

IDENTIFICATION OF CONSTRAINTS IN CONSTRUCTION PROJECTS

Utsav M. Bhavsar¹, Jayraj V. Solanki²

¹P.G. Student, Department of Civil Engineering, U.V. Patel College of Engineering, Ganpat University, Gujarat, India.

²P.G. Head and Assistant Professor, Department of Civil Engineering, U.V. Patel College of Engineering, Ganpat University, Gujarat, India.

Abstract - The goal of this project and its scope is to recognize the constraints in infrastructure construction projects. If constraints are well understood at the commencement of the project, enhanced performance can be guaranteed in future. Classifying and eliminating constraints from obstruction activities will help to decrease the suspicions in construction procedures and will escalate the limpidity of project management. This study was carried out on the basis of literature review and a questionnaire survey. The data for this study was collected through a questionnaire survey. The questionnaire forms were distributed to various construction companies by the means of email. The objectives of the study are to successfully diminish the constraints which will help in the lessening of needless wastage and loss of money and time because of poor planning. Importance Performance Analysis method (IPA) was used to analyze the collected data. Final results show the top limiting factors aka constraints causing delay, cost overrun and poor quality work.

Key Words: Constraints, TOC (Theory of Constraints), Five Focusing Steps, Importance Performance Analysis (IPA).

1. INTRODUCTION

In current construction situation, it is vital to grow with the new technology & concepts. The ultimate goal is nonstop improvement. Essentially in India, where the appropriate system of work is not followed, TOC will not only help in controlling the limiting factors but also help in continuously approaching the new techniques to overcome delay and cost overrun. Theory of Constraints (TOC) presented by Dr. Goldratt in his book titled *The Goal*. It is an overall management philosophy. Constraint is point where the project or task fails to perform at it is predicted.

“Anything that bounds an organization or individual from moving toward or achieving its goal” is known as a constraint. Constraints exists in all working environments. Though, there can be situations that we are not aware of the existence of the constraints, we tend to put more importance on the project goals. Even though constraints have been discussed in much of the management works, there is little detailed study on constraints in construction projects. The construction projects involve multi-party involvement. Complications can occur in project management in a multi-party working situation which can further develop into conflicts and disputes, resulting in cost consequences, direct

and indirect, to clients and contractors. The project team members have to meet client’s requirements on one hand and to overcome constraints on the other hand. It is important to identify the probable constraints in the construction project, which will help in the reduction of the unnecessary wastage and loss of money and time because of poor planning. Thus, controlling the constraints is a pre-condition for extraordinary performance of the project. The five categories in which the constraints may be divided are as follows:

TYPES OF CONSTRAINTS
Economic constraints
Legal constraints
Environmental constraints
Technical constraints
Social constraints

Fig -1: Type of Constraints

THE FIVE FOCUSING STEPS:

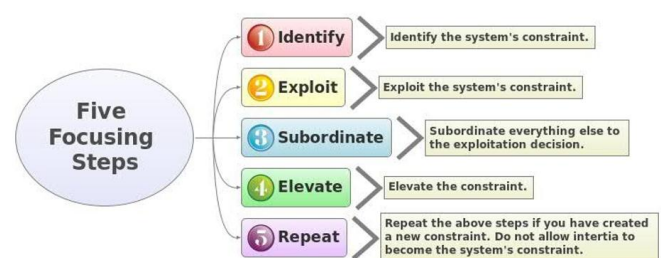


Fig -2: Five Focusing Steps

2. OBJECTIVE

The objective of this study was to explore the following aspects:

- To successfully diminish the constraints to overcome delay, cost overrun and poor quality work.
- To study the reasons behind the occurrence these kind of constraints and find out the ways to reduce and ultimately eliminate them.

- To show the importance of identifying and reducing the constraints in the current construction industry and its effects.
- To improve quality.
- To reduce pointless wastage of materials.

3. SCOPE OF WORK

To make the study more precise, general and realistic, surveys and analysis is limited within the definite boundary. The scope of study is limited to Gujarat state. All types of construction companies executing hard-core construction projects are considered and made a part of this research work.

4. RESEARCH METHODOLOGY

Following methodology was implemented to complete the research work.

1. Primary data was gathered by conducting a questionnaire survey and expert interview amongst many specialists like construction manager, architects, professors, contractors and builders.
2. Review of literature was done by referring local and global research papers, reference books, construction journals etc.
3. Data analysis was done on the basis of the collected data. Importance Performance Analysis (IPA) method.
4. Declaring the results and conclusion from the analyzed data.

