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Analysis of Constraints in Offshore Construction in Remote Location

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Abstract: ***Construction of offshore structure is a great challenging task for the construction industries in many developing countries. In the recent years, the developing countries invest large amount of money for the construction of offshore structures such as Ports, Jetties, sea walls, Reefs, Oil platforms etc,. Challenges faced by the executer are of different nature in different localities during the progression of these construction activities. Hence, it is required for a proper mapping of constraints for a timely and economic construction of the above mentioned offshore project. This paper mainly emphasis on adopting a suitable methodology for the mapping of various possible constraints for the proposed construction of offshore structures***
Additional Index Words: ***Offshore, construcLtion, projects***

I. INTRODUCTION

The offshore constructions which facilitate offshore activities are facing diversified challenges due to Socio Economic, Environmental, Political, and technical issues. Even though, several of these activities contribute for the enhancement of national economical level but creates an imbalanced situation in the physical characteristics and the quality of the coast. To maintain an appropriate balance between the offshore construction activities and the challenges, a companionable Eco friendly solution in par with ever-changing needs has to be framed considering the issues posed by the construction activities. For an Eco- friendly augmentation, mapping of several Constraints pertaining to the issues are to be prepared. Based on the constraint mapped data, the decision making system should be well planned in order to reduce or eliminate the constraints. Constraint management contributes two major functions such as, planning and control (Chua et al. 2005). Planning accentuates optimal scheduling using simple or complicated algorithms with an objective of gratifying project goals such as duration, cost, and quality. Control functions mainly focus on planning for supply chain management intended for implementation of work assignment, resource allocation, material delivery and inventory control. To reduce uncertainties in construction processes and increasing the transparency of project management identifying and removing constraints are very much required (Chua et al. 2003). Conflicts and disputes at the initial stage can be avoided by adopting appropriate measures such as proposing a framework and identifying the caustic factors which can restrain the conflicts and disputes in the construction industry Yates (2002). Until till date no research work have been done with mapping of constraints especially in the field offshore construction in remote location. The constraints pertaining to offshore and near shore construction activities in remote location comprise of capacity and demand as its functionality variables. Providing a system level reliable indicator enhances the progress of the activities towards achieving its goal (Dettmer, 1998). The constraints can be further categorized into two types: (1) internal constraint and (2) external constraints. Internal constraints are within the system which can be kept under control when the system and management tools are comprehensible. The management tools are to realize the demands; and to eliminate the constraint. The internal management handled by the middle manager who frequently encounters situations when a task is assigned by the top management with the expected constraints. The middle managers should have a sound knowledge about these constraints so has to meticulously plan for the completion of the task assigned. If the constraints cannot be overcome, there is a possibility of doing things by compensating their capability in order to accomplish the task. External constraints are outside the system and are less under control. The system has slack capacity to handle external constraints and action taken can merely minimize the effect of undesirable consequence rather than breaking the constraints. However, constraints can never be permanently broken. They merely migrate from one place to another and TOC has to re-apply. Removing constraints (Goldratt 1990, Chua et al., 2003) from bottleneck(s) are the most effective means of improving overall performance of the system. Identifying and removing constraints represents an iterative procedure that pushes system capacity closer and closer to its limit. Therefore, the process should be reapplied (Goldratt 1990as illustrated in Figure 1. It emphasizes balancing throughput across the entire production line and making the best use of available resources via continuous improvement.
This study emphasis on the difficulties/constraints faced during infrastructural development of remote locations. The main theme of this paper is on major construction vulnerability in offshore and coastal construction in remote locations and also mapping the

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constraints during execution of the projects as well as analysising the level of constraints using mean scale model with the real time data's taken from previous experience in similar working nature at remote locations.

A. Major Constrain involving the offshore and near shore construction work in all locations:

1) Constraints due to environmental conditions
2) Constrains in Remote Condition
3) Constraints due to construction equipment.
4) Constraints due to construction Manpower
5) Constraints due to raw materials availability.
6) Constraints due to Logistic issues.
7) Constraints due to Land Acquisition.
8) Constraints due to Regulations (safety/ labour law).
9) Constraints due to Financial Status Of Contractor.
10) Constraints due to Natural disasters
11) Government related approvals.

