INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X

Impact factor: 4.295

(Volume2, Issue6)

Available online at: www.ijariit.com

Project Success, its Performance Evaluation and Prediction for Transmission Construction Project

Pankaj Purushottam Chandwadkar (student) K.B.T.C.O.E, Nasik
Prof. R.V. Devalkar (Guide) K.B.T.C.O.E, Nasik

Abstract:-Existing studies tend to agree that there are links among certain key aspects of any project, their systematic enlisting and measurement and directional efforts to improve the performance of project. These aspects are selective and specific and if tracked in a systematic fashion along with necessary corrective action can not only measure any particular project's performance but also indicate to the higher management in the organization about the approach to be changed in selective area so as to enhance the business success, in general and project's success in specific.

This seminar tends to study various aspects, present a checklist and track sheets along with comments to improve the transmission project's performance. Transmission being critical activity and among the important services so as to serve the society's electricity needs, are taken into consideration.

A systematically addressed relationship among these criteria and that how these criteria affect the project success is the gist of this seminar. A sincere attempt is made for establishment of relationships of various factors affecting the project's success and utilizing that relationship for making alert and guiding during project monitoring of Transmission Project.

It is concluded that these aspects are not only important to improve project performances on quality, time, cost, and safety, but also critical to appropriately deal with transmission power projects' externalities for achieving the objectives on project migration, ecological, social and environmental impacts.

These results can help Project managers to better understand the relationship between the said aspects and project performance, and encourage them to optimize and take corrective actions for better project outcomes.

With support of a case study of 400 KV substation (transmission) project's data collected and it has revealed strong correlations between various aspects and project performances.

Keywords:-Project Success Criteria, Relationships, and Prediction of Transmission Construction Project's performance forecast, Monitoring and Control of project success.

I. Introduction

Transmission is in general is a transfer of generated form of energy (at a level of Extra High Voltage) from generation point to the distribution point (at a level of Low Voltage) via network of substation and transmission line.

The core aim of any Transmission Project is to deliver the infrastructure so as to ensure that it functions to transmit the power and strengthens the existing National Grids‟ capacity. Typically, the execution of transmission project comprises of project activities such as Engineering-Procurement- Construction. Further, the construction activities consist of field executional activities Civil-Electrical- Erection- Commissioning activities.

II. Need of Study

Overall, an addition of 90,000 ckm (circuit Kilometer) of 765-220kV lines, 154,000 MVA of substation capacity and 27,350 MW of national grid capacity is required in order to meet the 14th Five Year Plan. For this purpose, an investment of USD 35 billion is planned in the power transmission sector. The failure of project creates not only a financial loss but a social loss after the failure. In 2012-13, power shortages in India accounted for a GDP loss of USD 68 billion (0.4% of GDP), impacting multiple industries like agriculture, manufacturing, services etc. Improvement of this sector is essential for the economic well-being of the country and enhancement of the quality of life of citizens. Hence one can understand the importance of Project's success of a Transmission Project at all stages right from commencement to commissioning.

III. Objectives

The objectives of the study set are as follows:

- Identify the relative importance of success and failure attributes in Indian Transmission Construction industry.
- Understand the latent properties of these success and failure attributes by studying the critical success and failure factors for further suggestions to improve the performance.
- Prepare a checklist and describe the outcome of a pilot test.
- Discuss the steps leading to its development.
- Find the Project Management Practices Variables and their interrelationship to arrive to use the same for prediction of Project's Performance.

IV. Methodology

For the study, a huge amount of documented data on completed projects is required. Due to non-availability of documented data of completed projects for study in India, a questionnaire survey approach is considered to find out impacts of various attributes on project performance.

