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Evaluation of Critical Success Factors for Safety Program Implementation in High Rise Building Construction

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Abstract: This review paper focuses on the determination of the critical safety factors that governed the success of a safety management system for construction sites. Construction activity in India has made considerable development in the past two decades in the account with increase in development activities, government policies, and public demand. At the same time safety issues have become a major concern to construction organizations. Safety management on construction sites had always been a major issue in the construction industry of India. Particularly for Surat city where currently 547 construction project are ongoing and construction companies in Surat have tried to control the rising costs of accidents and reduce projects delays due to the accidents; however, they do not know why the safety programs do not work efficiently, or where to start. This situation suggested the need for the present study, which is aimed to identify the most critical factors affecting the implementation of safety programs in high rise building construction. Outcomes from this study will provide a set of critical factors that can be used to guide a successful construction safety program implementation as well as safety policy development in the construction industry in Surat. The factors affecting the success of activities and projects, often named critical success factors (CSFs) can be defined as "areas in which results, if they are satisfactory, will ensure success within and of the organization". The objective of the study is to determine the critical safety factors that governed the success of a safety management system for construction sites. The methodology adopted to achieve the objectives of this study is described in four main stages. The first stage involved a review of safety in the construction industry to identify the importance of safety in construction projects. Moreover, an extensive literature review is carried out to explore the factors that affect the successful implementation of a safety program. Second phase of research includes development of framework for ranking factors affecting the safety performance in construction work and design questionnaire to collect data. Third phase of research includes analysis of collecting data. In this phase data analysis will be done by Significant Index (SI) to rank the factor which affect the implementation of safety in construction. Fourth phase covers discussion on the ranking of the important factor that affects the implementation of safety among different parties and develop critical safety factor with the help of statistical computation. Fifth stage of research covers conclusion and recommendation part. The entire research work is done on the combined perception of different stake holders from Surat city and top 10 factors have been identified.

Keyword: Critical safety factors, Safety Programs, Construction Projects, and Success.

I. INTRODUCTION

Construction industry plays a fundamental role in increasing the economy of many countries. It provides the infrastructure required for other parts of the economy to grow, thus reflecting the level of economic development of the countries. However, it is also documented that the construction industry has the highest rate of accidents among all industries as well as the highest rate of disabling injuries and fatalities. Construction industry is considered as one of the most hazardous industrial sectors wherein the construction is more liable to worker accidents. Despite of recent development to improve safety on construction site, it still accounts for a disproportionate number of occupants-related fatalities. In developed countries, there are strict legal enforcement of safety in the construction industry and also in the implementation of safety management systems which are designed to minimize or eliminate accidents at work places. However, occupational safety in the construction industry is very poor in developing countries because lack of safety regulations and standards, low priority of safety, lack of data on safety at construction sites, lack of safety training, and lack of document. Construction industry is both economically and socially important. The safety record in the construction industry continues to be one of the poorest. Research shows that major causes of accidents are related to unique nature

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of the industry, human behavior, difficult work site conditions, and poor safety management, which result in unsafe work methods, equipment and procedures. The emphasis in both developing and developed countries needs to be placed on training and the utilization of comprehensive safety programs.

II. LITERATURE REVIEW

S. Al Haadir And K. Panuwatwanich identify the most critical factors that have an impact on the successful implementation of construction safety programs within the context of Saudi Arabia's construction industry.

Zubaidah Ismail, Samad Doostdar, Zakaria Harun determine the influential safety factors that governed the success of a safety management system for construction sites. Mohamed (1999) conducted an empirical investigation of construction safety management activities and performance in Australia. He investigated the effectiveness of safety management activities currently adopted by Australian contracting organizations. A safety management survey has been conducted in the contracting organizations operating in the State of Queensland, Australia. Based on a research model depicting statistical analysis techniques, a safety management index reflecting the intensity of level of safety management activities has been developed to provide a means whereby individual organizations can be assessed and graded on their safety management commitment and attitudes. The author reported a detailed empirical analysis carried out to examine the relationship between the intensity of safety management commitment and the overall safety performance, pro- activeness and record. Thanet Aksorn, B.H.W. Hadikusumo identified and ranked 16 CSFs of safety program implementation based on their degree of influence. It revealed that ''management support'' was the most influential factor for safety program implementation in the Thai construction industry. Sunku Venkata Siva Rajaprasad, Pasupulati Venkata Chalapathi concluded Management commitment has the maximum driving power and the most influential factor is safety policy, which states clearly the commitment of top management towards occupational safety and health.