II. METHODOLOGY

In this research work Questionnaire survey is used as a tool to find out the various factors and most influence parameter, also this survey hands a systematic approach and an easy format through which all the parameter are covered and can be easily assessed.

A. The Procedure As Follows

Step1: Identifying cost influencing parameters thorough literature review, data collection from various govt. authorities, contractors, site engineers, supervisors and labour supervisors Step2: Preparation of structured questionnaire considering all the above factors and arranging in a descending in accordance with the repetition adopted by majority of people. Step3: mapping of severity index based on the impact value of an individual factor on cost and benefit by giving a scale value of 0 to 10. Step4: Dividing the whole scale into two parts

Step5: Distribution and collection questionnaires from various govt. authorities, contractors, site engineers, supervisors and labour supervisors. total of 50 Questionnaires were distributed and collectedStep6:The scale value obtained by the individual factors from 50 questionnaires was noted down in table I and II. Step7:The values obtained from the questionnaires were analyzed on the basis of mean and coefficient of variance.

B. Data Collection

1) *Factors :* The Factors were collected from literature review pertaining to the particular issue also the factual data's were collected from various Experts from in the field of coastal construction and port managements, local govt. and private contractor, site engineers, site supervisors etc. In total a list of 30 factors were collected and included in the questionnaire as given below.

C. The 30 factors are as follows

1) Remote Condition
2) Land Acquisition
3) Project necessity
4) Soil & Rock Suitability / Drillability
5) Change in material specification
6) Material Related Problem (Transportation, Cost, Handling Etc.)
7) Project Size / Phases
8) Payment Related Problem From investor Side
9) Poor Communication Between Construction Parties
10) Lack Of Equipment Efficiency (Efficiency Of Operator, Suitability Of Particular Equipment To Site Condition)
11) Climatic Condition
12) Regulations (safety/ labour law)
13) design related issues
14) Financial Status Of Contractor

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15) Lack Of Experience & Knowledge Of Construction Parties
16) Local Issues
17) Labour Availability
18) Involvement Of More No. Of Parties (Contractor) In Single Project
19) Lack Of Efficiency Of Contractor To Achieve Time Goal Of Project
20) Availability Of Modern Equipment & Methods
21) Sub contract problems

D. Structured Questionnaire

The structured questionnaire were prepared by considering all the above 30 factors, which also includes few more blank points for any other factors which would be suggested by the technical persons if needed based on their experience. The questionnaires were prepared based on every factor having a scale of 0 to 10 (0 meaning the lowest & 10 meaning the highest). The purpose of scaling the factor is to understand the intensity of impact that the factor would produce on the constraints of the project according to the respective person. Below is the prepared structured questionnaire.

III. QUESTIONNAIRE SURVEY MODEL

A. Project Title

Questionnaire Survey: For Identifying Most constraints in offshore construction in remote location like islands, deserts and mountains etc.,

Date :/ / 2018

(To be filled by concerned Authority)

Following are the most constrain in offshore construction in remote loctains. Give the Rating in between 0 to10 as per your opinion.

1) Remote condition: 0 1 2 3 4 5 6 7 8 9 10
2) Land acquisition : 0 1 2 3 4 5 6 7 8 9 10
3) . Project necessity : 1 2 3 4 5 6 7 8 9 10
4) Soil & rock suitability / drillability : 1 2 3 4 5 6 7 8 9 10
5) Change in material specifications: 1 2 3 4 5 6 7 8 9 10
6) Material related problem (transportation, cost, handling etc.) : 1 2 3 4 5 6 7 8 9 10
7) Project size / phases : 1 2 3 4 5 6 7 8 9 10
8)

0 1 2 3 4 5 6 7 8 9 10

Name of industry / Organization : ----------
Name of signatory : ----------
Designation : ----------
Date :
Place :
Seal : Signature :

IV. ANALYSIS

A. The Analysis was carried out in two stages i.e.

1) Lower scale analysis
2) Higher scale analysis

$$X = TOTAL/N$$

3) After mean, standard deviation (σ) was calculated from the following formula given below

$$\sigma = \sqrt{\left(\frac{X^2}{N} - \left(\frac{X}{N}\right)^2\right)}$$

4) At last the coefficient of variance (C.V.) of individual factors was calculated by following formula.

