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Evaluation of Success Factors of BOT Project in Pakistan

(A Case Study of Lahore-Sialkot Motorway (LSM), M-11)

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Abstract — *The Lahore-Sialkot Motorway, M-11 (LSM) is in construction phase and located in the north south region in Pakistan. It connects Lahore and Sialkot through Sambrial. Its length is 91 km. Expected completion date is in December 2019 with its total cost of 44 billion Pak rupees. After its completion, expected travel time from Lahore to Sialkot will be 50 minutes. This project is B.O.T mode (Build-Operate-Transfer). The contractor is one of the largest private construction companies of Pakistan and as well as first local Trend Setter that offered B.O.T to a Government entity. Despite of the importance of B.O.T, it was also necessary to evaluate the key success factors of the B.O.T projects and to understand comparison of B.O.T and Item Rate Contract so that within under developing countries like Pakistan it should be realized either which mode of construction is in the best interest of the country economy keeping in view all the factors and parameters which affect on both type of construction modes (Item Rate Contract or BOT). Beyond of the Theoretical and other technical differences like contract type, design, planning, cost and quality of work, the challenges with respect to area, culture, environment, local government are also important considerations. This study gives not only a clear picture for all the success factors in this regard but also concludes that what is the better approach between B.O.T and Item Rate contract for Pakistan without compromising the quality of work and how the risks associated with B.O.T projects can be compensated. Similarly last but not least this study will help a lot for the government departments and local construction industries to understand the actual need of contract type either B.O.T contract or Item Rate contract which is most suitable for the upcoming projects in Pakistan.*

Keywords- *Build Operate Transfer (BOT), Success Factors, Evaluation, Pakistan, Motorway, LSM, Lahore-Sialkot Motorway (M11), Criticality Index, Pakistan.*

I. INTRODUCTION

With the passage of time, it has been realized that the development of any country is assessed by many factors; one of them is Infrastructure Development and specially Transport Infrastructure Development. This is the reason now the under developing countries are not only focusing on its Transport Development but also working on new mode of contract types presented by different researchers for a sustainable development without giving any extra resource burden to the local government. That's why BOT (Build-Operate-Transfer) mode of construction has become the most favorable contract type for an under developing country. Basically this type of contract is a PPP (Public Private Partnership) investment mode where any local or international construction company becomes responsible for the construction of the project and then operates it for a predefined period (say 20 or 25 years) to recover its cost with profit and after that the project is handed over to the relevant local authority or main client. In B.O.T projects, a lot of risks involve, therefore many of the researchers are working to evaluate the success factors of B.O.T and to minimize those risks.

Researchers of the many countries are working to find out success factors of the B.O.T projects which are being executed in their countries and have evaluated different success factors of the B.O.T contracts. These success factors cannot be the same for all the countries due to change of the culture, government stability, economic policy, financial soundness, public interest, environmental condition and local market condition etc. Consequently it is also important to evaluate the success factors of B.O.T Projects in Pakistan so that a comprehensive approach may be adopted keeping in view the success factors of BOT projects. In this regard Pakistani researchers are also working but case study of the B.O.T project like Lahore Sialkot Motorway (LSM) provide us more reliable success factors of the B.O.T Projects as no specific research related to Transport Infrastructure Development with B.O.T mode of contract has been carried out till now in Pakistan. In Item Rate contract type, Government has to invest first and has to pay mobilization advance to the contractor. Similarly many times, most of the important contracts have been awarded to financially poor contractors due to which most of the projects go under delay. Therefore B.O.T project is better option to avoid from these types of problems.

This study give us the success factors and all the important parameters upon which LSM Project has been started on B.O.T mode and tell us the practical approach how to specify and calculate success factors, soundness of the consortium of all stake holders, local challenges, achievements of the local contractors and we will be able to analyze all the significant parameters related to LSM Project with respect to its construction. This study deals only with the factors affecting on B.O.T contract type of projects. After this study, we are able to finalize Critical Success Factors of B.O.T based projects. It give us a guide line to evaluate factors which are most influence during construction of B.O.T based projects as well as give us an idea about gaps identification and to understand better working of project consortium of the companies. It deals purely with the execution of the B.O.T projects and does not entertain planning, government policies, legislations, financial models, cost effects of the B.O.T contract type projects.

II. RESEARCH METHODOLOGY

The study consists of the following steps.