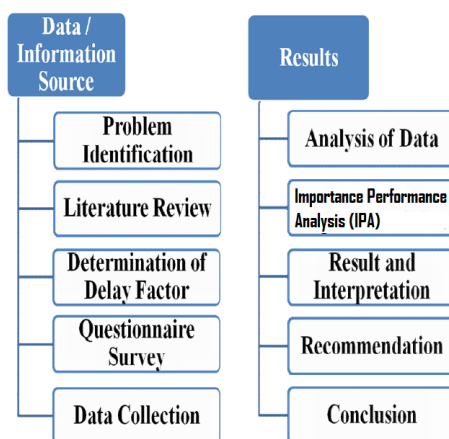


Fig -3: Research Methodology

5. MEASUREMENT OF DATA IN QUESTIONNAIRE SURVEY

The constraints disturbing the construction work (and responsible for delay & poor quality work) will be answered

by giving number from 1-5. The numbers in questionnaires signify the scale as:

Numeric scale	Weight of each scale
1.	Very low
2.	Low
3.	Medium
4.	High
5.	Very high

Fig -4: Measurement of Data

There are a total of 43 limiting factors (constraints) which I found during literature study and by interviewing various experts from the construction industry. These limiting factors falls under the 5 main types of constraints which are shown in the below figure.

SR. NO.	CONSTRAINTS					
		1	2	3	4	5
Economic Constraints						
1	Soundness in financing the project by owner					
2	Promising of completion of project					
3	Difficulties in obtaining loan from financiers					
4	Improper allocation of money to related parties					
Legal Constraints						
5	Difficulties in obtaining work permits					
6	Land acquisition					
7	Chances of change in drawing/design					
8	Building Regulations					
9	Safety regulations					
10	Disputes related to contractual documents					
11	Work laws (of the current government)					
12	Non-availability of land within city limits					
13	NOC's from different departments					
Technical Constraints						
14	Practicability of completing the project in given duration					
15	Delay in solving design problems					
16	Inappropriate project cost estimation					
17	Imperfect drawings & details					
18	Inappropriate power delegation					
19	Unavailability of skilled Engineers and Project Managers					
20	Established labs(for material testing) present or not at the place of execution					
21	Unavailability of storage space					
22	Restricted site area					
23	Poor coordination between different agencies					
24	Improper resource levelling					
25	Poor planning & scheduling					

Fig -5: Types of Constraints

Social Constraints					
26	Politicking (politics)				
27	Orthodox beliefs of people				
28	Emotional constraints				
29	Ownership of the problems				
30	Media (their honesty & dishonesty)				
31	Inadequate compensation for the land				
Environmental Constraints					
32	Environmental clearance certificate				
33	Weather effect on execution activities				
34	Air, water or ground pollution				
35	Noise and dust pollution				
36	Traffic & transport				
37	Topography & Soil strata				
Other Constraints					
38	Natural hazards				
39	Accidents on site during execution				
40	Unavailability of competent sub-contractors				
41	Difficult routes for accessing site				
42	New technology adoption				
43	Lack of labour (skilled workforce)				

Fig -6: Types of Constraints

Calculation for IPA

FACTORS	34	35	36	37	38	39	40	41	42	AVERAGE
	Impact	Impact	Impact	Impact	Impact	Impact	Impact	Impact	Impact	
Soundness in financing the project by owner	3	3	2	3	3	2	3	3	2	2.69047619
Promising of completion of project	3	4	3	3	4	3	4	4	3	3.023809524
Difficulties in obtaining loan from financiers	4	3	4	4	3	4	3	3	4	3.523809524
Improper allocation of money to related parties	4	3	3	4	4	3	4	4	4	3.547619048
Difficulties in obtaining work permits	4	3	3	4	4	4	4	5	4	4.119047619
Land acquisition	4	5	4	4	4	4	5	4	4	4.19047619
Chances of change in drawing/design	2	3	3	2	4	3	4	3	3	2.523809524
Building Regulations	4	5	4	4	5	4	5	4	4	4.285714286
Safety regulations	3	3	3	3	4	3	4	3	3	3.19047619
Disputes related to contractual documents	3	3	3	3	3	3	3	3	2	2.952380952
Work laws (of the current government)	3	4	3	3	4	2	4	4	2	3.023809524
Non-availability of land within city limits	4	4	4	4	3	4	3	4	4	3.523809524
NOC's from different departments	4	5	3	4	4	5	4	4	5	4.19047619
Practicability of completing the project in given duration	2	4	2	2	2	2	2	4	2	2.404761905
Delay in solving design problems	2	4	2	2	3	3	3	4	2	2.595238095
Inappropriate project cost estimation	2	5	2	2	2	3	2	5	3	2.619047619
Imperfect drawings & details	2	4	2	2	3	2	3	4	3	2.523809524
Inappropriate power delegation	2	3	3	2	2	3	2	3	3	2.452380952
Unavailability of skilled Engineers and Project Managers	3	4	4	3	4	4	4	4	4	3.976190476
Established habit for material/technical content or not at the sphere of execution	3	4	4	3	3	4	3	4	4	3.719047619

