conducted to evaluate the criticality of the listed CSFs.

3.2. The survey sample

The questionnaire explored some barriers that BOT power plant project encounter them. Therefore, the questionnaire was conducted with BOT participants involved in the Iranian electric power industry. For this purpose, the questionnaire was distributed to government organization, consultants, and concessionaires. A total of 142 questionnaires were distributed to BOT and BOO experts according to three above categories. They were dispersed only by the researcher, person by person, in order to help them if it is necessary. Moreover, this method of questionnaire distribution makes direct access to the respondents to ensure that the respondents realize the requirements of the questionnaire. The direct method is significant in encouraging respondent to answer the detailed questionnaire. A total of 129 questionnaires were gathered. From this number, 123 questionnaires were considered as valid questionnaires for analysis (Table II).

Table II: Distributed, returned, and missing questionnaire comparison

Description	*Quantity*	*Percentage (%)*
Questionnaire distributed	142	100
Questionnaire returned	129	91
Questionnaire valid and	123	86.5
Missing	19	13.5

The questionnaire was written in English language, but it was translated to Persian language because the study area was in Iran, and questionnaires were distributed among Iranian experts in BOT projects and also to facilitate easier reading and compatibility of understanding. The Likert scale was selected to obtain weight of 33 success factors to BOT power plant project in Iran. In this type of question, the respondents answer based on the amount of importance where 1 represented "not important", 2 "less important", 3 "important", and 4 "most important".

3.3. Data Analysis

The respondents are grouped into their position in organization or company including Managing Director, Project Manager, Technical Manager, Financial Manager, Planning Manager, and Junior Manager. These questionnaires' results are considered as reliable and valid, since the majority of the respondents were in positions of senior or middle manager. Table III illustrates the position of respondents in their organization or company.

Table III: Position of respondents in their organization/company

	Managing Director	***Project Manager***	***Technical Manager***	***Financial Manager***	***Planning Manager***	***Junior Manager***	***Total***
Public Sector	------	18	3	-----	6	15	42
Concessionaires	------	15	3	6	6	18	48
Consultants	3	15	6	-----	6	3	33
Total	3	48	12	6	18	36	123

On the other hand, these questionnaires' results are considered as reliable and valid in terms of their academic qualification. It means that 49 percent (60 people) of respondents approximately possess the Bachelor Degree and 51 percent (63 people) possess the Master Degree. Figure 1 shows number of respondents' academic qualification in three categories.