From the literature review, 5 performance measures Table 1- 78 PM practices were identified. The purpose of this research was to examine the extent to which PM practices adopted by Transmission EPC Contracting Organizations could affect project performance defined in Table 1. The research design was based on a survey, and data collected through the personal meeting. The data collection instrument was a questionnaire that was specially designed for this study. Respondents were requested to base their responses on one Section A of the questionnaire requested information of the project and required each respondent to rate its level of success in five areas Table 1 on a seven-point scale. Y1 cost performance, Y2 time performance, and Y5 profit margin can be ascertained quantitatively. Taking Y1 as an example, if the project exceeded budget by more than 5%, the respondent would rate '1', whereas if the project achieved cost savings of more than 5%, the rating should be '7'. Respondents rated two qualitative measures, Y3 quality and Y4 owner satisfaction, based on their perception of whether expectations were met or not, on a seven-point Likert scale. In Section B, respondents were asked to indicate the PM practices adopted on a seven-point Likert scale Table 2. The last section gathered demographic characteristics of respondents and their companies. The questionnaire was pretested before an industry wide survey was conducted.

V. Literature Review

Construction projects are unique and temporary in nature and so is their management. PMBOK 2003 (Project Management Body of Knowledge) defines project management as the application of knowledge, skills, tools, and techniques to project activities to meet project requirements. **Rockart** 1982 first used critical success factor CSF in the context of information systems and project management. **Rawlinson** 1999 states that critical success factors are those fundamental issues inherent in the project, which must be maintained in order for team working to take place in an efficient and effective manner. They require day-to-day attention and operate throughout the life of the project. **Avots** 1969 concludes that choice of wrong project manager, the unplanned project termination, and unsupportive top management are the main reasons for project failure. **Chitkara** 1998 points out inadequate project formulation and the improper management of the projects as the primary reasons for project failures. **Morris and Hough** 1987 through a study of eight large and complex projects having great potential economic impact but were poorly managed and generally failed to identify the success factors, such as project objectives, technical uncertainty innovation, politics, community involvement, schedule duration urgency, financial contract legal problems, and implementation problems. **Schultz et al.** 1987 classify critical success factors in two groups and conclude that these groups affect project performances at different phases of implementation. The first group is referred to as the strategic group that consists of factors like project mission, top management support, and project scheduling. The other group is the tactical group, which consists of factors like client consultation and personnel selection and training. **Pinto and Slevin** 1989 through a study of 159 research and development R&D projects develop a 10-factor model of the project implementation process and a Project Implementation Profile that can be used by the project managers to periodically monitor the state of each of the factors throughout a project's life. These factors are project mission; top management support; project schedule-plans; client consultation; personnel; technical tasks; client acceptance; monitoring and feedback; communication; and trouble-shooting. Further they also find that the relative importance of the critical success factors changes with the project life cycle stage. **McNeil and Hartley** 1986 emphasize the role of project planning on project performance and suggest that skilled people need to be intimately involved in the planning process. **Lim and Ling** 2002 find the client's role as an important ingredient in achieving the project success and Chan et al. 2001 assert inter organizational teamwork as a major factor in ensuring project success. **Ashley et al**. 1987 conclude that construction project success is repeatable and requires a great deal of work to understand it for achieving cost effectiveness and a competitive position. They are port that a statistically significant difference exists between key attributes of average and outstanding construction projects. These key attributes are planning effort construction and design; project team motivation; project manager goal commitment; project manager technical capabilities; control systems; and scope and work definition. **Chua et al.** 1999 applied a neural network approach and identified eight important project management attributes associated with achieving successful budget performance. **Chan et al.** 2001 investigated the project success factors for design and build D&B projects and identified six project success factors. These are project team commitment; client's competencies; contractor's competencies; risk and liability assessment; End-users‟ needs; and constraints imposed by end-users. Further they found project team commitment, client's competencies, and contractor's competencies to be important to bring a successful project outcome. In recent research, **Zhang** 2005 studied critical success factors for public private partnerships in infrastructure development while **Abraham** 2003 studied critical success factors for the construction industry. In addition to the typical risks of a domestic project, the international construction process has unique political, economic, and Cultural risks **Lee and Walters** 1989; **Han and Diekmann** 2001. The management of international construction projects entails the handling of several complex patterns of relationships among clients, contractors, financiers, customers, insurers, PM team, de-signers, and others **Simkoko** 1992. International projects involve complex risks that are particular to international transactions **Lee and Walters** 1989. Despite these complexities, most construction firms have entered international markets based on personal intuition or previous experience. It is therefore necessary to ascertain effective PM practices that should be adopted in international construction to bring about project success. Project performance indicators are the influential forces that either facilitate or impede project success **Lim and Mohamed** 1999. **Konchar and Sanvido** 1998 measured success in terms of unit cost, construction speed, delivery speed, cost growth, schedule growth, and several quality measures. **Chan and Chan** 2000 produced a consolidated framework that included the additional dimensions of user expectation, participant's satisfaction, environmental performance, health and safety, and commercial value. To this list, Ling et al. 2004 added owner's satisfaction and owner's administrative burden. From these studies, this research chose five performance measures to ascertain project success see Table 1 on the basis of minimizing overlaps among the performance measures. These were used as the dependent variables of this study. After defining performance measures Table 1, the next step is to review PM actions that affect project success. The U.K.-based Chartered Institute of Building published a code of practice for PM CIOB 2002 and the U.S.-based Project Management Institute PMI has its guide to PM body of knowledge PMI 2004. This study adopted the PMIBOK‟s nine PM knowledge areas and correspondingly, identified PM actions following PMBOK PMI 2004. The PM functions or knowledge areas are: 1 project scope; 2 time; 3 cost; 4 risk; 5 quality; 6 human resources; 7 communications; 8 procurement management; and 9 integration of these functions. Knowledge, skills, tools, and techniques are applied to manage these functions in an iterative process.