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$C.=\sigma X$

5) The C.V. for a single variable aims to describe the dispersion of the variable in a way that does not depend on the variable's measurement unit. The higher the CV, the greater the dispersion in the variable. The CV for a model aims to describe the model fit in terms of the relative sizes of the squared residuals and outcome values. The lower the C.V., the smaller the residuals relative to the predicted value. This is suggestive of a good model fit.

Based on the mean value obtained by the individual factors the factor getting the higher value was selected as the most cost influencing factor and these factors were arranged in ascending order.

Lower scale analysis

Factors	Scaling coefficient					Total	Mean x	SD	c.v
	0	1	2	3	4				
1) Remote Condition based on the distance from main locations	0	3	4	5	9	62	2.07	0.37	0.18
2) Land Acquisition process	0	2	4	5	2	65	2.17	0.39	0.18
3) Project necessity (Real needful of the project)	4	4	5	8	3	74	2.47	0.44	0.18
4) Soil & Rock Suitability	0	3	2	5	8	86	2.87	0.51	0.18
5) Change in material specifications in between the project	1	3	2	5	4	70	2.33	0.42	0.18
6) Material Related Problem (Transportation, Cost,	0	3	2	4	5	53	1.77	0.32	0.18
7) Project Size (Volume of the project in work and time related)	1	3	2	5	4	53	1.77	0.32	0.18
8) Payment Related Problem From investor Side	0	1	12	5	4	68	2.27	0.41	0.18
9) Poor Communication Between Construction Parties	3	3	2	11	6	106	3.53	0.63	0.18
10) Lack Of Equipment (Efficiency Of Operator, Suitability Of Particular Equipment To Site Condition)	0	1	7	5	5	102	3.40	0.61	0.18
11) Climatic Condition (Like wind, waves, tides, current etc.,)	1	0	5	3	7	85	2.83	0.51	0.18
12) Regulations (safety/ labour law)	1	2	4	6	13	129	4.30	0.77	0.18
13) Structural design related issues (Like foundation/ superstructure)	4	3	4	6	5	123	4.10	0.74	0.18
14) Financial Status Of Contractor (Cash flow details and profit &Loss details)	2	3	4	5	11	110	3.67	0.66	0.18
15) Lack Of Experience & Knowledge Of Construction	1	0	2	4	10	138	4.60	0.83	0.18
16) Local Issues	1	3	2	3	2	36	1.20	0.22	0.18
17) Labour Availability	2	3	4	2	4	31	1.03	0.19	0.18
18) Involvement Of More No. Of Parties (Consortium of many contractors) In Single Project	1	4	3	4	5	52	1.73	0.31	0.18
19) Lack Of Efficiency Of Contractor To Achieve Time Goal Of Project	0	2	3	5	8	77	2.57	0.46	0.18

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20) Availability Of Modern Equipment & Methods	0	2	4	4	5	76	2.53	0.45	0.18
21) Sub contract problems	1	2	2	1	7	51	1.70	0.31	0.18
22) Technicality Involved (Method of Construction)	0	1	5	4	8	72	2.40	0.43	0.18
23) Time (Delay In Project Completion Affect Overall Procurement Cost, Labour Cost, Equipment Cost Etc.)	0	2	0	2	9	82	2.73	0.49	0.18
24) Natural disasters	1	2	0	6	4	52	1.73	0.31	0.18
25) Tenders	2	1	4	3	5	40	1.33	0.24	0.18
26) Exchange rate fluctuation	1	3	3	4	5	52	1.73	0.31	0.18
27) Poor Site Management	0	2	3	5	7	70	2.33	0.42	0.18
28) Conflict Among Project Participants	2	3	2	12	8	128	4.27	0.77	0.18
29) Re Work Due To Poor Material Quality Used Before	2	1	4	5	11	159	5.30	0.95	0.18
30) Government related approvals	2	1	1	2	1	26	0.87	0.16	0.18