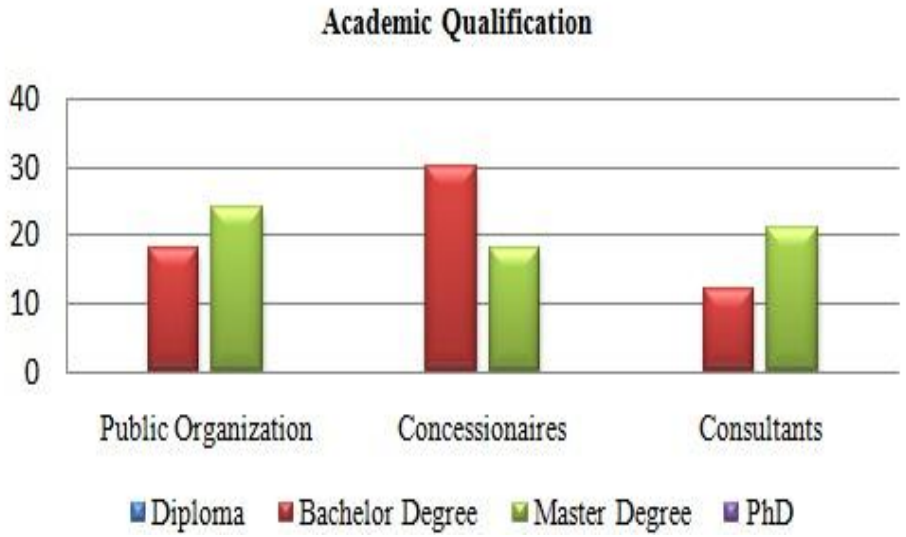

Figure1. Academic qualification of respondents

In order to increase the reliability and validity of data collection, all respondents were selected through experts who had experience in BOT infrastructure projects in Iran. In public organization, 15 respondents have 6-10 years experience in BOT power plant projects and 9 respondents have less than 6 years experience in this field. It means that 78.5 percent of the respondents have more than 6 years experience in BOT projects. Moreover, in concessioners, 33 respondents have 6-10 years experience in BOT power plant projects and 12 respondents have less than 6 years experience in this field. It clearly seems that the majority of respondents (75%) have experience in BOT project more than 6 years. Finally, in consultants' category, around half of the respondents (45.5%) have more than 6 years experience in BOT power plant projects in Iran. Therefore, it corroborates to obtain high-quality data to ensure regarding the reliability and validity of data collection. Figure 2 illustrates the experience of respondents in BOT infrastructure projects.

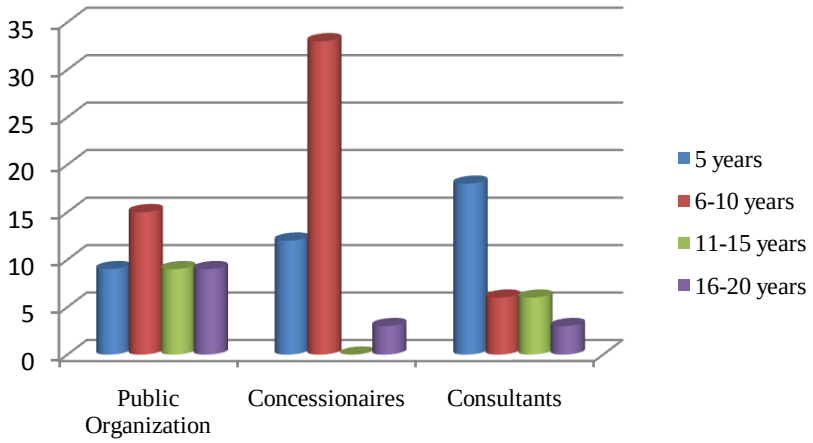

Figure2. Experience of respondents in BOT infrastructure projects

On the other hand, in public organization, 15 respondents have collaborated in 2-5 BOT power plant projects, 9 respondents in 6-10 projects and also 12 respondents in more than 11 projects. It means that 85 percent of respondents have cooperated in more than 2 BOT power plant projects. In concessionaires' category, 18 respondents have been involved only one BOT power plant projects, 27 respondents in 2-5 projects, and 3 respondents in 6-10 projects. Therefore, this refers to 62.5 percent cooperation of the respondents in more than 2 BOT power plant projects. Furthermore, in consultants' category, 21 respondents have worked in 2-5 BOT power plant projects, 3 respondents in 6-10 projects, and 3 respondents in more than 11 projects. This implies to 82 percent collaboration of the respondents in more than 2 BOT power plant projects. Finally, it is concluded that the majority of the respondents (75%) have totally been involved in more than 2 BOT power plant projects. The respondents' participation in BOT infrastructure projects in Iran is indicated in Figure 3.

