

**APPLICATION OF TWO STAGE FACTOR ANALYSIS FOR
IDENTIFICATION OF KEY DETERMINANTS FOR
SUCCESSFUL PROJECT IMPLEMENTATION IN THE
INDUSTRIAL AREA OF WEST BENGAL(INDIA)**

Dr (Mrs) Seema Sarkar Mondal*

Mr Angshuman Chowdhury*

Abstract—

This paper aims to identify Key determinants for successful Project Implementation in the state of West Bengal with special focus in the Durgapur Industrial area. The research is motivated by the fact that of late there has been limited success in Project Implementation in West Bengal which had earlier been very successful in Large scale project Implementation. Project related Professionals of the region were deliberated and interviewed. An objective realization instrument developed using 47 determinants identified in the research as possible drivers in Project implementation based on Likert's seven point scale of ranking. These 47 determinants were grouped into eight category or Factor group which are: Economic factors , External Environment and Regulatory Framework , Infrastructure and resource linkages, Project characteristics , Project management , Project Manager and Project team , Project stakeholders and Social factors. Based on the 72 respondent input to Objective Evaluation Questionnaire from each eight category two most critical determinants are selected through factor analysis. Total 16 Key Determinants were identified with which further second stage Factor analysis is done to identify the criticality and importance of each determinant. Also these determinants are extractor to form 5 components which determines the fate of any Project. So through this research, priority is also determined for the area and project manager based on priority can devote their time and energy to ensure that the Project is successfully completed. The customisation of Project planning and Project design has been the key determinant for successful project implementation.

Index Terms— Project, Project management, Project Implementation, determinants, Factor Analysis, Success Factors, Principal Component Analysis, Likert's ranking scale.

* Dept. of Mathematics, National Institute of Technology, Durgapur(India).

INTRODUCTION

A project can be considered to be the achievement of a specific objective, which involves a series of activities and task which consumes resources as suggested by A K Munns

and B F Bjeirmi(1). There are various factors that determine the fate of the project and is not limited to Project Management only as stated by A D Wit (2). The project life cycle is an important phenomenon which needs to be studied. As per King and Cleland (3) it can be divided into 4 stages which are Conceptualization , Planning , Execution and Termination.

Project Echo was developed by Alex Bavelas (4) wherein the Project Managers of successful projects were asked to indicate things that they could do that would substantially help implementation success. As per Slevin & Pinto (5) there are 10 factors which are critical and can lead to Project failure or success.

The 10 factors are Project Mission, Top management support, Project Schedule/plan, Client Consultation, Personnel, Technical task , Client acceptance, Monitoring and Feedback , Communication and troubleshooting. However critical or key factors vary widely from location to location. Locally for each area similar factors needs to be identified and priority table needs to be drawn so that Project Managers can engage scarce resources effectively based on the priority so that success of the Project is fully assured. As suggested by Muller & Turnerb (10) Project managers competency aspect cannot be neglected for listing the determinants.

This Research has been focused for Industrial Belt of West Bengal in an around Durgapur. Based on the Brainstorming and interview with Project Managers engaged in the said area 47 Determinants were identified. Based on the 47 determinants the OBJECTIVE EVALUATION QUESTIONNAIRE was prepared. For each 47 determinants Likert's 7 point scale method of evaluation similar to Benedict and Achimba (6) was applied which are – Strongly Disagree, Disagree , Somewhat Disagree , Neither Disagree/Agree , Somewhat Agree , Agree and Strongly Agree.

Total 72 respondents were identified from the target area who are involved in Project work and have great knowledge in execution of Project in the said area like DVC , SAIL-IISCO, Videocon , Matix Fertilisers, Essar, Reliance etc. The experience, Industry type and functions of project are

varied to get correct representation. These 72 respondents were interviewed and OBJECTIVE EVALUATION QUESTIONNAIRE (OEQ) were filled by them based on their experience of Project execution on the target area. The data generated from the OEQ are tabulated and fed in the SPSS.