Higher Scale Analysis

Factors								Mean x	SD	CV
	Scaling coefficient						TOTAL			
	5	6	7	8	9	10				
1) Remote Condition based on the distance from main locations	4	8	5	4	3	5	212	7.07	1.27	0.179505
2) Land Acquisition process	9	6	8	5	7	2	175	5.83	1.05	0.179505
3) Project necessity (Real needful of the project)	6	3	3	5	5	4	164	5.47	0.98	0.179505
4) Soil & Rock Suitability	7	4	7	6	5	3	142	4.73	0.85	0.179505
5) Change in material specifications in between the project	5	11	4	4	6	5	176	5.87	1.05	0.179505
6) Material Related Problem (Transportation, Cost,	12	7	4	8	3	2	213	7.10	1.27	0.179505
7) Project Size (Volume of the project in work and time related)	9	10	6	5	3	2	255	8.50	1.53	0.179505
8) Payment Related Problem From investor Side	7	5	6	7	1	2	191	6.37	1.14	0.179505
9) Poor Communication Between Construction Parties	5	6	4	3	5	2	119	3.97	0.71	0.179505
10) Lack Of Equipment (Efficiency Of Operator, Suitability Of Particular Equipment To Site Condition)	4	15	4	5	2	2	155	5.17	0.93	0.179505
11) Climatic Condition (Like wind, waves, tides, current etc.,)	2	11	10	5	3	3	250	8.33	1.50	0.179505

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12) Regulations (safety/ labour law)	8	1	7	3	0	5	127	4.23	0.76	0.179505
13) Structural design related issues (Like foundation/ superstructure)	4	4	8	6	3	3	125	4.17	0.75	0.179505
14) Financial Status Of Contractor (Cash flow details and profit &Loss details)	7	1	13	2	1	1	154	5.13	0.92	0.179505
15) Lack Of Experience & Knowledge Of Construction	7	5	6	12	1	2	159	5.30	0.95	0.179505
16) Local Issues	9	6	11	5	3	5	232	7.73	1.39	0.179505
17) Labour Availability	7	5	6	7	6	4	232	7.73	1.39	0.179505
18) Involvement Of More No. Of Parties (Consortium of many contractors) In Single Project	6	5	16	4	1	1	201	6.70	1.20	0.179505
19) Lack Of Efficiency Of Contractor To Achieve Time Goal Of Project	12	5	6	4	3	2	214	7.13	1.28	0.179505
20) Availability Of Modern Equipment & Methods	2	13	4	11	2	3	169	5.63	1.01	0.179505
21) Sub contract problems	7	4	5	9	3	9	218	7.27	1.30	0.179505
22) Technicality Involved (Method of Construction)	9	8	3	3	7	2	176	5.87	1.05	0.179505
23) Time (Delay In Project Completion Affect Overall Procurement Cost, Labour Cost, Equipment Cost Etc.)	6	6	10	2	12	1	224	7.47	1.34	0.179505
24) Natural disasters	2	3	17	4	9	2	318	10.60	1.90	0.179505
25) Tenders	5	6	4	13	3	4	183	6.10	1.09	0.179505
26) Exchange rate fluctuation	10	8	8	2	1	5	179	5.97	1.07	0.179505
27) Poor Site Management	18	2	7	1	3	2	267	8.90	1.60	0.179505
28) Conflict Among Project Participants	5	8	3	2	1	4	140	4.67	0.84	0.179505
29) Re Work Due To Poor Material Quality Used Before	4	6	7	3	5	2	108	3.60	0.65	0.179505
30) Government related approvals	8	12	6	13	2	2	199	6.63	1.19	0.179505

Result Of Lower Scale Analysis

Factors	Scaling coefficient					Total	Mean x	SD	c.v
	0	1	2	3	4				
30) Government related approvals	2	1	1	2	1	26	0.87	0.16	0.18
17) Labour Availability	2	3	4	2	4	31	1.03	0.19	0.18
16) Local Issues	1	3	2	3	2	36	1.20	0.22	0.18
25) Tenders	2	1	4	3	5	40	1.33	0.24	0.18
21) Sub contract problems	1	2	2	1	7	51	1.70	0.31	0.18
18) Involvement Of More No. Of Parties (Consortium of many contractors) In	1	4	3	4	5	52	1.73	0.31	0.18