Fig -8: Average Values of Impact

6. DATA ANALYSIS

42 responses were received from the questionnaire survey and now that collected data was analyzed to find out the most vital constraints affecting the construction projects. So, here **Importance Performance Analysis** method has been applied.

Importance Performance Analysis (IPA) is a quantitative approach for measuring how people feel about a certain characteristic of an issue.

Cartesian diagram comprises of four quadrants which are:

- Quadrant I (top priority)
- Quadrant II (keep achievement)
- Quadrant III (excessive)
- Quadrant IV (low priority)

FACTORS	36	37	38	39	40	41	42	AVERAGE
	Performance level	Performance level	Performance level	Performance level	Performance level	Performance level	Performance level	
Soundness in financing the project by owner	4	4	3	4	4	4	3	3.119047619
Promising of completion of project	3	4	3	4	3	4	3	3.19047619
Difficulties in obtaining loan from financiers	5	4	5	4	5	4	5	3.78095238
Improper allocation of money to related parties	5	4	5	4	5	4	5	3.476190476
Difficulties in obtaining work permits	5	3	5	3	5	3	5	3.857142857
Land acquisition	5	5	5	5	5	5	5	4
Chances of change in drawing/design	3	3	5	3	3	3	5	2.904761905
Building Regulations	5	5	5	5	5	5	5	4
Safety regulations	5	5	5	5	5	5	5	3.523809524
Disputes related to contractual documents	4	4	4	4	4	4	4	3.161904762
Work laws (of the current government)	5	4	5	4	5	4	5	3.933333333
Non-availability of land within city limits	5	4	5	4	5	4	5	3.78095238
NOC's from different departments	5	4	5	4	5	4	5	3.761904762
Practicability of completing the project in given duration	3	3	3	3	3	3	3	2.574285714
Delay in solving design problems	2	3	2	3	2	3	2	2.5
Inappropriate project cost estimation	2	3	2	3	2	3	2	2.452380952
Imperfect drawings & details	3	3	2	3	3	3	2	2.428571429
Inappropriate power delegation	3	3	2	3	3	3	2	2.571428571
Unavailability of skilled Engineers and Project Managers	4	4	4	4	4	4	4	2.976190476
Established habit for material/technical content or not at the sphere of execution	4	4	4	4	4	4	4	3.933333333

Fig -9: Average Values of Performance Level

Both the above images shows the average values of Impact and Performance level which are calculated on the basis of the data received from the respondents through the questionnaire survey.