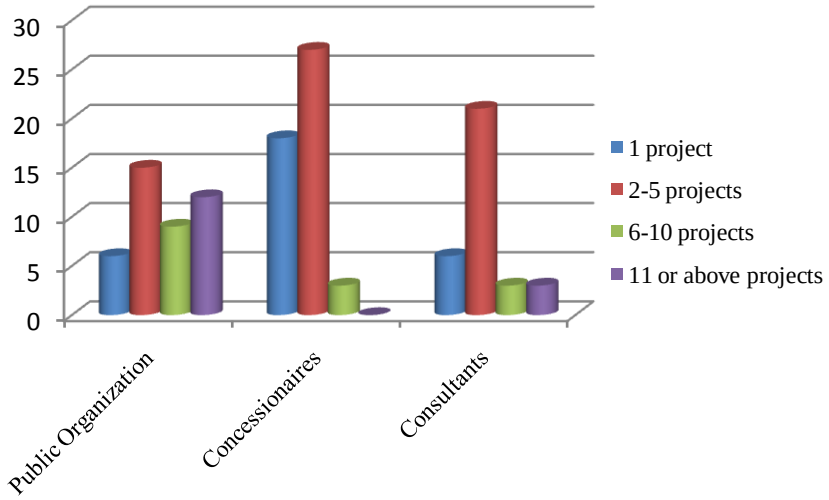

Figure3. Respondents' participation in BOT projects

The method utilized in this research was one-way ANOVA data analysis. This method is used where we have one independent variable whit three or more levels (groups) and one dependent continuous variable. As mentioned earlier, there are three categories of the respondents including government organization, concessionaires, and consultants. This method of analysis is also utilized to show the differences or similarities of their comments.

IV. FINDING AND DISCUSSION

Thirty three success factors have been considered to recognize respondents' ideas in these three classifications including consultants (33 persons), the government organization (42 persons), and concessionaires (48 persons). The mean scores of assigned by consultants to Appropriate project identification, Stable political situation, Favorable legislation regulation, and Well-organized and committed public agency are greater than 3.50. This indicates that these three factors are

the most important factors in view of consultants (Table IV). On the other hand, the mean scores of twenty nine sub-factors have been considered between 2.50 to 3.50. These sub-factors comprise of Favorable project management, Attractive financial package, Reasonable risk allocation, Government support, Commitment and responsibility of public and private sectors, Competitive and transparent procurement process, Experience with BOT project by public sector, Utilize local company in project company, Technology transfer, and Concrete concession agreement, Select suitable consortium, Overhauling guarantees, Sound environment impact, Training local staff, A multidisciplinary and multinational team, Short concession period, Good relationship with government, Public safety, Social support, Profit sharing with government, Special guarantees by the government, Select suitable subcontractor, Standardization of engineering contract, Multilateral investment guarantees agency insurance, Technical solution advance, Quality control and supervision, Capability to lead project by government, Operation in good condition, and Financial market availability. This refers to the significance of these 29 success factors in view of consultants. Therefore, in their viewpoint, all thirty three success factors are regarded as important or the most important factors because their mean scores are greater than 2.50.

Moreover, in government organization, the success factor of Attractive financial package has the highest mean score (3.67) and is considered as the most important through all thirty three sub-factors. This is followed by Stable political situation (score of 3.64), Favorable legislation regulation (score of 3.62), Reasonable risk allocation (score of 3.59), and Favorable project management (score of 3.51) by considering of mean score more than 3.50. Furthermore, the mean scores of twenty eight factors have been considered between 2.50 to 3.50. These factors comprise of Appropriate project identification, Technical solution advance, Technology transfer, Utilize local company in project company, Reasonable risk allocation, Commitment & responsibility of public & private sectors, Concrete concession agreement, Select suitable consortium, Government support, Overhauling guarantees, Profit sharing with government, Good relationship with government , Training local staff, Quality control and supervision, Sound environment impact, Select suitable subcontractor, A multidisciplinary and multinational team, Standardization of engineering contract, Short concession period, Competitive & transparent procurement process, Public safety, Experience with BOT project by public sector, Multilateral investment guarantees agency insurance, Capability to lead project by government, Special guarantees by the government , Well-organized & committed public agency, Operation in good condition, Social support, and Financial market availability. This implies that these 28 aforementioned success factors are important in view of government organization. Therefore, in their viewpoint, all thirty three critical success sub-factors are also regarded as important or the most important factors because of their mean scores greater than 2.50.