- Literature Review
- Research Objective, Selection of BOT Success Factors, Questionnaire of BOT Success Factors
- Establishment of Questionnaire, Preliminary Survey
- Data Collection, Data Analysis
- Results and Recommendations

III. DATA COLLECTION AND DATA ANALYSIS

For data collection, 33 questions are finalized. First part (A) is Respondent Information and Second part (B) consists on Factors of BOT Project LSM. After that 33 Questions are divided into 6- Groups.

- Design
- Main Contractor
- QA/QC Consultants
- I.E (Independent Engineer)
- Client
- Sub Contractors

Questions are scaled out using ***Likert Scale.*** For survey purpose, face to face interview, telephone and online Google survey technique is used. Data from 100 participants of engineering background has been collected. There are 23 samples of respondents from client, 15 samples from designer, 27 samples from site consultants and 35 samples from contractor.

Microsoft Excel is used for Data Compilation in a systematic approach. 3300 entries received from 100 respondents. 33 Questions are considered as Variables to find the Criticality Index for 33 Variables. Following formula is used to find out Criticality Index of Success Factors of BOT Project. (J. Lelieveld, J. S. Evans, M. Fnais, D. Giannadaki, & A. Pozzer, 2015b).

$$C.I = \frac{\sum_{i=1}^{5} Wi\,Xi}{\sum_{i=1}^{5} Xi}$$

Where;
C.I = Criticality Index
i = Response of Respondent
W = Weight to *i*-th response
X = Occurrence of *i*-th Response

The value of Criticality Index is between 0 and 1. More tendencies of C.I values towards 1 represent the more criticality of variables. Any variable having value greater than 0.5, is considered as 'More Critical'.

The respondent's data is analyzed in accordance with the type of company in which respondents are working and following info is received as shown in below figure.

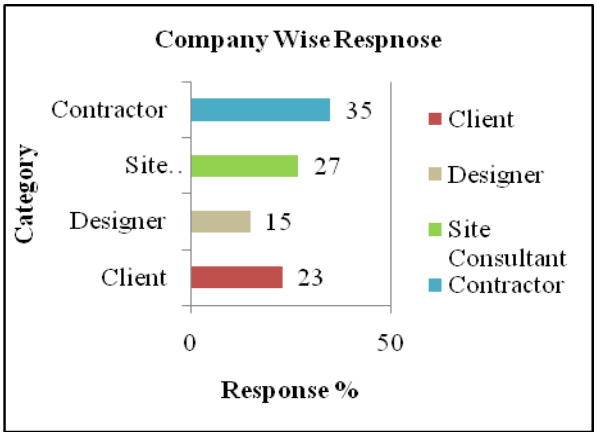

Figure 1.Company wise Data of the Respondents

Similarly the data of respondents is also collaborated with respect to respondents experience in number of years. It gives us 7 groups starting from 0-5 years, 5-10 years, 10-15 years, 15-20 years, 20-25 years, 25-30 years and 30-35 years.

Table 1.Experience Wise Respondents Data

Sr. No	Experience (Years)	Frequency	Percentage
1	0-5	51	51%
2	6-10	30	30%
3	11-15	05	05%
4	16-20	07	07%
5	21-25	03	03%
6	26-30	02	02%
7	31-35	02	02%
Total		100	100%

When age wise data is categorized, minimum age of respondent is observed 22 years and maximum age is observed 58 years.

Table 2.Age Wise Respondents Data

Sr. No	Age (Years)	Frequency	Percent
1	22-25	20	20%
2	26-35	63	63%
3	36-45	10	10%
4	46-50	05	05%
5	51-60 and above	02	02%
Total		100	100%

When data is categorized with respect to education and gender then it gives us minimum education level of respondent is DAE/B.Tech and maximum education level is Phd in engineering as well as 97% male respondents and 3% female respondents.