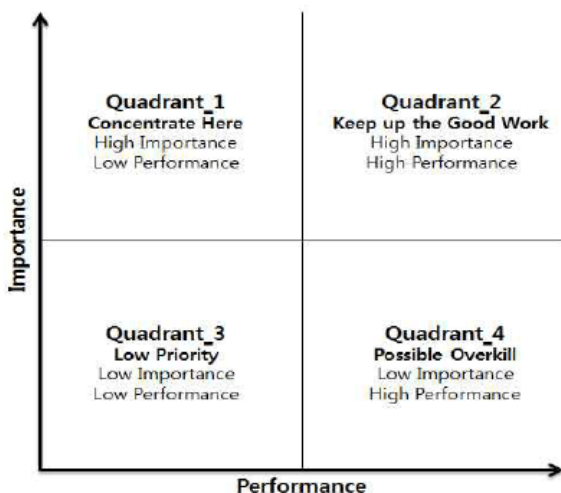


Fig -7: Importance Performance Analysis

FACTORS	Impact	Performance
Soundness in financing the project by owner	2.6904762	3.119047619
Promising of completion of project	3.0238095	3.19047619
Difficulties in obtaining loan from financiers	3.5238095	3.738095238
Improper allocation of money to related parties	3.547619	3.476190476
Difficulties in obtaining work permits	4.1190476	3.857142857
Land acquisition	4.1904762	4
Chances of change in drawing/design	2.5238095	2.904761905
Building Regulations	4.2857143	4
Safety regulations	3.1904762	3.523809524
Disputes related to contractual documents	2.952381	3.261904762
Work laws (of the current government)	3.0238095	3.333333333
Non-availability of land within city limits	3.5238095	3.738095238
NOC's from different departments	4.1904762	3.761904762
Practicability of completing the project in given duration	2.4047619	2.571428571
Delay in solving design problems	2.5952381	2.5
Inappropriate project cost estimation	2.6190476	2.452380952
Imperfect drawings & details	2.5238095	2.428571429
Inappropriate power delegation	2.452381	2.571428571
Unavailability of skilled Engineers and Project Managers	3.9761905	2.976190476
Established labs (for material testing) present or not at the place of execution	3.2142857	3.333333333
Unavailability of storage space	2.3809524	2.428571429
Restricted site area	2.3333333	2.285714286
Poor coordination between different agencies	2.6428571	2.714285714
Improper resource levelling	2.5238095	2.785714286
Poor planning & scheduling	2.8333333	3
Politicking (politics)	2.6666667	2.976190476
Orthodox beliefs of people	2.8333333	3.285714286
Emotional constraints	2.5952381	2.952380952
Ownership of the problems	2.7380952	3.023809524
Media (their honesty & dishonesty)	2.452381	2.738095238
Inadequate compensation for the land	2.8809524	3.166666667
Environmental clearance certificate	4	3.571428571
Weather effect on execution activities	2.4761905	2.619047619
Air, water or ground pollution	2.4761905	2.619047619
Noise and dust pollution	2.5714286	2.785714286
Traffic & transport	3.052381	2.833333333

Fig -10: Average values of Impact & Performance level

IPA CARTESIAN DIAGRAM

From the above calculations, a two-dimensional graph is plotted which is of Impact vs Performance level. This graph is divided into four quadrants.

The graph is divided into four quadrants using two lines which are drawn from the points that we get by taking the **average of the average values** of impact and performance level. The average values of impact and performance level are shown in the above figure.

The below figure shows the Cartesian diagram of IPA on the basis of which we can find out the factors which are most important for delay and over budgeting.



Chart -1: IPA Cartesian Diagram

- All the factors whose values of **impact is high** and **performance is low** will be in 1st quadrant and they would be considered of the **highest priority**.
- All the factors whose values of **impact is low** and **performance is high** will be in 3rd quadrant and they would be considered of the **lowest priority**.
- The below image shows the value of impact and performance of each factor.

Sr. No	Factors (Constraints)	Impact	Performance level
1	Soundness in financing the project by owner	Low	High
2	Promising of completion of project	High	High
3	Difficulties in project financing by owner (Budget limit)	Low	High
4	Improper allocation of money to related parties	High	Low
5	Difficulties in obtaining work permits	High	Low
6	Land acquisition	High	Low
7	Chances of change in drawing/design	Low	High
8	Building Regulations	High	High
9	Safety regulations	High	High
10	Disputes related to contractual documents	High	Low
11	Work laws (of the current government)	High	High
12	Non-availability of land within city limits	Low	High
13	NOC's from different departments	High	Low
14	Practicability of completing the project in given duration	Low	High
15	Delay in solving design problems	High	Low
16	Inappropriate project cost estimation	High	Low
17	Imperfect drawings & details	High	Low
18	Inappropriate power	Low	Low

Fig -11: Impact – Performance measurement

25	Poor planning & scheduling	High	High
26	Politicking (politics)	High	Low
27	Orthodox beliefs of people	Low	High
28	Emotional constraints	Low	High
29	Ownership of the problems	High	High
30	Media (their honesty & dishonesty)	Low	Low
31	Inadequate compensation for the land	High	High
32	Environmental clearance certificate	High	Low
33	Weather effect on execution activities	Low	High
34	Air, water or ground pollution	High	High
35	Noise and dust pollution	High	High
36	Traffic & transport	Low	High
37	Topography & Soil strata	High	Low
38	Natural hazards	High	Low
39	Accidents on site during execution	High	Low
40	Unavailability of competent sub-contractors	High	Low
41	Difficult site access routes	Low	High
42	New technology adoption	High	High
43	Lack of labor (skilled workforce)	High	Low

Fig -12: Impact – Performance measurement

7. RESULTS

The restricting factors (constraints) coming in the 1st quadrant has high importance and low performance. These are the factors having high priority which are responsible for delay and over budgeting.