PM practices within each PM knowledge area that may affect project success were then systematically identified. Altogether, 78 PM practices were operationalized: six under Scope Management labeled as (Scope-11 to Scop16) ; six under Time Management (Time21-Time26) ; nine under Cost Management (Cost31-Cost39) ; nine under Quality Management (Qlty41-Qlty49) ; 16 under Risk Management (Risk51-Risk516) ; nine under Human Resource Management (HRM61-HRM69) ; nine under Communication Management (Com71-Com79) ; seven under Procurement Management (Proc81-Proc87) ; and seven under Integration Management (Integ91-Integ97) . These were used as the independent variables of this study.

Concluding remark on Literature review

Many studies have happened regarding factors affecting success and prediction by using interrelations among variables of the project but these studies were confined to a single project of a constructional project; however transmission constructional projects have been rarely studied. The attempt through this seminar is to project this attempt which has been rarely done in the past.

Factors affecting the success of any transmission project

1. Project Manager's Competence

2. Supportive Owners and Top Management
3. Favorable Working Conditions
4. Monitoring, Feedback, and Coordination
5. Favorable Working Conditions
6. Commitment of All Project Participants
7. Owner's Competence
8. Critical Failure Factors
9. Project Manager's Ignorance
10. Hostile Socioeconomic Environment
11. Owner's Incompetence
12. Indecisiveness of Project Participants
13. Harsh Climatic Condition at Site
14. Project Specific Factor
15. Extent of Contribution of Critical Factors

Checklist and Its Application

(Note- The answers are representatives for purpose of demonstration of checklist contents.)

I. Technical Performance (Completed jointly by Sr. manager & PM)

(1) Was the team assembled appropriate for the project?

Ans- Yes the Team performed as a single unit under the leadership of Project manager

(2) Were calculations checked, well-organized and comprehensive?

Ans- the Engineering department played a key role in designing the layout, foundation with supporting field details as provided time to time. It also carried out material inspection prior dispatch in the presence of M/s VEPL (PMC)

(3) Did QC program accomplish its objectives?

Ans- Yes, the FQP (Field Quality Plan) was strictly implemented and all set and agreed technical parameters regarding execution of works were followed.

(4) How closely did project follow proposal?

Ans- There was not too much difference between initial LOA (Letter of Award) and initial scope and the executed LOA and executed scope.

(5) How was scope change handled?