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Single Project									
24) Natural disasters	1	2	0	6	4	52	1.73	0.31	0.18
26) Exchange rate fluctuation	1	3	3	4	5	52	1.73	0.31	0.18
6) Material Related Problem (Transportation, Cost,	0	3	2	4	5	53	1.77	0.32	0.18
7) Project Size (Volume of the project in work and time related)	1	3	2	5	4	53	1.77	0.32	0.18
1) Remote Condition based on the distance from main locations	0	3	4	5	9	62	2.07	0.37	0.18
2) Land Acquisition process	0	2	4	5	2	65	2.17	0.39	0.18
8) Payment Related Problem From investor Side	0	1	12	5	4	68	2.27	0.41	0.18
5) Change in material specifications in between the project	1	3	2	5	4	70	2.33	0.42	0.18
27) Poor Site Management	0	2	3	5	7	70	2.33	0.42	0.18
22) Technicality Involved (Method of Construction)	0	1	5	4	8	72	2.40	0.43	0.18
3) Project necessity (Real needful of the project)	4	4	5	8	3	74	2.47	0.44	0.18
20) Availability Of Modern Equipment & Methods	0	2	4	4	5	76	2.53	0.45	0.18
19) Lack Of Efficiency Of Contractor To Achieve Time Goal Of Project	0	2	3	5	8	77	2.57	0.46	0.18
23) Time (Delay In Project Completion Affect Overall Procurement Cost, Labour Cost, Equipment Cost Etc.)	0	2	0	2	9	82	2.73	0.49	0.18
11) Climatic Condition (Like wind, waves, tides, current etc.,)	1	0	5	3	7	85	2.83	0.51	0.18
4) Soil & Rock Suitability	0	3	2	5	8	86	2.87	0.51	0.18
10) Lack Of Equipment (Efficiency Of Operator, Suitability Of Particular Equipment To Site Condition)	0	1	7	5	5	102	3.40	0.61	0.18
9) Poor Communication Between Construction Parties	3	3	2	11	6	106	3.53	0.63	0.18
14) Financial Status Of Contractor (Cash flow details and profit &Loss details)	2	3	4	5	11	110	3.67	0.66	0.18
13) Structural design related issues (Like foundation/ superstructure)	4	3	4	6	5	123	4.10	0.74	0.18
28) Conflict Among Project Participants	2	3	2	12	8	128	4.27	0.77	0.18
12) Regulations (safety/ labour law)	1	2	4	6	13	129	4.30	0.77	0.18
15) Lack Of Experience & Knowledge Of Construction	1	0	2	4	10	138	4.60	0.83	0.18
29) Re Work Due To Poor Material Quality Used Before	2	1	4	5	11	159	5.30	0.95	0.18
						0			

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Results of higher scale analysis