The 47 Determinants forming the Objective Evaluation Questionnaire are –

| | |
|-----------------------------------------------------------------------------|----|
| Commitment Contractor/Supplier/Vendors to approved Plans /ProjectSpec. | X1 |
| Skills, training and development undertaking by project staff/workers . | X2 |
| Commitment of stakeholders for Successful completion. Stakeholders Analysis | X3 |
| Existence of use of scientific Project Management tools and techniques. | X4 |
| Accuracy of project cost estimates. | X5 |
| Government outlook and Policy towards Ind. | X6 |
| Client commitment to project financing requirements. | X7 |

The 47 determinants are reviewed and categorised into 8 Factor Groups based on similarity. The category earmarked are as follows:-

- 1) Economic Factors.
Determinant: X14,X26,X36,X37,X42,X43
- 2) External Environment and Regulatory framework.
Determinant: X6,X8,X9,X16,X19,X39,X47
- 3) Infrastructure and Resource Linkage.
Determinant: X13,X20,X25,X31,X32,X33,X34

| | |
|----------------------------------------------------------------------|-----|
| External Environmental factors (Political /Social) | X8 |
| Regulatory requirements, standards and law. | X9 |
| Accuracy of designs and specifications. | X10 |
| SHE (Safety/Health/Environment) standards and SHE policy Adherence. | X11 |
| Accuracy of time estimates for project schedule. | X12 |
| Infrastructure support Like Roads , Power , Port , Rail etc. | X13 |
| Economic Instability. | X14 |
| Able Leadership in Project Implementation. | X15 |
| Weather condition/Climate of the Project Area. | X16 |
| Collective responsibility among project stakeholders. | X17 |
| Internal Communication. | X18 |
| External Communication with right Public relations. | X19 |
| Resources Linkages. | X20 |
| Full proof security of the Project Site. | X21 |
| Interference of NGO and media. | X22 |
| Coordination among Project team. | X23 |
| Experience of Project team to work in similar environment. | X24 |
| Availability of Power and Power infrastructure near vicinity | X25 |
| Standard of living of the nearby area. | X26 |
| Literacy level of surrounding area. | X27 |
| Proximity of customers near project site. | X28 |
| Promoter background and origin. | X29 |
| Land cost level in the project region. | X30 |
| Ground water or surface water availability. | X31 |
| Wind force and direction. | X32 |
| Nearness of Airport. | X33 |
| Nearness of Seaport. | X34 |
| Ethnic / regional composition of Project team. | X35 |
| Global recession and economic slump. | X36 |
| Land Fertility in the project region. | X37 |
| Technology tieup partner competency. | X38 |
| Government stake in Private / Private stake in government. | X39 |
| Customisation level in Project planning. | X40 |
| Customisation level in Project design | X41 |
| Financial strength of participating Banks in Bankers consortium. | X42 |
| Positive ROI & IRR of the Project. | X43 |
| Crime rate of nearby villages as per Law & Order. | X44 |
| Fragmented land ownership. | X45 |
| Corruption Level in the region. | X46 |
| Existing Pollution level in the Project region. | X47 |

- 4) Project Characteristics.
Determinant: X10,X12,X24,X40,X41
- 5) Project management.
Determinant: X4,X5,X11,X18.
- 6) Project Manager and Project Team.
Determinant: X2,X15,X23,X24,X35
- 7) Project Stakeholders.
Determinant: X1,X3,X7,X17,X29,X38.
- 8) Social Factors.
Determinant: X30,X44,X45,X46,X21,X22,X27.

Factor Analysis is applied for each of the 8 Factor Groups individually with the data collected from 72 Respondents. Based on inputs Factor wise Communalities and Total Variance is calculated. Two component extractions is done and then based on component Matrix 2 main determinants for each factor group or category is selected for further analysis. Factor Analysis is carried out by SPSS software as guided by Andy Field (7).

From each Factor group or Category 2 key determinants are identified based on maximum weightage as per Component Matrix outcome. Total 16 Determinants from 8 category/Factors are shortlisted for further analysis through Factor Analysis and the Mathematical formulations were based on T W Anderson(8).