Ans- The scope changes were time to time shown and explained to client after drawing approval and during Monthly Review Meetings.

(6) Were project risks discussed with client?

Ans- Yes. The Client was posted informed by the excessive cost element due to changes in designs and specifications as per the field conditions.

Time Performance (Completed by PM)

(1) Date of LOA = 7th April 2011

(2) Date of Land Handing Over = 13th March 2012

(3) Duration of Project as per Letter of Award = 18 Months

(4) Contractual Completion Date = 12th Sept 2013

(5) Completion of Project (In %) as on 30.11.2015 = 67%

(6) Expected Date of Completion= 31.03.2016

(7) Duration (Revised) Of Project = 48.5 Months

(8) The Delay Percentage = 269%

III. Financial Performance (Completed by PM and Accounts Department)
(Comparison Restricted to Civil Works Only based on availability of Data)
Criteria Budget Actual
Total cost (In Lac) 1040 1022
Labor cost 162 123
Profit 11 % 13%
Direct cost 1022
Budget 1.5 + expenses _ 1166
Sales cost ratio (|b|/ (a|] 1.14 (@ 14% profits)
Payment performance: (Inputs from Commercial Department)- 45-60 Days (Good)
Excellent, Very Good, Good, Slow, Very Slow
<30 30-45 45-60 60-90 >90 days outstanding
** Above Figures are received by M/s Jyoti Structures Limited
IV. Client Satisfaction (Completed by Executive Engineer of MSETCL)
(1) Is the client satisfied with the service Jyoti Structures Limited provided?
Ans- Yes. But had comments over Procurement Issues
(2) Were opportunities for future service to client recognized and acted upon
Ans- the Project is under progress and has exceeded the 2 times extensions as given by client. Hence currently it is not clear that there shall be a repeat order in future or not?

Annexures of Data Collection
Annexure
(I) Letter Of Award and Synopsis of the Project- To have a brief idea at a glance.
(II) Bar Chart (Mutually Agreed) Between the Customer (MSETCL) and Jyoti Structures Limited- To Support the Duration of Project and Time Performance Assessment
(III) Master Budget (Civil Works) s- To support Cost Performance and Financial Performance Assessment.
(IV) Field Quality Plan: To support Quality Performance Assessment.
Project performance indicators are the influential forces that either facilitate or impede project success. From these studies, this seminar chooses five performance measures to ascertain project success as per Table 1 on the basis of minimizing overlaps among the performance measures.

These are used as the dependent variables of this study.

Multiple Linear Regressions
Multiple linear regression MLR analysis was used to predict the performance of projects undertaken by M/s Jyoti Structures Ltd based on the PM practices adopted by them. The independent/ predictor variables are the PM practices and/or their attributes adopted by JSL when operating in Transmission Sector in Maharashtra and the dependent variable is one of the project success measures Table 1. Each model is expressed by
$Y_i = \alpha\_+\beta_1 X_1 + \beta_2 X_2 + {}^{-} + \boldsymbol{\beta}_k X_{ki} + €_i$
where Y_i is measure of project success dependent variable based on respondent's ratings of the items in Table 1; X_i =PM practice adopted by Jyoti Structures Ltd which is an independent variable ;β =estimated regression coefficient;α =constant; and €=error term, which is a random variable with mean 0.
In applying MLR, it is assumed that the relationship between Y and the independent variables can be approximated by a linear model that provides best fit estimates of the model parameters by minimizing the error of the model Otto and Longnecker 2001. The stepwise method was used to select variables for the MLR analysis. This method was chosen because it accommodates partial correlation structures for variables already in the model. The predictive power of the model is judged through adjusted R^2, which is a better estimate of the model's goodness-of-fit than the coefficient of determination R^2. Adjusted R^2 does not inevitably increase as the number of included independent variables in
For example, if Y is annual income ($1000/year), X1 is educational level (number of years of schooling), X2 is number of years of work experience, and X3 is gender (X3 = 0 is male, X3 = 1 is female), then the population mean function may be
$E(Y|X) = 15 + 0.8 \cdot X1 + 0.5 \cdot X2 - 3 \cdot X3.$
Based on this mean function, we can determine the expected income for any person as longas we know his or her educational level, work experience, and gender.