FACTORS	SC						TOTAL	MEAN X	S.D (SIG)	C.V
	5	6	7	8	9	10				
29) Re Work Due To Poor Material Quality Used Before	4	6	7	3	5	2	108	3.60	0.65	0.18
9) Poor Communication Between Construction Parties	5	6	4	3	5	2	119	3.97	0.71	0.18
12) Regulations (safety/ labour law)	8	1	7	3	0	5	127	4.23	0.76	0.18
28) Conflict Among Project Participants	5	8	3	2	1	4	140	4.67	0.84	0.18
4) Soil & Rock Suitability	7	4	7	6	5	3	142	4.73	0.85	0.18
14) Financial Status Of Contractor (Cash flow details and profit &Loss details)	7	1	13	2	1	1	154	5.13	0.92	0.18
10) Lack Of Equipment (Efficiency Of Operator, Suitability Of Particular Equipment To Site Condition)	4	15	4	5	2	2	155	5.17	0.93	0.18
15) Lack Of Experience & Knowledge Of Construction	7	5	6	12	1	2	159	5.30	0.95	0.18
3) Project necessity (Real needful of the project)	6	3	3	5	5	4	164	5.47	0.98	0.18
20) Availability Of Modern Equipment & Methods	2	13	4	11	2	3	169	5.63	1.01	0.18
2) Land Acquisition process	9	6	8	5	7	2	175	5.83	1.05	0.18
5) Change in material specifications in between the project	5	11	4	4	6	5	176	5.87	1.05	0.18
22) Technicality Involved (Method of Construction)	9	8	3	3	7	2	176	5.87	1.05	0.18
26) Exchange rate fluctuation	10	8	8	2	1	5	179	5.97	1.07	0.18
25) Tenders	5	6	4	13	3	4	183	6.10	1.09	0.18
8) Payment Related Problem From investor Side	7	5	6	7	1	2	191	6.37	1.14	0.18
30) Government related approvals	8	12	6	13	2	2	199	6.63	1.19	0.18
18) Involvement Of More No. Of Parties (Consortium of many contractors) In Single Project	6	5	16	4	1	1	201	6.70	1.20	0.18
1) Remote Condition based on the distance from main locations	4	8	5	4	3	5	212	7.07	1.27	0.18
6) Material Related Problem (Transportation, Cost,	12	7	4	8	3	2	213	7.10	1.27	0.18
19) Lack Of Efficiency Of Contractor To Achieve Time Goal Of Project	12	5	6	4	3	2	214	7.13	1.28	0.18
21) Sub contract problems	7	4	5	9	3	9	218	7.27	1.30	0.18
23) Time (Delay In Project Completion Affect Overall Procurement Cost, Labour Cost, Equipment Cost Etc.)	6	6	10	2	12	1	224	7.47	1.34	0.18
16) Local Issues	9	6	11	5	3	5	232	7.73	1.39	0.18
17) Labour Availability	7	5	6	7	6	4	232	7.73	1.39	0.18
11) Climatic Condition (Like wind, waves, tides, current etc.,)	2	11	10	5	3	3	250	8.33	1.50	0.18
7) Project Size (Volume of the project in work and time related)	9	10	6	5	3	2	255	8.50	1.53	0.18
27) Poor Site Management	18	2	7	1	3	2	267	8.90	1.60	0.18
24) Natural disasters	2	3	17	4	9	2	318	10.60	1.90	0.18

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V. CONCLUSION

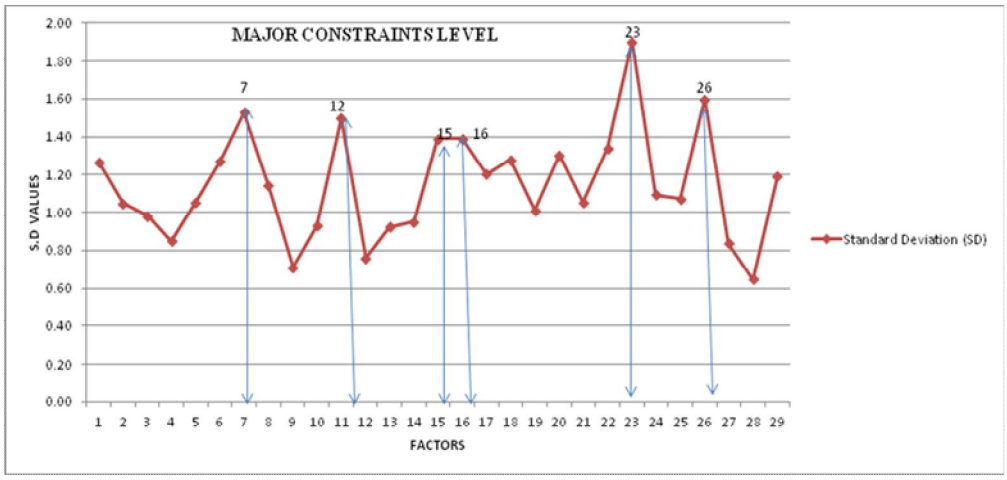

Fig: 1.Standared deviation value with factors

The results obtained from the two different scales were analyzed and was concluded that, the lower scale result does not much effect the project in overall view but the higher scale result gave a maximum impact on the offshore project in remote location. The above chart with reference to serial numbers 7, 12, 15, 16, 23, and 26 on the questionnaire are more effective constraints in remote location projects which as to be given more importance. The above analysis aims on identifying constraints associated with the achievement of all project objectives in terms of cost, time, quality, environment and safety on the basis of a questionnaire survey and can be sent to potential stake holder and experts for their perseverance.

