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Critical Success Factors in Construction Safety with Actual Safety Performance

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Abstract : This paper study about Crical Success Factors in Construction safety .As India is one of the developing countries in the world. As per the development concerns India achieves the highest position to having the self fulfill their demand and want to become a developed nation. Development starts with good infrastructure development. This can be achieved by the construction industry. For the construction of high rise buildings there is the continuous risk of accidents because of working at height without safety precautions. It proves the construction industry is one of the most hazardous industries. So that can be reduced by using the Relationship Between the critical success factors and actual safety performance. Critical success factors:1)Good communication 2) Resource allocation 3) incentives 4) Teamwork 5) personal motivation and awareness 6) supervision 7) site safety 8) Training frequency 9) skill labor 10) personal Protective Equipments 11) Unsafe acts and accidents 12) Management support 13) project size 14) Level of risks 15) Regular equipments maintenance 16) work Experience 17) Training language 18) owners Involvement 19) number of employees 20) climate and environment. Among these 20 factors, which factors are most critical while achieving the construction safety of various sites in Nashik, Maharashtra, India by using AHP.

IndexTerms – **Critical Success Factors, Analytical Hierarchy Process.**

I. INTRODUCTION

Critical success factors (CSFs) are areas in which results, if they are satisfactory, will ensure success within and of the organization. In the context of safety, CSFs include events, resources, and actions that are required to implement a safety program effectively. Construction site safety is an aspect of construction-related activities concerned with protecting construction site workers and others from death, injury, disease or other health-related risks. Construction is an often hazardous, predominantly land-based activity where site workers may be exposed to various risks, some of which remain unrecognized. Site risks can include working at height, moving machinery (vehicles, cranes, etc.) and materials, power tools and electrical equipment, hazardous substances, plus the effects of excessive noise, dust and vibration.

1.1. PROBLEM STATEMENT:

Investigating the Relationship between Critical Success Factors and Actual Safety Performance, This study aims to analyze and establish the correlation between identified critical success factors and the tangible safety performance within a specific context. By examining factors such as training, equipment maintenance, and employee engagement, the project seeks to provide insights into optimizing safety measures for enhanced organizational well-being.

1.2. OBJECTIVES:

Objectives is to find out the most critical success factors for construction safety purpose onsite by doing questionnaire survey of various sites in Nashik and to achieve the most affecting success factor for construction site.

1.3. SCOPE OF THE PROJECT WORK:

The scope of your project involves investigating the correlation between critical success factors and real safety performance. This would likely include identifying key success factors, gathering relevant data, and analyzing how these factors impact safety outcomes. Consider factors like training, equipment maintenance, and employee engagement. Your project may provide valuable insights for enhancing safety measures within the construction safety.

2. RESEARCH METHODOLOGY

The General Methodology of this Work is First of all finding the topic by considering interest of study. After that the topic gets selected as a critical success factors in construction safety with the actual safety performance.

After that next step of the study is to make a literature survey on the given topic, then the find out the gap between the Researches and read out the various research papers on the construction safety field. So, from the 20 factors will be identified by the experience stakeholders by taking Questionnaire survey. Make a literature review on the same topic. Make a list of various factors which are more affecting by meeting and interviewing a expertise in the field of construction safety like a safety engineer and site engineer. Now, identified 20 factors will be analyzed by using Various Research Paper. By visiting to 30 sites collecting a sample data for the project work. Remaining work of collection and analyzing data should be done.

The 20 Factors considered for study as Follows: 1)Good communication 2) Resource allocation 3) incentives 4) Teamwork 5) personal motivation and awareness 6) supervision 7) site safety 8) Training frequency 9) skill labor 10) personal Protective Equipments 11) Unsafe acts and accidents 12) Management support 13) project size 14) Level of risks 15) Regular equipments maintenance 16) work Experience 17) Training language 18) owners Involvement 19) number of employees 20) climate and environment.