The 2 Determinants selected for each factors from are as follows :-

- 1) Economic Factors.
Determinant: X14,X42
- 2) External Environment and Regulatory framework.
Determinant: X8,X9
- 3) Infrastructure and Resource Linkage.
Determinant: X32,X34
- 4) Project Characteristics.
Determinant: X40,X41

5) Project management.

Determinant: X11,X18.

6) Project Manager and Project Team.

Determinant: X23,X24

7) Project Stakeholders.

Determinant: X7,X17

8) Social Factors.

Determinant: X45,X46

The data collected for the selected 16 determinants are put to analysis for determination of key determinants. It is achieved by use of Factor analysis. Communalities for the above are drawn and Total variance is determined. Finally 5 components is extracted for ensuring 64.7 % success. The total variance matrix through the use of Principal component analysis is mentioned in Table1

| Component | Initial Eigenvalues | | |
|-----------|---------------------|---------------|--------------|
| | Total | % of Variance | Cumulative % |
| 1 | 4.114 | 25.715 | 25.715 |
| 2 | 1.996 | 12.473 | 38.188 |
| 3 | 1.658 | 10.362 | 48.549 |
| 4 | 1.478 | 9.235 | 57.785 |
| 5 | 1.110 | 6.939 | 64.723 |
| 6 | .930 | 5.815 | 70.538 |
| 7 | .856 | 5.347 | 75.885 |
| 8 | .731 | 4.570 | 80.455 |
| 9 | .667 | 4.166 | 84.621 |
| 10 | .543 | 3.396 | 88.016 |
| 11 | .439 | 2.743 | 90.760 |

| | | | |
|----|------|-------|---------|
| 12 | .409 | 2.559 | 93.319 |
| 13 | .312 | 1.949 | 95.267 |
| 14 | .302 | 1.887 | 97.154 |
| 15 | .253 | 1.584 | 98.738 |
| 16 | .202 | 1.262 | 100.000 |

| Extraction Sums of Squared Loadings | | |
|-------------------------------------|---------------|--------------|
| Total | % of Variance | Cumulative % |
| 4.114 | 25.715 | 25.715 |
| 1.996 | 12.473 | 38.188 |
| 1.658 | 10.362 | 48.549 |
| 1.478 | 9.235 | 57.785 |
| 1.110 | 6.939 | 64.723 |

| Rotation Sums of Squared Loadings | | |
|-----------------------------------|---------------|--------------|
| Total | % of Variance | Cumulative % |
| 2.624 | 16.401 | 16.401 |
| 2.141 | 13.381 | 29.783 |
| 2.051 | 12.817 | 42.600 |
| 1.931 | 12.069 | 54.669 |
| 1.609 | 10.055 | 64.723 |