Furthermore, in category of concessionaires, the success factors of Capability to lead project by government has the highest mean score (3.63) and is considered the most important through of all thirty three sub-factors. The mean scores assigned to Stable political situation, Favorable legislation regulation, and Appropriate project identification are greater than 3.50. In other words, this indicates the importance of these three factors through others in concessionaires' viewpoint. Moreover, the mean scores of twenty nine factors consist of Experience with BOT project by public sector, Competitive and transparent procurement process, Special guarantees by the government, Commitment and responsibility of public and private sectors, Social support, Utilize local company in project company, Government support, Concrete concession agreement, Select suitable consortium, Technology transfer, Standardization of engineering contract, Good relationship with government, Favorable project management , Profit sharing with government, Technical solution advance, Sound environment impact, Quality control and supervision, Training local staff, A multidisciplinary and multinational team, Public safety, Reasonable risk allocation, Select suitable subcontractor, Overhauling guarantees, Attractive financial package, Multilateral investment guarantees agency insurance, Well-organized & committed public agency, Short concession period, Operation in good condition, and Financial market availability have been considered between 2.50 to 3.50. This implies that these 29 success factors are important in view of concessionaires. Therefore, because of the mean scores of all 33 success factors greater than 2.50, they are concerned as important or the most important factors in view of the concessionaires.

In Table IV, from the analysis, it is concluded that the most important sub-factors (rank 1) in viewpoint of three categories respondents are Appropriate project identification" for consultants, Attractive financial package for a government organization, and Capability to lead the project by government for concessionaires. Appropriate project identification is the most important success factors in project procurement system in consultants' view because it needs to utilize especial experts in BOT projects by the government. While, government organization respondents pointed to the attractive financial package as the most significant factors in BOT projects because they have concentrated on the best financial proposal by concessionaires to solve their limited budget. In contrast, concessionaires noticed to the government's ability to lead projects because it is more important to success the infrastructure projects in their viewpoint. The least important factor (rank 33) belongs to Financial market availability for all three classifications of the respondents. In other words, all respondents believe that financial market availability does not play significant role as the success factor in BOT infrastructure projects.

Eventually, although there are some differences in rank, the mean scores are very close and more than 2.50. Hence, all 33 success factors are considered as important factors in BOT infrastructure projects. There is no important difference between consultants, government organization, and concessionaires in respect of the success factors in BOT infrastructure projects according to the statistical results (significance) because significant indexes are more than 0.05 [19].

Table IV: Views of consultants, government organization, and concessionaires about success factors in BOT projects