For example, according to this mean function, a female with 12 years of schooling and 10 Years of work experience would expect to earn $26,600 annually. A male with 16 years of
Schooling and 5 years of work experience would expect to earn $30,300 annually.

Measures	**Label**	Description	**Measurement scale1-7 (Likart Scale)**
Cost performance	Y1	Cost performance of service actual versus budget	0.3= Failed with high margin 0.4= Failed with low margin 0.5= Passed
Time Performance	**Y2**	Time/schedule performance of service actual versus plan	Same as Y1
Quality Performance	**Y3**	Output quality of your service e.g., technical quality, workmanship quality	Same as Y1
Owner Satisfaction	**Y4**	Owner satisfaction with your service quality	Same as Y1
Profit Margin	**Y5**	Profit margin derived from service	Same as Y1
Scope	**Y6**	Excess Scope Management during execution w.r.t original scope	Same as Y1

Impact of Project Performance Factors

Independent Variable	Predictors		T value	P value	VIF
$R2$ =0.430; Adj. $R2$ =0.371	Scope 14	-0.367	-2.595	0.015	1.019
Max Y1=5.24; Min= −1.77	Cost 37	0.328	2.321	0.027	1.018
Y2: Time performance	Time 21	0.496	3.585	0.001	1.090
R^2 =0.49; Adj. $R2$ =0.437	Cost 35	-0.596	-3.849	0.001	1.366
Max Y1=6.17; Min= −3.21	Cos 74	0.471	3.086	0.004	1.327
Y3: Quality performance	Scope12	0.391	4.644	0.000	1.109
R^2 =0.821; Adj. $R2$ =0.795	Scope 16	0.677	7.142	0.000	1.405
Max Y1=11.94; Min=0.18	Qlty45	0.670	6.347	0.000	1.742
	HRM68	-0.222	-2.183	0.038	1.619
Y4: Owner satisfaction	Scope12	0.316	3.275	0.003	1.458
R^2 0.828; Adj. $R2$ =0.796	Cost 37	0.282	3.404	0.002	1.075
Max Y1=12.71; Min=1.82	Scope16	0.519	5.383	0.000	1.458
	Qlty45	0.440	4.734	0.000	1.357
	Time22	0.259	2.693	0.012	1.446
Y5: ProÞt margin	Scope 12	0.632	5.258	0.000	1.016
$R2$ =0.574; Adj. $R2$ =0.545	Risk512	0.346	2.881	0.007	1.016

Max Y1=6.85; Min=0.98

Note: Standardized regression coefficient, calculated using ordinary least square method; *t*-value=value of *t*-statistic, to be compared to the theoretical *t*-distribution for accuracy; *p*-value=significance of *t*-statistic. For significance 0.05, the null hypothesis that =0 is rejected, there is less than a 5% chance that the *t*-statistic is wrong due to random occurrence. VIF=variance initiation factor measures the collinearity of each exploratory variable; and Durbin-Watson=detects and measures autocorrelation.

VI. Data Analysis Details

(1) The stepwise method was used to select variables for the MLR analysis. This method was chosen because it accommodates partial correlation structures for variables already in the model.

(2) The predictive power of the model is judged through adjusted *R*2, which is a better estimate of the model's goodness-of-fit than the coefficient of determination *R*2. Adjusted *R*2 does not inevitably increase as the number of included independent variables increases. The optimum regression model should be the one that best fits the data and yields the most accurate prediction of the dependent variable.

(3) As regression models should only be constructed from internally reliable variables, a reliability test was carried out on the PM practices in an iterative process by estimating Cronbach's Alpha

(4) Each variable was added into the computation, and those that do not contribute to increasing the value of Cronbach's alpha are not considered internally consistent, and would be excluded. Using the SPSS software, was calculated as 0.925, whereas the conventional cutoff for Cronbach's alpha is 0.7 (Otto and Long-Necker 2001). This indicates that the PM practices are internally consistent, and therefore all were included in model construction.