So, by doing the analysis by IPA method, we found out that 15 constraints from a total of 43 constraints have top most effect on the construction project. Those factors (constraints) are: -

Improper allocation of money to related parties E
Difficulties in obtaining work permits L
Land acquisition L
Building Regulations L
Environmental clearance certificate EN
Topography & Soil strata EN
Natural hazards O
Accidents on site during execution O
Unavailability of competent sub-contractors T
Lack of labor(skilled workforce) O
Unavailability of skilled Engineers and Project Managers T
NOC's from different departments L
Politicking S
Inappropriate project cost estimation T
Imperfect drawings & details T
Disputes related to contractual documents L

Fig -13: Result

Where,

L = Legal Constraints

T = Technical Constraints

E = Economic constraints

EN = Environmental Constraints

S = Social Constraints

O = Other Constraints

Thus, from the above results, we can say that the **LEGAL CONSTRAINTS** has the most important impact on the construction projects followed by Technical constraints up to other constraints.

8. CONCLUSION

From this research work, it can be specified that finding and eradicating constraints from obstructing activities helps us to reduce the uncertainties in construction processes and upsurges the transparency and efficiency of project

management. Construction projects are subject to abundant constraints of various types, including contractual due dates, resource limitations, and safety, land acquisition etc.

This research is done to identify the constraints and to find out the major ones prevailing in the construction industry that affects the construction projects in a very adverse manner. From this research, **Legal Constraint (and the factors falling under this section responsible for delay)** was found out to be a major one.

9. RECOMMENDATIONS

First of all, one should find out the constraint prevailing in the project. Once the constraints are known, different steps should be taken accordingly to eliminate those constraints. The main reason for the delay of land acquisition should be known and a way to overcome it should be found. Different methodologies should be adopted according to the type of the constraint to know its intensity and the overall impact to make its elimination process much easier.

REFERENCES

- [1] Chua D. K. H. and Shen L. J., "Key Constraints Analysis with Integrated Production Scheduler" Journal Of Construction Engineering And Management, 7, 2003, pp.753-764.
- [2] Lau E. and Kong J. J., "Identification of Constraints in Construction Projects to Improve Performance" The Joint International Conference on Construction, Culture, Innovation and Management, 2006, pp - 655-663.
- [3] Rahman H. A, Takim R and Min W. S., "Financialrelated causes contributing to project delays" Journal of Retail & Leisure Property, 8, 3, 2009, pp. 225-238.
- [4] Goldratt, E. M. 1990. Theory of constraints. Croton-On-Hudson, NY: North River Press.
- [5] Mayer, R. J., Painter, M. K., and Lingineni, M. 1995. Information integration for concurrent engineering (IICE) towards a method for business constraint discovery (IDEF9). Knowledge Based Systems, Inc. Texas: Human Resources Directorate Logistics Research Division.
- [6] Jacob, D. B., & William T. McClelland, J. (2001). Theory of Constraints Project Management: A brief introduction into the basics. Retrieved 7 24, 2017,
- [7] Bushong, G., & Talbott, J. C. (1999). The CPA in the industry, An application of Theory of Constraints. The CPA journal.
- [8] Mishra.A.K., Mallik.K. Factors and Impact of Risk Management Practice on success of Construction Projects of Housing Developers, Kathmandu, Nepal. International Journal of Sciences: Basic and Applied Research (IJSBAR) (2017) Volume 36, No 7, pp 206-232.
- [9] Adekunle, S. G.(2008).Systems and relationships for construction quality,International Journal of Quality & Reliability Management. 3(2):1-17.

- [10] Atkinson, T. Y.(2005). Factors Affecting Quality in the Delivery of Public Housing Projects in Lagos State, Nigeria,International Journal of Engineering and Technology, 6(5):1-18
- [11] Goldratt, C. E. (2014).The role of Management Actions in the Cost, Time and Quality Performance of High Rise Commercial Building Projects. Unpublished PhD Thesis, University of Sydney, Sydney.