III. RESEARCH METHODOLOGY

1) *Problem Identification:* It is well known that construction projects have many work-related accidents and injuries.In recent years, to overcome such safety problems, safety program implementation has been given significant consideration as one of the effective methods. In order to effectively gain from safety programs, factors that affect its implementation need to be studied. Hence, this study tries to identify such critical success factors (CSFs) of safety programs.
2) *Data Collection:* The data collection stage is one of the crucial stage of the research process which provides an input to the data analysis stage. For this research the data will be collected as two forms first is primary data collection and other is secondary data. Primary data includes information collected from sources such as personal interviews, questionnaires surveys which is concerned with a specific intention and on a specific subject and observation and discussion by the researcher him or herself and canbeself-assessedfurther.Itisadirectapproach.Secondarydataincludesinformation already available somewhere, whether it be in journals or on the internet, publications or records. Secondary data allows for comparison.
3) *Criteria for Identification:* On the basis of the critical literature review from Literature published in various national, international and other online and local journals; national, international and other conferences; various reports; master and Ph.D. dissertations; books; various standards published by various authorities; etc. the various factors affecting the safety program implementation in construction industry. Total 29 factors were found.
4) *Questionnaire Survey Approach:* The questionnaire designed on the bases of the literature review was distributed among various stakeholders like Contractors, Site Engineer, Architect, Consultant in the region of Surat City.
5) *Data Collection:* The survey work was carried out within the scope of the study and among the selected respondents of the sample. The questionnaires was distributed among respondents in Surat City and data was collected through these filled questionnaires.
6) *Questionnaire distribution and collection:* Total 200 questionnaires were distributed to different respondent s in Surat District. Total 124 respondents provided their response for this research work. A list of the stakeholders who showed their response has been presented. The responses were obtained after personal requests and visits to their respective offices. 124 responses collected i.e. 62% response rate which is considered very good for this kind of survey. Though the total number of questionnaires sent and ther esponses received were limited,the survey covered most of the known experts and consultants of the construction projects in Surat District. The reliability of the survey results is expected to be high because all the respondents are top-level experienced stakeholders. Table1 shows distribution of responses.

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Table -1: Data Distribution and Collection

Sr. No	Respondent	Questionnaires Distribution	Responses Returned	Percentage of Responses
1	Civil engineer	80	53	66.25 %
2	Contractor	50	33	66 %
3	Architect	40	22	55 %
4	Consultant	30	16	53.33 %
5	Total	200	124	62 %

The ranking method used for the research is Significant Index method through which a ranking of the factors which is most important for safety program implementation.

7) *Introduction of Significance index:* The Significance index (SI) was used to rank the relative significance of the CSFs. These rankings make it possible to cross-compare the relative importance of the factors as perceived by the four groups of respondents (i.e. Site Engineer, Contractors, Architect, and Consultant). The procedure used in analyzing the results was aimed at establishing the significance of the various factors responsible for safety implementation by giving rank to the factors by SI technique.

The formula to calculate SI is given below:

$$SI = \frac{R_{i0} \times 0 + R_{i1} \times 20 + R_{i2} \times 40 + R_{i3} \times 60 + R_{i4} \times 80 + R_{i5} \times 100}{R_{i0} + R_{i1} + R_{i2} + R_{i3} + R_{i4} + R_{i5}}$$

Where,

SI= Significance index for the ith factor,

R_{i0} = Number of responses as “0” for the ith factor,

R_{i1} = Number of responses as “1” for the ith factor,

R_{i2} = Number of responses as “2” for the ith factor,

R_{i3} = Number of responses as “3” for the ith factor,

R_{i4} = Number of responses as “4” for the ith factor,

R_{i5} = Number of responses as “5” for the ith factor.