(5) Using SPSS software, five optimum MLR models were developed to predict likely project outcomes based on PM practices adopted by Transmission Construction Contracting firms in Maharashtra see Table 3.

(6) The following discussion focuses on significant explanatory variables PM practices that affect each performance measure. Construction industry practitioners could adopt these PM practices, which may help in achieving project success.

Cost Performance

Cost Performance Y1 indicates a comparison between the actual and the budgeted cost of the project. Table 3 shows that 37% of Transmission Project's cost performance in India can be predicted by three PM practices that they adopt, and the prediction model is given in the following equation. To achieve cost savings in the project, foreign Transmission Contracting Firms should have high quality responses to perceived variations Scop12; have low extent of claims/ disputes in the contract Scop14; and have high financial strength Cost37

Y1 Cost Performance= 0.473 Scop 12 − 0.367 Scop 14 + 0.328 Cost 37

Where, Y1=predicted cost performance max=5.24; min= −1.77 ; Scop12=quality of a firm's response to perceived change orders Scale 1to 7; 1=low; 7=high ; Scop14=extent of claims or disputes Scale 1to7; 1=low; 7=high ; and Cost37=firm's financial strength Scale 1to7; 1=low; 7=high .

Firms with higher quality responses toward perceived variations Scop12 are likely to have better cost performance Y1 . This is consistent with the findings of Love and Irani 2003 that early implementation of a change control mechanism ensures that changes are properly monitored, and this reduces reworks. Minimum reworks lead to cost savings and/or lower chance of cost growth. Firms need to be financially strong Cost37 to handle the project and maintain a healthy cash flow. The extent of claims and disputes in the contract should be reduced Scop14 by careful definition of the project scope and detailed drafting of contract conditions

Time Performance Y2

Schedule performance is a comparison made between the actual and planned duration for the project. Time performance would be improved if timing of acceptance, approval, and commitment of the schedule by the project team Time21 is early, firms have few monitoring activities to detect cost overruns Cost35 and the likelihood of being engaged by client or project team members in future is high Com74 . Table 3 shows that 44% of variance in time performance can be explained by three variables and the prediction model is given in

Y2 Time Performance= 0.496 Time21 − 0.596 Cost35 + 0.471 Com74

where Y2=predicted time performance max=6.17; min= −3.21; Time21=timing of acceptance, approval and commitment of schedule Scale 1Ð7; 1=very late; 7=very early; Cost35 =extent of monitoring activities to detect cost over runs Scale 1Ð7; 1=low; 7=high; and Com 74=likelihood of being engaged by client or project team members in future Scale 1Ð7; 1=poor; 7=excellent.

With early acceptance, approval, and commitment from the project team on the schedule Time21, time performance is improved. The earlier the project team approves and complies with the schedule, the better the chance for the project to proceed on schedule.

Work sequences should be viewed as an entirety be-cause the impact of one event or decision could affect overall project performance Lee et al. 2006.

Surprisingly, more monitoring activities to detect cost overrun Cost35 would lead to poorer schedule performance = −0.385. It departs from the study of Ling 2004 of domestic construction in which contractors with high ability in financial management would have projects that have good schedule performance. This may be because more resources put into detecting cost overrun may result in less focus on managing the project execution, resulting in project delays.