2.1. METHODOLOGY FLOW CHART

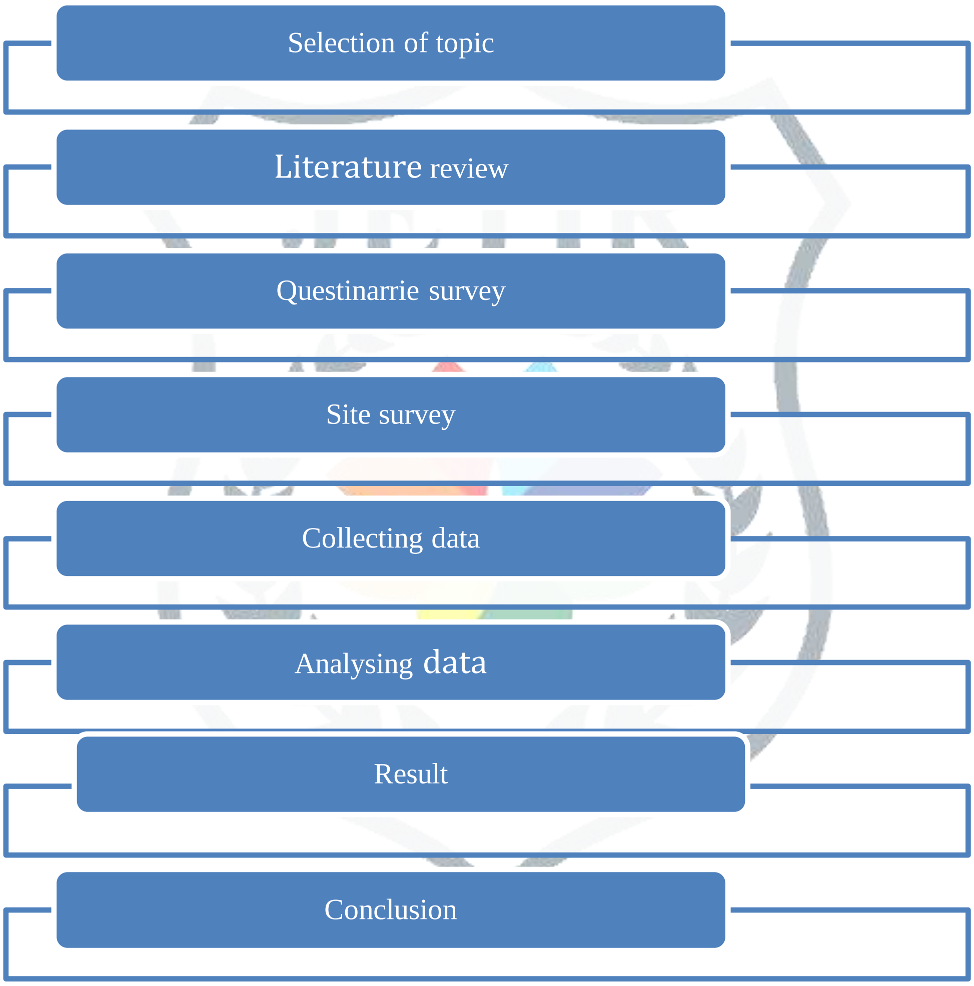

Figure .2.1 Methodology flow chart

3. DATA COLLECTION

Data collection done as per the Questionnaire Survey conducted by various construction sites in the Nashik. By considering and studying Journal and published paper from institution on the Critical Success Factors.

3.1. Factors find out from Literature:

Table 3.1. . Factors find out from Literature

Sr. No.	Factors	Sr. No.	Factors
1	Site safety officer	16	Positive Group Norms
2	Training frequency	17	Appropriate Supervision
3	Skill labor	18	Safety Training
4	Personal protective equipment	19	Personal Competency
5	Unsafe acts and accident	20	Pre task Safety Meeting
6	Management support	21	Safety Resource
7	Labor Age	22	Staffing for safety written plan
8	Improper Planning	23	PPE
9	Resource allocation	24	Clear and realistic goals
10	Incentives	25	Regular Equipment maintenance
11	Teamwork	26	Work Experience
12	Personal motivation and awareness	27	Training language
13	Teamwork	28	Owners Involvement
14	Continuing Participation of Employees	29	No. of Employees
15	Program evaluation	30	Sufficient resource allocation