Table 1.2 Rank And SI Value Of Factor By Significant Index Method

SR. NO	GROUP OF FACTOR	CODE	FACTOR	SI	RANK
1	WORKER PARTICIPATION	A1	Personal attitude	67.25806	12
2		A2	Personal motivation	60.32258	19
3		A3	Employee experience	72.41935	10
4		A4	Employees language/communication barriers	55.48387	25
5		A5	Employee age	61.77419	16
6	SAFETY PREVENTION&CONTROL SYSTEM	B1	Safety management system	78.3871	5
7		B2	Safety training	70.48387	11
8		B3	Equipment and Maintenance	65.96774	13
9		B4	Personal competency	73.87097	6
10		B5	Program evaluation	55	27
11	SAFETY ARRANGEMENT	C1	Communication	52.09677	28
12		C2	Allocation of Authority and Responsibility	59.03226	21
13		C3	Adequate resource allocation	49.83871	29
14		C4	Safety engineer on site	85.80645	2
15		C5	Management rules and Regulation	88.54839	1

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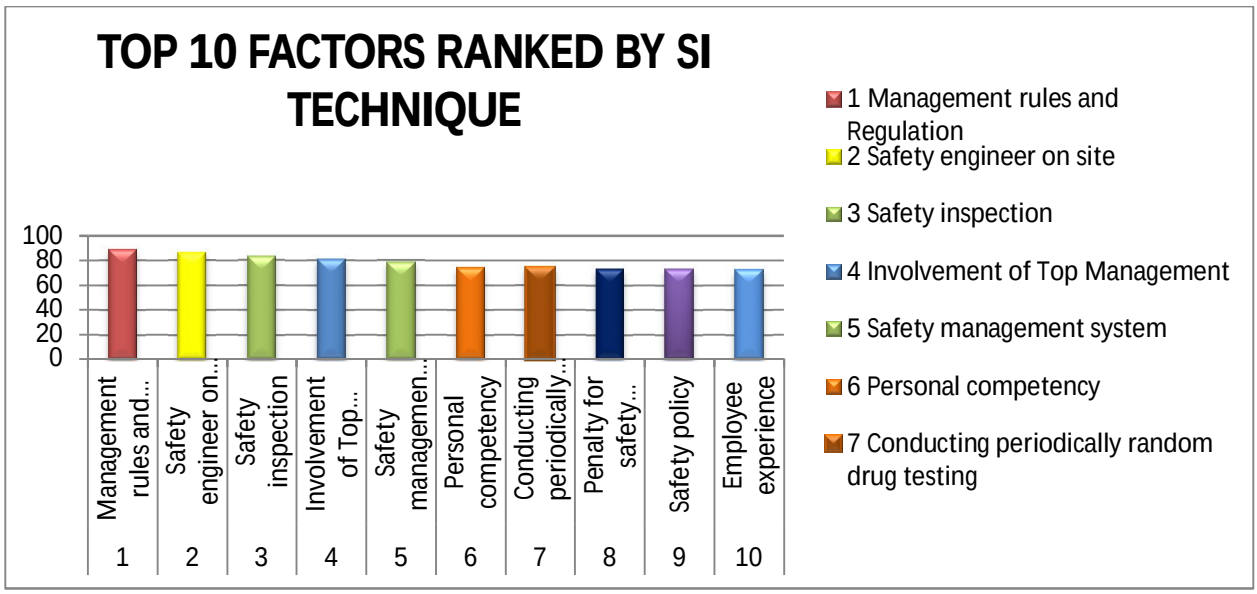
16		C6	Safety inspection	82.90323	3
17	ORGANIZATION AL STRUCTURE	D1	Safety policy	73.20581	9
18		D2	Involvement of Top Management	80.80645	4
19	RELATIONSHIP FACTOR	E1	Interfaces with the stakeholder	55.48387	25
20		E2	Internal personal relationships	57.41935	22
21		E3	Relation between labour & contractor	55.96774	23
22	PROJECT NATURE	F1	Cost of the project	59.67742	20
23		F2	Application of new technology in construction	60.64516	18
24		F3	Limited working area	61.77419	16
25	ROLE OF GOVERNMENT & ENGINEERING SOCIETY	G1	Issuing safety laws, standards,regulations &legislations	55.96774	23
26		G2	Penalty for safety mesasures	73.22581	8
27	MEDICAL FACILITY	H1	Availability of medical advice	63.70968	15
28		H2	Availability of adequate facilities for first aid treatment	64.35484	14
29		H3	Conducting periodically random drug testing	73.70968	7

Table 1.2: Top 10 Factors Overall Ranking by SI Method

	FACTOR NAME	SI
1	Management rules and Regulation	88.54839
2	Safety engineer on site	85.80645
3	Safety inspection	82.90323
4	Involvement of Top Management	80.80645
5	Safety management system	78.3871
6	Personal competency	73.87097
7	Conducting periodically random drug testing	73.70968
8	Penalty for safety measures	73.22581
9	Safety policy	73.20581
10	Employee experience	72.41935



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IV. CONCLUSION

Overall combined ranking considering the perception of all the stakeholders is done. Based on the analysis, 10 critical success factors have been identified which is most affect the successful implementation of safety program in high rise building construction. In the decreasing order ranking of the factors for combined stakeholders are: Management rules and Regulation, Safety engineer on site, Safety inspection, Involvement of Top Management, Safety management system, Personal competency, Conducting periodically random drug testing, Penalty for safety measures, Safety policy, Employee experience. Rank of each factors and their importance is identified by the Significant Index (SI) method.