Total Variance Explained Table -1

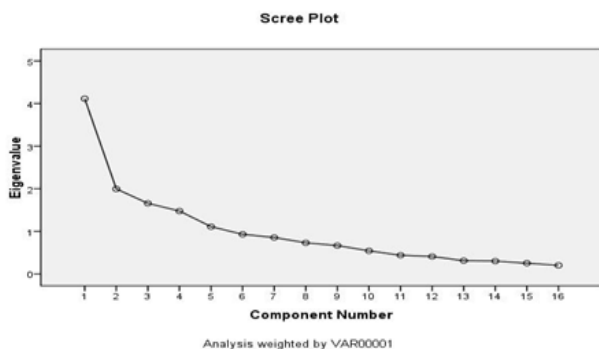


Fig. 1

Rotated Component Matrix

| | Component | | | | |
|----------|-----------|-------|-------|-------|-------|
| | 1 | 2 | 3 | 4 | 5 |
| VAR00014 | -.010 | .773 | .101 | .012 | .131 |
| VAR00042 | .349 | .618 | -.076 | .142 | .201 |
| VAR00008 | -.070 | .799 | -.022 | .182 | .026 |
| VAR00009 | .090 | .285 | .124 | .822 | -.106 |
| VAR00032 | -.127 | -.085 | .766 | .339 | .024 |
| VAR00034 | .072 | .038 | .706 | -.060 | -.019 |
| VAR00040 | .802 | .139 | .097 | .162 | -.011 |
| VAR00041 | .831 | .149 | .134 | -.008 | .058 |
| VAR00011 | .181 | .005 | -.108 | .799 | .268 |
| VAR00018 | .158 | .095 | -.001 | -.067 | .843 |
| VAR00023 | .662 | -.141 | -.017 | .107 | .264 |
| VAR00024 | .468 | -.160 | .492 | .230 | .144 |
| VAR00007 | .423 | .312 | .310 | .424 | .208 |
| VAR00017 | .078 | .176 | .025 | .234 | .784 |
| VAR00045 | .284 | .438 | .529 | -.155 | -.064 |
| VAR00046 | .394 | .129 | .526 | -.302 | .004 |

Table - 2

Component Transformation Matrix

| Component | 1 | 2 | 3 | 4 | 5 |
|-----------|-------|-------|-------|-------|-------|
| 1 | .655 | .427 | .391 | .364 | .320 |
| 2 | -.321 | .426 | -.627 | .464 | .327 |
| 3 | -.411 | .723 | .373 | -.186 | -.367 |
| 4 | -.332 | -.317 | .391 | .760 | -.242 |
| 5 | -.434 | -.113 | .402 | -.198 | .773 |

The Scree Plot for the research is mentioned in Fig.1. is analysed as per Andy Field (7). Finally the Rotated Component Matrix (Table -2) was derived to identify the main influencing factors or determinants for the extracted components.

Based on Component matrix and further analysis following were concluded :

A) Factors X40 and X41 having weightage 0.678 and 0.676 respectively are the most important determinant for project success both of which falls under Project characteristics. So as a Key Factor for Project success, Project Characteristics is the most important Category which Project Proponent must be careful.

B)The 5 Components extracted for achieving 64.723 % assured success and its constituents are as follows :

INTERPRETATION TABLE

| SL No | Component | Variables | Co-relati on With factor | Component Details |
|-------|-------------|-----------|--------------------------|---------------------------------------------------------------------|
| 1 | Component 1 | X-40 | 0.802 | Customisation of Project and Coordination among Project team |
| | | X-41 | 0.831 | |
| | | X-23 | 0.662 | |

| | | | | |
|---|-------------|------|-------|-----------------------------------------------------------------------------------------------|
| 2 | Component 2 | X-14 | 0.773 | Economic Factors and External Environment |
| | | X-42 | 0.618 | |
| | | X-08 | 0.779 | |
| | | | | |
| 3 | Component 3 | X-32 | 0.802 | Infrastructure, Social factors and project team competency |
| | | X-33 | 0.831 | |
| | | X-24 | 0.492 | |
| | | X-45 | 0.529 | |
| | | X-46 | 0.526 | |
| | | | | |
| 4 | Component 4 | X-9 | 0.822 | Regulatory framework, standard & Client commitment to Project finance requirement. |
| | | X-11 | 0.799 | |
| | | X-7 | 0.424 | |
| | | | | |
| 5 | Component 5 | X-18 | 0.843 | Internal communication & Collective Responsibility |
| | | X-17 | 0.784 | |
| | | | | |

C)The interpretation table clearly confirms that the most important determinant for Project success is Customisation and Coordination of Project Team. Customisation is very important as in Nano Project of TATA at Singur whose design was based on huge land requirement became a failure because in West Bengal Land is scare. So ideally Plant layout and design should be based on these local considerations otherwise failure like Singur Project may get repeated.

D) Based on Questionnaire Survey and analysis of the data collected from them it can be concluded that following factors are key to Project success:

I) Customisation in Project & Coordination among project Team.

II) Economic and External factors.

III) Infrastructure , Social factor and Competency of Project Team.

IV) Regulatory Framework, standard & Client /Stakeholders commitment to project finance.

V) Internal Communication and Collective Responsibility.