3.2 Factors Considered for analysis

Table 3.2. . Factors Considered for analysis

Sr. No.	Factors	Sr. No.	Factors
1.	Good communication	11.	Unsafe acts and accident
2.	Resource allocation	12.	Management support
3.	Incentives	13.	Project size
4.	Teamwork	14.	Level of Risk
5.	Personal motivation and awareness	15.	Regular Equipment maintenance
6.	Supervision	16.	Work Experience
7.	Site safety officer	17.	Training language
8.	Training frequency	18.	Owners Involvement
9.	Skill labor	19.	No. of Employees
10.	Personal protective equipment	20.	Climate and environment

3.3 CALCULATION STEPS: Step 1: First Step For the calculation is to Take Mean of the individual Factors which are Computed From the Questionnaire Survey. Put down the Responses Given from site Engineers. The Responses note as per the number 1,2,3 From Scale. $x_{ij}=\frac{1}{k}\left[x_{ij}^{\sim 1}+x_{ij}^{\sim 2}+\cdots\ldots x_{ij}^{\sim k}+\right]\ i=1,2,\ldots,m\ and\ j=1,2,\ldots,n$

Step 2: Take Cumulative % to that individual Factor and give the rating as per %.

Table 3.3. . Data collection(A)

Sr. No.	Critical Success factor	Responses															Mean	Avg	Cmt
1	communication with workers	3	3	3	3	2	2	3	2	3	3	2	3	3	2	3	2.67	0.052	9.76
2	Resource Allocation	3	3	3	3	1	2	2	2	3	3	2	3	2	1	2	2.33	0.046	14.32
3	Incentives	2	1	3	3	3	2	2	3	2	2	2	1	3	2	1	2.13	0.042	18.48
4	Teamwork	3	3	3	3	3	3	2	2	3	3	3	2	2	0	3	2.53	0.049	23.43
5	Personal motivation & awareness	3	3	3	3	3	2	3	3	3	2	2	1	2	2	3	2.53	0.049	28.38
6	Supervision	3	3	2	3	3	2	3	3	3	3	2	3	3	3	3	2.80	0.055	33.84
7	Site safety	3	3	2	3	3	2	3	2	3	3	3	1	2	2	2	2.47	0.048	38.66
8	Training frequency	1	1	3	1	1	1	3	1	2	1	2	1	2	3	3	1.73	0.034	42.04
9	Skill labour	3	3	2	2	3	2	2	2	2	2	2	3	3	2	3	2.40	0.047	46.73
10	Personal Protective Equipments	3	3	2	3	3	3	3	3	3	3	3	2	2	2	3	2.73	0.053	52.07
11	Unsafe acts and Accidents	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	2.93	0.057	57.79
12	Management support	2	3	2	2	2	2	2	2	2	3	3	3	3	3	2	2.40	0.047	62.48
13	Project size	3	3	3	3	3	1	3	3	2	3	3	2	3	3	3	2.73	0.053	67.82
14	Level of Risk	3	2	3	1	3	3	3	3	3	3	2	3	3	2	3	2.67	0.052	73.02
15	Regular Equipment maintenance	2	2	0	2	3	3	2	2	3	1	2	3	2	2	2	2.07	0.040	77.06
16	Work Experience	3	3	2	3	3	3	2	3	2	3	2	2	3	2	3	2.60	0.051	82.13
17	Training Language understood (%)	3	3	3	3	3	2	3	3	3	2	2	2	3	2	3	2.67	0.052	87.34
18	Owners involvement	2	3	2	3	2	3	2	3	1	3	3	3	3	3	2	2.53	0.049	92.29
19	No. of employees	1	1	2	2	2	1	2	1	1	2	3	2	2	3	2	1.80	0.035	95.80
20	Climate and Environment	3	3	2	2	3	1	1	2	2	2	2	2	2	2	3	2.13	0.042	100.00

Table 3.4. . Data collection(B)