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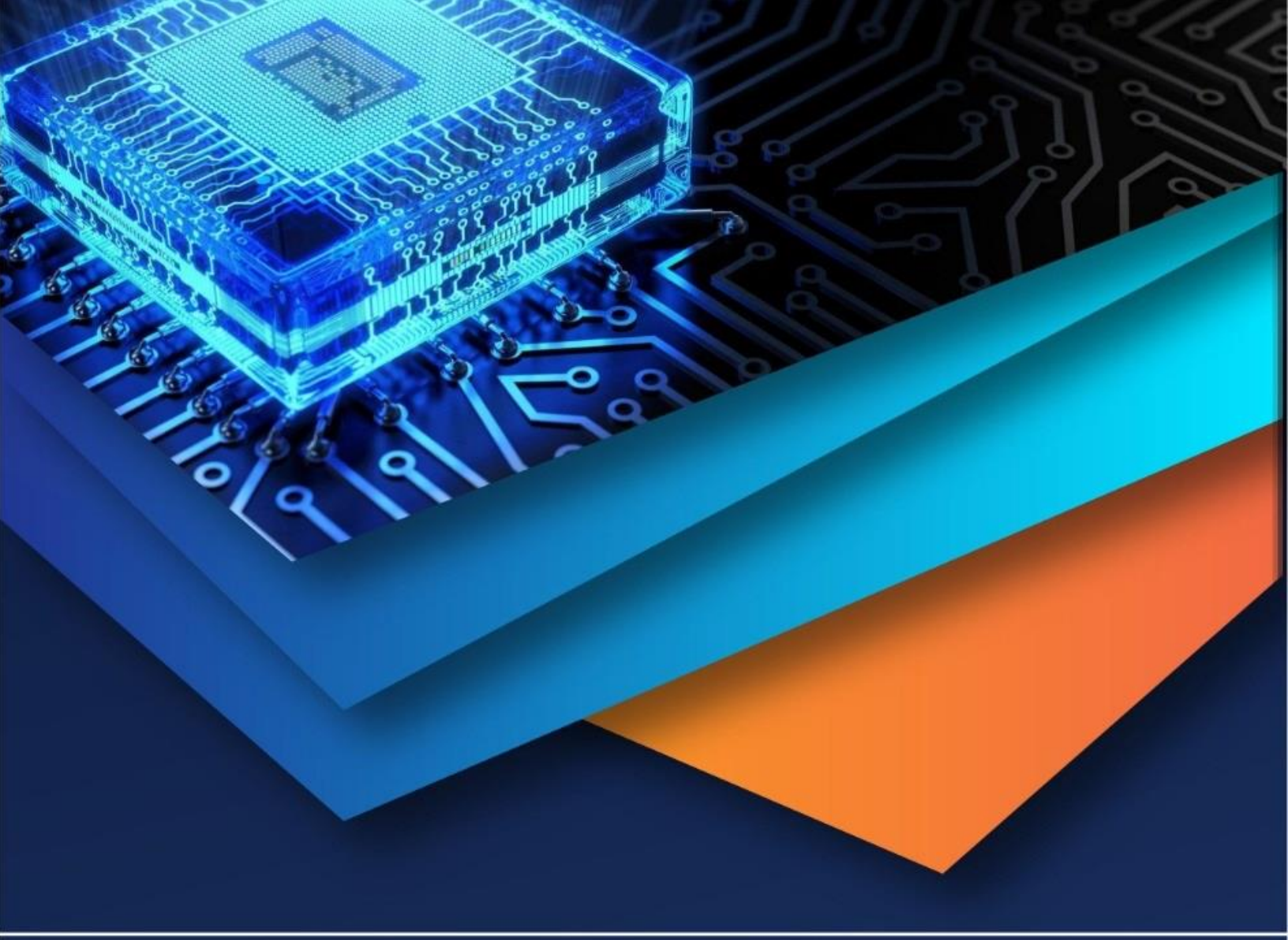

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