Quality Performance Y3

Quality Performance Y3 gives an indication of workmanship, technical and functional quality performance. Table 3 shows that 80% of project quality performance can be explained by four PM practices. Quality performance would be improved if: a firm's responses to perceived variations Scop12 are of high quality; the contract is subdivided into smaller components Scop16; quality of technical staff or workmen is high Qlty45; and compensation level to expatriate staff is not generous HRM68. The prediction model for Y3 is given in

Y3 Quality Performance = 0.391 Scop12 + 0.677 Scop16 + 0.67 Qlty45− 0.222 HRM68

where Y3=predicted quality performance max=11.94; min =0.18 ; Scop12=quality of a firm's response to perceived change orders Scale 1to7; 1=low; 7=high ; Scop16=extent of subdividing the contract Scale 1to7; 1=one large integrated contract; 7 =many smaller contracts ; Qlty45=quality of technical staff/ workmen Scale 1Đ7; 1=low; 7=high ; and HRM68 is the compensation level to expatriate staff Scale 1to7; 1=standard salary; 7=generous allowance

Y3 shares three predictive variables Scop12, Scop16, and Qlty45 with Y4 and these are discussed in the next section. Previous studies have not investigated the relationship between compensation level of expatriate staff and project performance. This study found a negative relationship between level of expatriate staff compensation and project quality performance = −0.222. Increasing quality of workmen leads to higher project quality = +0.67. The implication is that money should be spent more on recruiting and retaining high quality workers than expatriate staff as the former undertake the physical work and if they can do things right the first time, this would lead to higher quality performance.

Owner Satisfaction Y4

Owner satisfaction Y4 is an indication of how satisfied the owner is with the project. Table 3 shows that 80% of owner satisfaction can be explained by five PM practices. Owner satisfaction would be improved if: a firm's responses to perceived variations Scop12 are of high quality; the contract is subdivided into smaller components Scop16; quality of technical staff or workmen is high Qlty45; quality of schedule is high Time22; and the foreign firm has high financial strength Cost37. The prediction model for Y4 is given in

Y4 Owner Satisfaction = 0.316 Scop12 + 0.519 Scop16+ 0.44 Qlty45 + 0.259 Time22+ 0.282 Cost37

where Y4=predicted owner satisfaction level max=12.71; min =1.82 ; Scop12=quality of a firm's response to perceived change orders Scale 1to7; 1=low; 7=high ; Scop16=extent of subdividing the contract Scale 1to7; 1=one large integrated contract; 7=many smaller contracts ; Qlty45=quality of technical staff/ workmen Scale 1 to 7; 1=low; 7=high ; Time22=quality of schedule Scale 1to 7; 1=low; 7=high ; and Cost37=firm's financial strength Scale 1to7; 1=low; 7=high .

Giving high quality responses toward perceived variations Scop12 would ensure that changes to the contract are quickly identified and implemented. These indicate the importance of close monitoring of changes, which would minimize reworks and result in high quality outputs and increased owner satisfaction.

High quality schedule Time22 also leads to high owner satisfaction. The implication is the importance of preparing a realistic schedule, which takes into account all important activities, thus enabling activities to be carried out in proper sequences, and using correct procedures, and reducing the chance of project delay.

Profit Margin Y5

Profit Margin Y5 is the profit derived by Transmission Construction Firms. Table 3 shows that 55% of a project's profitability can be explained by two variables. To obtain higher profit margin, Transmission Construction Firma should provide high quality responses to perceived variations Scop12 and be able to control labor issues and management risks Risk 512. The prediction model is given in

Y5 Profit Margin = 0.632 Scop12 + 0.346 Risk512

where Y5=predicted profit margin max=6.85; min=0.98 ; Scop12=quality of the firm's response to perceived change orders ;Scale 1to7; 1=low; 7=high ; and Risk512=ability to control labor issues and management risk Scale 1 to 7; 1=poor; 7=high .

Previous studies did not investigate factors affecting profit margins in international projects.

The results show that failure to control labor issues and management risk Risk512 effectively would lead to reduction in profitability level. Transmission Construction Industry depends heavily on manual labor.

Model Validation

Model validation was conducted to ensure that the constructed MLR models are generalizable to the population and not specific to the sample used in estimation. A diagnostic test was first conducted and the residual plots of *R* being actual *Y* less the predicted Y versus predicted *Y* showed a random distribution. This indicates that the normality assumption is valid. Next, in order to check for collinearity, the variance initiation factor VIF was calculated for each explanatory variable. The VIFs calculated see Table 3 were within the acceptable range of 5.0, indicating that there is little evidence of collinearity among the set of explanatory variables Haan 2002.