Sr. No	Critical Success factor	Responses																	Mean	Avg	Cmt
1	communication with workers	3	3	3	2	2	2	3	2	3	3	2	3	3	2	2	3	3	2.59	0.052	9.95
2	Resource Allocation	3	3	3	3	1	2	2	2	3	3	2	3	2	1	2	2	3	2.35	0.047	14.69
3	Incentives	2	1	3	3	3	2	2	3	2	2	2	1	3	2	1	2	2	2.12	0.043	18.96
4	Teamwork	3	3	3	3	3	3	2	2	3	3	3	2	2	0	3	2	3	2.53	0.051	24.05
5	Personal motivation & awareness	3	3	3	3	3	2	3	3	3	2	2	1	2	2	3	2	3	2.53	0.051	29.15
6	Supervision	3	3	2	3	3	2	3	3	3	3	2	2	3	3	3	2	2	2.65	0.053	34.48
7	Site safety	3	3	2	3	3	2	3	2	3	3	3	1	2	2	2	2	3	2.47	0.050	39.46
8	Training frequency	1	1	3	1	1	1	3	1	2	1	2	1	2	3	3	3	3	1.88	0.038	43.25
9	Skill labour	3	3	2	2	3	2	2	2	2	2	2	3	3	2	3	2	2	2.35	0.047	47.99
10	Personal Protective Equipments	3	3	2	3	3	3	3	3	3	3	3	2	2	2	3	3	2	2.71	0.055	53.44
11	Unsafe acts and Accidents	3	3	3	3	2	2	3	3	2	3	2	3	3	3	3	1	2	2.59	0.052	58.65
12	Management support	2	3	2	2	2	2	2	2	2	3	3	3	3	3	2	2	2	2.35	0.047	63.39
13	Project size	3	3	3	3	3	1	3	3	2	3	3	2	3	3	3	3	3	2.76	0.056	68.96
14	Level of Risk	3	2	3	0	3	3	3	3	3	1	2	3	2	2	0	3	3	2.29	0.046	73.58
15	Regular Equipment maintenance	2	2	0	2	3	3	2	2	3	1	2	3	2	2	2	2	1	2.00	0.040	77.61
16	Work Experience	3	3	2	3	3	3	2	3	2	3	2	2	3	2	3	2	2	2.53	0.051	82.71
17	Training Language understood (%)	3	3	3	3	3	2	2	3	3	2	2	2	3	2	3	3	3	2.65	0.053	88.04
18	Owners involvement	2	3	2	3	1	3	2	3	1	3	3	3	2	3	2	2	2	2.35	0.047	92.78
19	No. of employees	1	1	2	2	2	1	2	1	1	2	3	2	2	1	2	2	2	1.71	0.034	96.21
20	Climate and Environment	3	3	2	1	1	1	1	2	2	2	2	2	2	2	3	1	2	1.88	0.038	100.01
																			49.6		

Table 3.5. . Data Analysis

Sr. No.	Critical Success factor	Cumulative %		Cumulative %		Avg. Total
1	Communication with workers	0.098	9.76	0.100	9.95	9.855
2	Resource Allocation	0.143	14.32	0.147	14.69	14.505
3	Incentives	0.185	18.48	0.190	18.96	18.72
4	Teamwork	0.234	23.43	0.241	24.05	23.74
5	Personal motivation & awareness	0.284	28.38	0.291	29.15	28.765
6	Supervision	0.338	33.84	0.345	34.48	34.16
7	Site safety	0.387	38.66	0.395	39.46	39.06
8	Training frequency	0.420	42.04	0.432	43.25	42.645
9	Skill labour	0.467	46.73	0.480	47.99	47.36
10	Personal Protective Equipments	0.521	52.07	0.534	53.44	52.755
11	Unsafe acts and Accidents	0.578	57.79	0.587	58.65	58.22
12	Management support	0.625	62.48	0.634	63.39	62.935
13	Project size	0.678	67.82	0.690	68.96	68.39
14	Level of Risk	0.730	73.02	0.736	73.58	73.3
15	Regular Equipment maintenance	0.771	77.06	0.776	77.61	77.335
16	Work Experience	0.821	82.13	0.827	82.71	82.42
17	Training Language understood (%)	0.873	87.34	0.880	88.04	87.69
18	Owners involvement	0.923	92.29	0.928	92.78	92.535
19	No. of employees	0.958	95.80	0.962	96.21	96.005
20	Climate and Environment	1.000	100.00	1.000	100.0	100.00