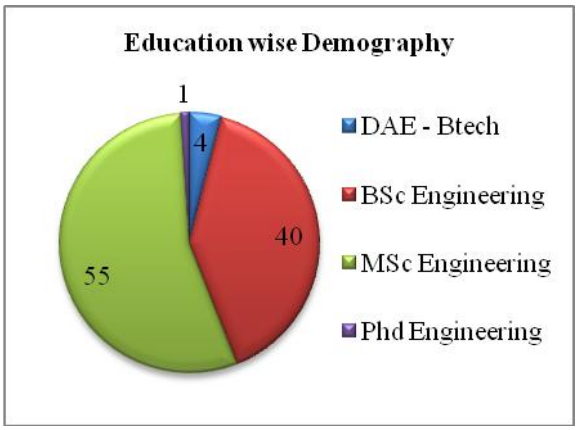

Figure 2.Education wise Data of the Respondents

IV. RESULTS AND DISCUSSIONS

The data collected to perceive the factors affecting on BOT Projects in Pakistan especially Lahore Sialkot Motorway (LSM) effects of project is ordinal data which is best possibly can be viewed in the form of indices of each factor to determine which one is more critical as explained in previous chapter. The criticality index of each factor has been calculated and results are shown in below Table and Figure. It represents that out of total 33 selected success factors, 11 factors are greater than 0.8 which are more critical factors. Similarly 20 factors are between from 0.5 to 0.8 on this index, are critical. 1 factor is also considered less critical as its C.I is greater than 0.4 and less than 0.5. Factors with C.I equal to zero or less than 0.3 is only 1 and hence this factor is considered as non-critical.

Table 3.Critical Index of Success Factors of BOT

1	Proper Prequalification	0.892
2	Economic Design	0.890
3	Sufficient Technical Staff	0.880
4	Payments as per Design	0.878
5	Financial Capacity	0.872
6	Record Keeping	0.866
7	Design Vetting	0.862
8	Technical Inputs of I.E	0.860
9	Client Action on I.E Reports	0.830
10	Complicated/Missing Design	0.826
11	Financial Commitments	0.812
12	Prequalification	0.798
13	Sub Designer/Sub Consultant	0.788
14	Coordination with Government	0.788
15	Independent QA/QC	0.782
16	Impartial Role of I.E	0.772
17	Unnecessary Meetings	0.772
18	Work Sublet	0.770
19	Jointly Site Visit	0.760
20	Site Laboratory & Equipments	0.760
21	Technical Team	0.752
22	Feasible Timelines	0.746
23	Sub Contractor Prequalification	0.744
24	Instructions by Client	0.736
25	Project Constraints	0.728
26	Local Sub Contractor	0.728
27	Project Progress & EVA	0.720
28	Work Methodology	0.714
29	Design Review by QA/QC	0.692
30	Strong Communication	0.672
31	IPC Handling	0.588
32	Complicated Design	0.446
33	Training Workshop	0.302