Point wise Conclusion

(1) Similar to other Industries, Projects of Transmission Construction Industry follow Success and failure patterns. The success or Failure Of Project is mainly governed by Project management Practices which mainly consider Time, Scope, Quality, Customer satisfaction and Profit Earned as the main aspects to contribute to the success of project.

(2) Forecast regarding the end result (be that success or failure) can be adjudged prior during Monitoring and Control of Transmission Project by using MLR (Multiple Linear Regression).

(3) Huge amount of saving in Project time, Project cost can be achieved and this proves a good tool for Monitoring and Controlling for the Higher Management in the organization.

(4) Five predictive models are constructed. Using several PM practices, these MLR models can explain between 37 to 80% different aspects of Project Performance other than Project Management Practices, there are certain other aspects of project which also affect the success of project, can be included in the analysis as additional variables and again the complex relationship so formed can be interrelated by this tool or even other mathematical tool like Fuzzy Delphi Analysis.

References

1. Abraham, G. L. 2003. ―Critical success factors for the construction industry.‖ Proc., Construction Research Congress in Construction— Wind of Change: Integration and Innovation CD-ROM , Construction Institute of Construction Research Council, ASCE, Univ. of Colorado at Boulder, Boulder, Colo.
2. Ashley, D. Jaselskis, E., and Lurie, C. B. 1987. ―The determinants of construction project success.‖ Proj. Manage. J.-18 2, 69–79.
3. Chitkara, K. K. 1998. Construction project management: Planning, scheduling and controlling, McGraw-Hill, New Delhi.
4. Holt, G. (1997). ―Construction research questionnaire and attitude measurement: Relative index or mean.‖ J. Constr. Procure., 3(2), 88–94.
5. Project Performance Evaluation Checklist For Consulting Engineers, By William W. Wuellner,1 Member, ASCE
6. Models for Predicting Project Performance in China Using Project Management Practices Adopted by Foreign AEC Firms pp.363-389, 2008.
7. Rowlinson, S. 1999. "Selection criteria." Procurement systems: A guide to best practice, S. Rowlinson and P. McDermott, eds., E and F.N.Spon, London, 276–299.
8. Zhang, X. 2005. "Critical success factors for public-private partnerships in infrastructure development." J. Constr. Eng. Manage., 1 3 1 1 ,3–14
9. R. L., and Longnecker, M. 2001. An introduction to statistical methods and data analysis, Duxbury, PaciÞc Grove, Calif.
10. Chua, D. K. H., Kog, Y. C., and Loh, P. K. 1999. ÒCritical success factors for different project objectives.Ó *J. Constr. Eng. Manage.*, 125 3, 142Ð150.
11. Construction Industry Institute CII. 2004. Risk assessment on interna-tional projects: a management approach, Austin, Tex.
12. Enderwick, P. 1993. ÒMultinational contracting.Ó transnational corpo-rations in services K. P. Suavant and P. Mallampally, eds., Routledge, New York, 186Ð203.
13. Fortune, J., and White, D. 2006. ÒFraming of project critical success factors by a systems model.Ó Int. J. Proj. Manage, 24 1, 53Ð65.
14. Gale, A., and Luo, J. 2004. ÒFactors affecting construction joint ven-tures in China.Ó Int. J. Proj. Manage, 22 1, 33Ð42.
15. Gunhan, S., and Arditi, D. 2005. ÒInternational expansion decision for construction companies.Ó J. Constr. Eng. Manage., 131 8, 928Ð937.
16. Haan, C. T. 2002. Statistical methods in hydrology, 2nd Ed., Iowa State University Press, Ames, Iowa.
17. Han, S. H., and Diekmann, J. E. 2001. ÒApproaches for making risk-based go/no-go decision for international projects.Ó J. Constr. Eng. Manage., 127 4, 300Ð8.
18. Hyväri, I. (2006). "Project management effectiveness in project-oriented