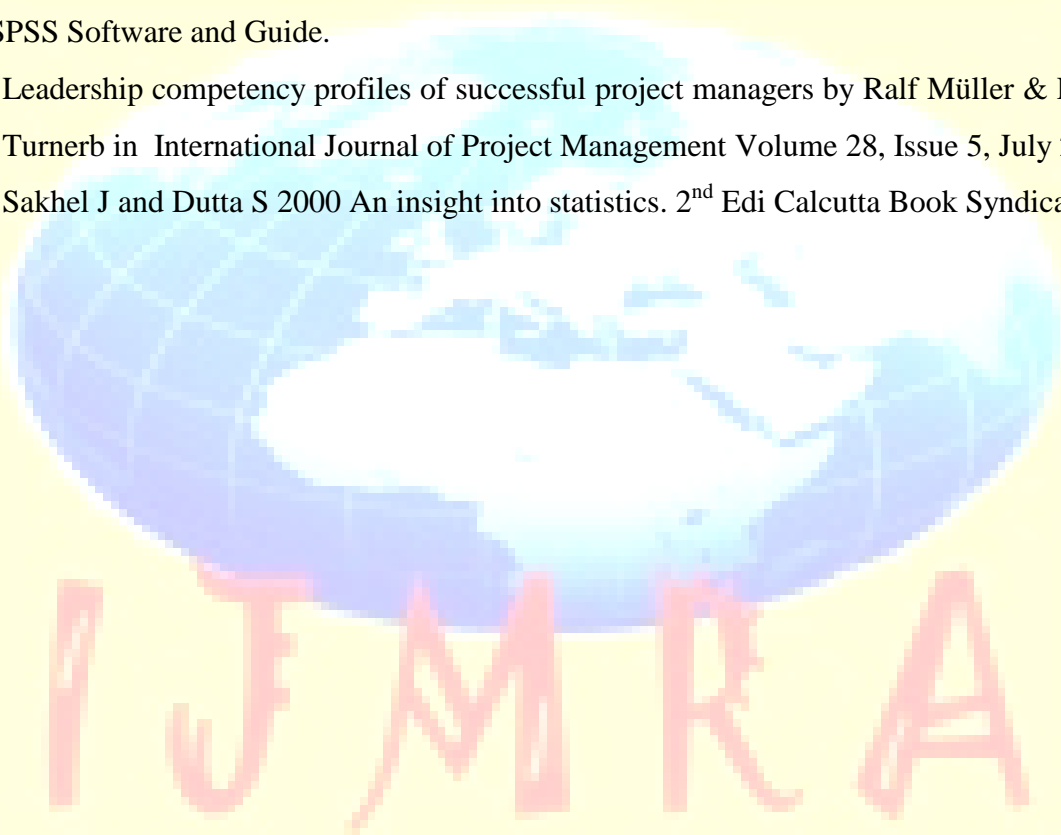
CONCLUSION

. From the research it can be concluded that Customisation of Project design and Plan is most important determinant for Project Implementation. Coordination among Project team has positive correlation to customisation Process. It is found that implementation of Agile Project Management, Lean Techniques and Six Sigma techniques (DMAIC) help a great deal to achieve necessary customisation which will be evaluated in future research. Continuous Change management also needs to be incorporated in the Project execution process. In future the research will try to correlate the implementation of the above techniques and also to formulate a Customisation Indexing process through which it can be satisfactorily ascertained whether the Project is adequately customised or not.

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Author's Profile:



Mr Angshuman Chowdhury is working in the field of Project management for more than 10 years and has been instrumental in implementing 2 Greenfield and 2 Brownfield expansion Project. He has done B.tech in Mechanical Engineering , Post Graduate Diploma in Marine Engg , MTech in Operations Research & Business Management and also MBA in international Business.

Presently he is Asst General Manager in Matix Fertilisers and Chemicals Ltd and Part time Research scholar at National Institute of Technology, Durgapur. He is associated for past several years with QCFI – Quality Circle Forum of India , Institute of Engineers (I) and other professional bodies. He has been a faculty and done consultancy to various organizations like ECL , Saint Gobain , DVC , SAIL , DCL etc.

Mr Chowdhury has published Research Papers in 2 International Journals related to Project Management and Lean Manufacturing Techniques.