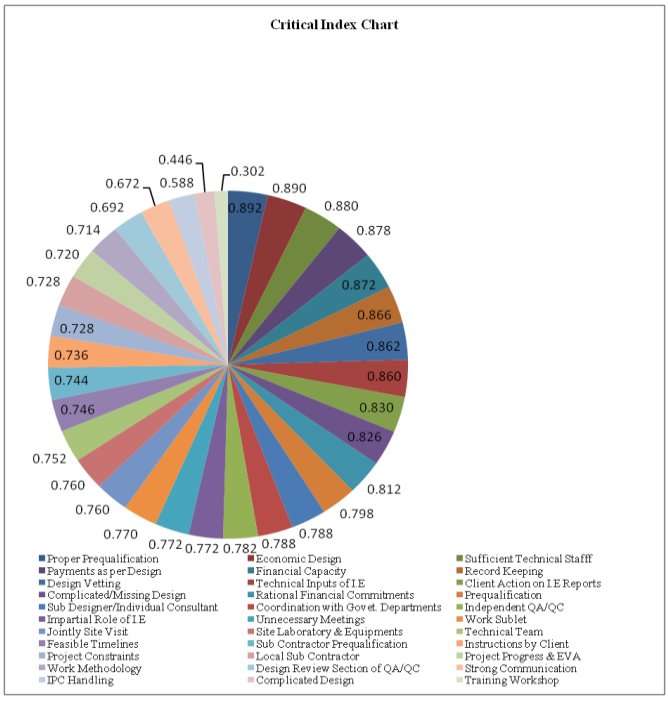

Figure 3.Critical Index of Success Factors of BOT Projects in Pakistan

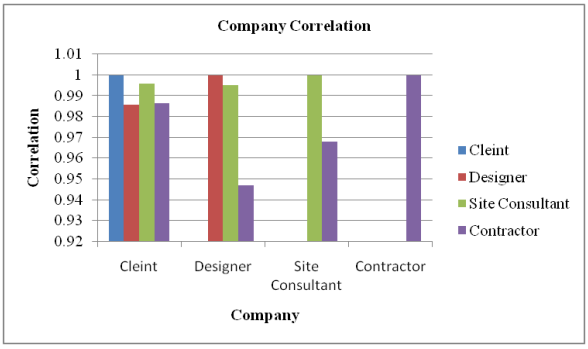

Figure 4.Company Correlation of Respondents

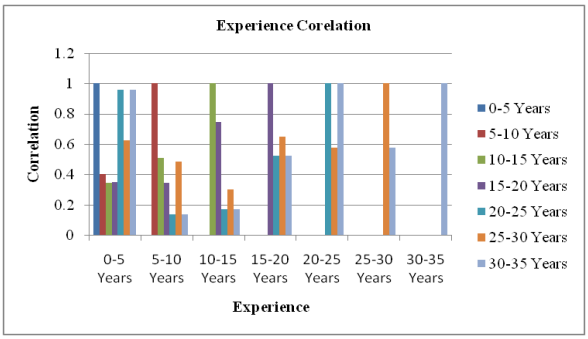

Figure 5.Experience wise Correlation of Respondents

A single factor ANOVA (analysis of variance) in Excel has been used to analyze company wise effect on respondent's data which is also known as one-way ANOVA to test the "Null Hypothesis" that means different groups of data are all equal. If the value of *F* is greater than *F Critical*, it indicates that the means of the groups are not equal or at least one group has different mean. By using *"Single Factor ANOVA"* technique, value of F is 0.0964 and value of F critical is 2.9340 (i.e. F < F critical). It shows that means of all groups are equal and hence companies of respondents have no effect on response. In other words, success factors are critical for respondents of all companies.

Similarly when experience wise respondent's data is analyzed with *"Single Factor ANOVA"* technique, value of F is 5.0129 and value of F critical is 2.8477 (i.e. F > F critical). It shows that groups do not have equal means therefore BOT project has different impact with respect to experience of people working in different companies.

A t-Test is performed with the assumption that there are two unequal variance based on experience of the respondents. This test is applied on two groups at one time to determine the significance difference if exists. The **null hypothesis** is that there is no significant difference in the means of each sample and if value of **t stat** turns out to be greater than **t critical**, the **null hypothesis** is rejected. In our case we obtained value of **t stat** less than **t critical**. It shows that null hypothesis is accepted that means there is significant difference in means of each sample.

The reliability of this data is determined by *Lee Cronbach's alpha* which is **0**.78 in our case which means data is confidently reliable.

V. CONCULSIONS AND RECOMMENDATIONS

- Design of BOT Project should be most economical.
- Payments should be in accordance with the activity job and design.
- Minimum delay in payments is recommended for smooth process of activities.
- There should be impartial role of I.E and QA/QC consultants,
- Design vetting from strong third party is appreciable.
- Direct technical input from I.E should be practiced.
- Proper and realistic prequalification is mandatory.
- Early action on I.E reports from client should be adopted.
- Strong financial capacity of main contractor should be assessed and is recommended.
- Proper and comprehensive record keeping is also very necessary.
- Strong and sufficient Technical team for a BOT project is always a key demand of the project.
- Well furnished site laboratory and up to date testing equipment is recommended.
- Strong and quick coordination should be adopted.
- Feasible time lines are also one the key component of success of the project.
- Individual Consultant or Sub Designer on site can also save from many design hurdles.
- Project Manager should be well attentive and have strong grip on project progress and earned value analysis.
- Main contractor should establish design review section on site.

- Jointly site visit on fortnightly based is recommended.
- Client should avoid from verbal instructions and should practice written instructions to keep away from later on disputes.
- Site clearance entirely should be completed from client end.
- Unnecessary meetings from client side should be avoided.
- Prequalification of sub contractors is also obligatory to award the sub let work to a merit based sub contractor.
- Work methodology and methodology for the use of different equipments is essential to estimate the work performance of the machinery and equipments.
- There should be prior agreed work division which will be sublet so that main contractor cannot be free from his obligatory responsibilities.
- There should be some criteria for the hiring of local sub contractors.
- Correlation between different companies is requisite and large but not different experience of the team is mandatory as per previously analysis.

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