4. RESULTS AND DISCUSSION

The collected data from the questionnaire survey is analyzed using AHP method. the Mean are calculated for each factor and the ranking is given accordingly. While Considering the all ranking the Supervision on site is most Critical Success Factor, If the supervision is good at the site, then the chances of doing the work properly and with safety precautions are more as compared to work without supervision, And second one Personal Protective Equipments Third is Communication with Workers, Fourth is work Experience that is experience of that particular labor who working on the job, If the labor who works on that job is skilled in it, the chances of accidents will be reduced. Fifth one is Teamwork.

Table 4. . Ranking of Factors

Sr. No.	Critical Success factor	Mean	Rank
1	Supervision	2.725	1
2	Personal Protective Equipments	2.72	2
3	Communication with workers	2.63	3
4	Work Experience	2.565	4
5	Teamwork	2.53	5
6	Personal motivation & awareness	2.53	6
7	Level of Risk	2.48	7
8	Site safety	2.47	8
9	Project size	2.45	9
10	Owners involvement	2.44	10
11	Skill labor	2.375	11
12	Management support	2.375	12
13	Training Language understood (%)	2.36	13
14	Resource Allocation	2.34	14
15	Unsafe acts and Accidents	2.276	15
16	Incentives	2.125	16
17	Regular Equipment maintenance	2.035	17
18	Climate and Environment	2.005	18
19	Training frequency	1.805	19
20	No. of employees	1.755	20

5. CONCLUSION

Following Recommendation to the factors in construction project to increase the safety on construction project. There are first five factors which are considered as most critical success factors for the construction site are as follows:

1. Supervision

How this factor affected:

lack of proper supervision, chances are that the constructors may come across a sign of awaiting disaster without knowing it. No matter the size of your construction site, the possibilities for risks and injuries can be incredibly high.

Recommendation & suggestion:

Effective supervision includes being able to identify hazards and risks in the work area and taking appropriate action. Do the work so it is completed according to the plan.

2. Personal Protective Equipments

How this factor affected:

Personal Protective Equipments is the second most important and critical factor in which the workers as well as every person who comes in the contact of construction site. This is safety apparatus which helps workers less hazardous condition if any mistake or something wrong happens to the human life.

Recommendation & suggestion

Every man come on site should wear safety equipments like safety helmet, safety shoes, workers working at height must wear harness, site compulsory possess safety net. It will give the safe environment for the workers.

3. Communication with Workers

How this factor affected

As the higher authority like Site Engineers and Contractors must have Great communication bond with workers for the achievement of safety. Workers should understand the Importance of safety by considering the project importance.

Recommendation & suggestion

To avoid delays in completion of work within time it required to have great communication with Workers from Engineers. for implementing change order and to make corrections in safety training Language as per their Understanding.

4. Work Experience

How this factor affected:

As to have experienced workers on the specific job will eventually increased their work performance. And because, of this the productivity of work also increases. And the chances of any wrong or accidental condition get reduced. Experience in working on relevant projects and using equipment is essential. Worker must have physical strength, endurance and work well with hands.

Recommendation & suggestion

It is important to have the experience workers is effective to the overall project because with the help of experience the workers may give the effective project on the basis of quality as well as within the time or on the time so the chances of delaying of project may get reduced.

5. Teamwork

How this factor affected

A major impact on the construction work has been marked as the teamwork between the workers. As the teamwork may causes the clashes within firm and it directly affects the mind illness and it directly causes less affective workplace.

Recommendation & suggestion

Team coordination may cause healthy work environment which gives the safe working condition. It is important to aware that how to lead people for construction project manager, in order to arrive at a successful construction project and it comes through the good teamwork within the firm.

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