Table-1

S.NO	Factors
7	Project Size (Volume of the project in work and time related)
12	Regulations (safety/ labor law)
15	Lack Of Experience & Knowledge Of Construction
16	Local Issues
23	Time (Delay In Project Completion Affect Overall Procurement Cost, Labor Cost, Equipment Cost Etc.)
26	Exchange rate fluctuation

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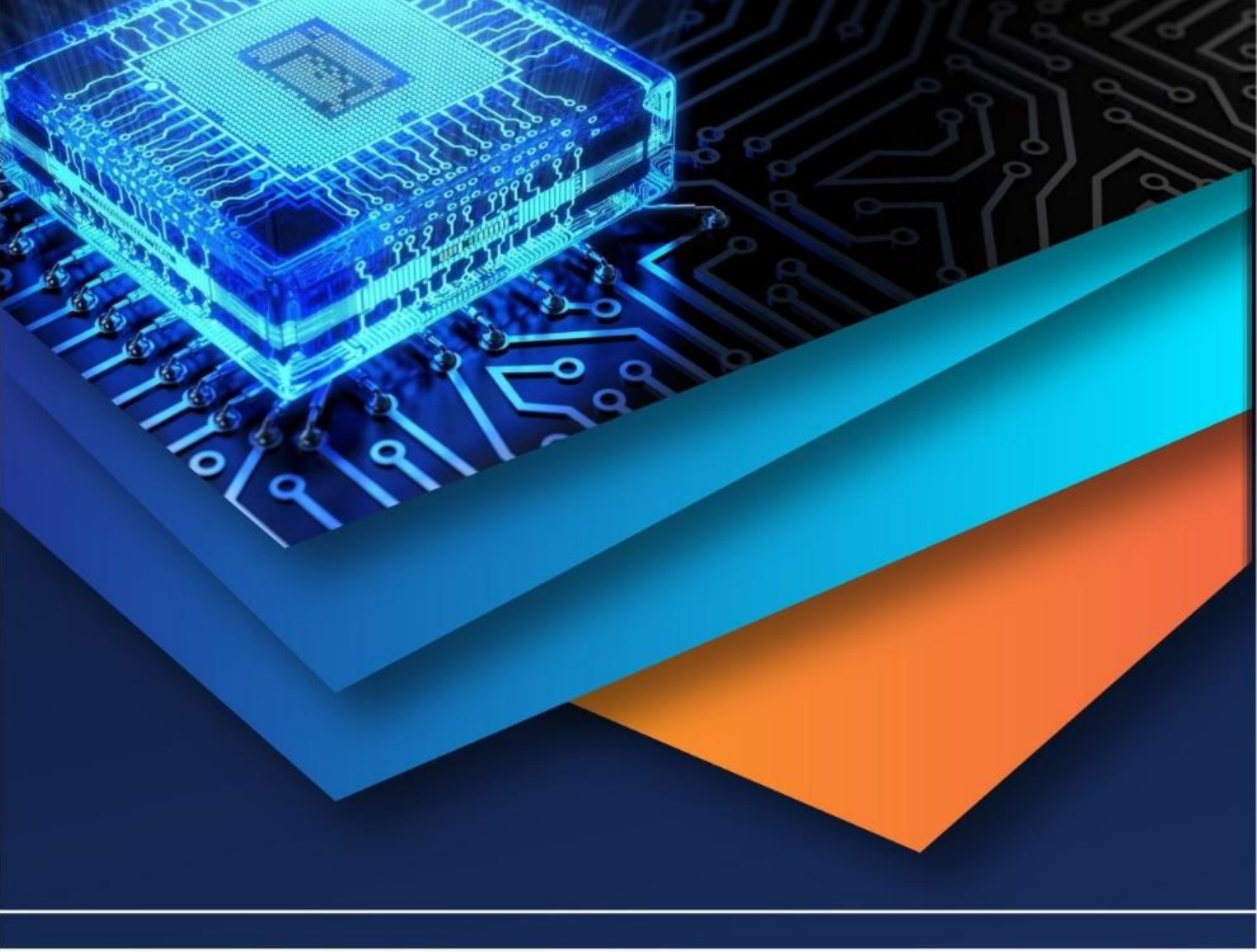

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