Success Factors	Consultants (N=33)			Government Organization (N=42)			Concessionaires (N=48)			Significance
	Mean	S.D.	Rank	Mean	S.D.	Rank	Mean	S.D.	Rank	
Appropriate project identification	3.70	0.60	1	3.41	0.63	6	3.53	0.65	4	0.827
Stable political situation	3.67	0.54	2	3.64	0.58	2	3.60	0.57	2	0.887
Favorable legislation regulation	3.64	0.55	3	3.62	0.58	3	3.58	0.61	3	0.916
Well-organized & committed public agency	3.54	0.88	4	3.02	0.87	30	3.04	0.85	30	0.776
Favorable project management	3.49	0.51	5	3.51	0.55	5	3.19	0.58	18	0.850
Attractive financial package	3.47	0.69	6	3.67	0.49	1	3.06	0.73	28	0.900
Reasonable risk allocation	3.44	0.71	7	3.59	0.75	4	3.13	0.76	24	0.767
Government support	3.42	0.78	8	3.26	0.73	13	3.31	0.72	10	0.834
Commitment & responsibility of public & private sectors	3.40	0.61	9	3.31	0.64	10	3.33	0.60	8	0.835
Competitive & transparent procurement process	3.38	0.70	10	3.07	0.71	24	3.39	0.71	6	0.952
Experience with BOT project by public sector	3.35	0.77	11	3.07	0.78	26	3.41	0.80	5	0.787
Utilize local company in project company	3.30	0.68	12	3.33	0.69	9	3.31	0.70	9	0.980
Concrete concession agreement	3.27	0.67	14	3.31	0.68	11	3.29	0.68	12	0.973
Technology transfer	3.27	0.63	13	3.36	0.66	8	3.25	0.67	14	0.774
Select suitable consortium	3.24	0.66	15	3.29	0.67	12	3.27	0.68	13	0.962
Overhauling guarantees	3.22	0.61	16	3.23	0.63	14	3.11	0.65	27	0.947
Sound environment impact	3.21	0.60	17	3.14	0.68	19	3.17	0.69	19	0.904
Good relationship with government	3.18	0.77	21	3.19	0.74	16	3.20	0.74	16	0.987
Short concession period	3.18	0.73	20	3.10	0.69	23	2.96	0.77	31	0.384
Training local staff	3.18	0.58	18	3.17	0.62	17	3.15	0.68	21	0.968
A multidisciplinary and multinational team	3.18	0.58	19	3.12	0.67	21	3.15	0.68	22	0.918
Public safety	3.15	0.67	22	3.07	0.75	25	3.13	0.70	25	0.880
Social support	3.13	0.70	23	2.71	0.67	32	3.31	0.65	11	0.853
Special guarantees by the government	3.12	0.70	25	3.02	0.72	29	3.36	0.74	7	0.838
Profit sharing with government	3.12	0.60	24	3.19	0.64	15	3.19	0.64	17	0.869
Select suitable subcontractor	3.11	0.60	26	3.12	0.62	20	3.12	0.63	26	0.980
Multilateral investment guarantees agency insurance	3.10	0.77	28	3.05	0.73	27	3.04	0.77	29	0.955
Standardization of engineering contract	3.10	0.53	27	3.11	0.57	22	3.24	0.61	15	0.852
Technical solution advance	3.09	0.58	29	3.36	0.65	7	3.17	0.63	20	0.863
Quality control and supervision	3.06	0.61	30	3.14	0.65	18	3.15	0.65	23	0.812
Capability to lead project by government	3.00	0.75	31	3.05	0.82	28	3.63	0.77	1	0.915
Operation in good condition	2.91	0.88	32	2.83	0.88	31	2.79	0.90	32	0.842
Financial market availability	2.79	0.86	33	2.57	0.89	33	2.66	0.90	33	0.259

V. CONCLUSION

BOT approach has a key role in rapid development of Iranian electric power industry to provide energy for massive demand in economic growth. According to extensive literature review, this research establishes success factors for BOT power plant project in Iran comprise of 33 factors.

In This study, 123 valid questionnaires were received from the respondents including government organization, consultants, and concessionaires. These questionnaires' results are considered as reliable and valid since the majority of the respondents were in positions of senior or middle manager. Moreover, majority of the respondents had BOT experience more than 6 years in government organization and concessionaires.

From the analysis, the mean scores of assigned by consultants to Appropriate project identification, Stable political situation, Favorable legislation regulation, and Well-organized & committed public agency are greater than 3.50. This indicates that these three factors are the most important factors in view of the consultants. For government organization, the success factor of Attractive financial package has the highest mean score (3.67) and is considered the most important through all thirty three sub-factors. Capability to lead the project by government with highest mean scores (3.63) is considered as the most important factors through all 33 success factors by concessionaires. The assigned mean scores to Stable political situation, Favorable legislation regulation, and Appropriate project identification are greater than 3.50. Despite the difference in ranking, the mean scores are very close and more than 2.50. Therefore, the respondents believe that all thirty three success factors are important in BOT infrastructure projects. There are no significant differences between consultants, government organization, and concessionaires in respect of the success factors in BOT power plant projects in Iran.

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