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A STUDY OF ELEMENTS OF A CONSTRUCTION SAFETY PROGRAMS, ADOPTION AND DEVELOPMENT OF SAFETY CULTURE & GOVERNMENT REGULATIONS

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Abstract - *To be successful in the construction industrial arena, every business must be safe, dependable, and long-lasting in its operations. The construction industry must detect hazards, evaluate related risks, and reduce risks to an acceptable level. Hazard Identification and Risk Assessment (HIRA) is performed to identify unwanted occurrences that may lead to a danger, analyses the hazard of this undesirable event that could occur, and typically estimate the extent, size, and probability of adverse consequences. It is generally acknowledged within the construction industry in general that different risk assessment methods contribute significantly to advances in the safety of complex operations and equipment.*

With the fast globalization, there has been a huge rise in building activity all over the globe, particularly in emerging countries such as India. The current research focuses on the risks associated with these building operations. This thesis will be helpful in avoiding possible risks since the data utilized in the research was acquired after analyzing questionnaires sent to 25 active construction firms, 12 of which corresponded with completed questionnaires. The thesis focuses on the application of the RII (relative importance index) method for assessing various important variables and providing numerous mitigation strategies for avoiding risks that may arise throughout the project's development phases. To produce dangerous circumstances, the hazard analysis, accident analysis, causes of accidents, and kinds of risks were carefully examined.

Key Words: Safety management, Construction safety, Risk Severity Index, Risk Occurrence Index, Safety Risk Index, Relative Importance Index.

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1. INTRODUCTION

Building safety design includes the safety of building workers when developing the permanent components of a project. The design defines the design and components of a facility and therefore has an important effect on the construction of the project and the safety hazards connected with it. For instance, a decision should be made on the work site about fall protection. [1]. The potential of falling injustice is therefore opened if insufficient protection against falling occurs, employees are not educated or fall protection is not utilised. If the designer specifies a parapet wall of 42 inches in height, 131 not only complies with building code (public safety), it also eliminates the danger of falling injuries throughout the construction life, because protection against falling is not necessary. Several additional recommendations on designing the permanent characteristics of a construction project to promote safety have been recorded and show that many of the injury incidents occur during planning, schedule, and design upstream circumstances. Although the design's effect on building safety is obvious and the prospective advantages of its adoption are visible, this idea is presently not widely used in the construction business in the United States. Safety design has shown to be a successful building intervention in the United States. In order to develop building safety by providing a structured approach to the exchange of information and project cooperation on building security, this thesis provides a structured CM method. Based on the results of a structured study aimed at design and CM experts in the construction sector, the suggested structured CM methodology was created [1].

The construction business has three major features that directly affect the safety of buildings. Each feature will be briefly described [2]:

1.1 Fragmentation

The fragmentation is one of the distinctive characteristics of the building sector. Design-Bid-Build was the most common mode of delivery in the United States (DBB). In this way, the construction manager is entirely responsible for the safety of the worker and, traditionally, the designers have not taken care of the safety of the site because they believe that they lack sufficient training. Modern techniques of delivery, whereby designers and builders work jointly, may improve safety performance. One research indicates that both the performance of the projects and the safety performance in projects with greater safety and project performance are different.

1.2 Dynamic Work Environment

Construction occupations, unlike industrial ones, are not easily duplicated. Each job site has its own unique characteristics, and construction activity is always changing. Building experts do a variety of jobs, and a whole new building project might be their next assignment [2]. In comparison to production and construction, the findings show that in the production industry, task repetition, predictability, and standardization are high, whereas in the construction business, they are low.

1.3 Safety Culture

The phrase "culture of safety" was originally used following the Chernobyl catastrophe in 1986 by a post-accident review conference. In every accident the poor safety culture is regarded as an important cause. Table 1 presents a range of definitions of safety culture. The definition of safety culture is varying for researchers and organizations, but the foundation of these is all identical. Furthermore, everyone identifies a safety culture as essential for companies to handle safety issues [2].

2. SAFETY MANAGEMENT

In the past three decades, the usage of security management systems has become increasingly widespread. The underlying causes of accidents at various construction facilities were studied by researchers. Some mentioned the role played by designers, building managers and owner in security. The initial step towards a security management system is to examine and detect the factors of injuries and deaths based on the literature assessment.

Researchers have attempted not only to identify any link but also the correct cause among the events and factors causing the wounds or deaths. Inquired into the company's loss of two years by 1,032 industrial companies in Ontario (companies employing more than 50 employees). The factor analysis technique was also used by the researched industrial businesses in Michigan (companies with more than 50 employees). Similarly, Michigan companies (those with over 100 employees) evaluated the factor approach. Several prior research on the link between work and organizational variables and injury rates have been evaluated and examined [5].

3. DATA COLLECTION

Construction safety must be guaranteed via rigorous project planning, design and layout. Many mishaps are recorded as no appropriate precautions are originally implemented in planning.

Respect for regulations and norms regulating safe work practices is required in the construction of industrial buildings. In order to do this, the Company and the contractors must collaborate to establish a connection between the legal need and the practical method. The company must insist on all safety and health requirements that relate to the construction project at hand.

Continuous supervision by a competent person is, along with norms and standards, a must work without occurrences. It is thus essential that appropriate attention is made in building safety with a conceptualization of each project.

19 hazardous actions and unsafe circumstances, affecting projects in India, are determined based on a review of different incidents and literature. The following are the different variables and their explanation.

4. QUESTIONNAIRE SURVEY

Questionnaire Regarding Unsafe Act and Unsafe Condition in Construction Projects

In the Questionnaire survey we have selected 3 company for data collection and we have performed the Questionnaire survey inside with worker of construction companies. We collected 50 response from three companies.

Selected company name are described below:

•Company 1

Name:- GS SURVEY AND ENGINEERS

Address:- Shiv Shakti Complex, B3A, 3RD FLOOR, Vinod Nagar East, New Delhi, Delhi 110091

•Company 2

Name:- SPACEKON CONSTRUCTIONS PVT. LTD.

Address:- S7A/1, East Arjun Nagar, Shahadara, Delhi, 110032

•Company 3

Name:- Lafycon Engineering Services Pvt Ltd.

Address:- Chowdhary Complex, A139, Basement-2, IP Ext, Madhu Vihar, New Delhi, 110092

5. RESPONSE OF QUESTIONNAIRE

Table 1: Questionnaire Responses

(Where VL = Very low, L=low, M=medium, H=high, VH=very high)											
S.NO	**Unsafe act and unsafe condition**	**Occurrence**					**Severity**				
		V L	**L**	**M**	**H**	**V H**	**V L**	**L**	**M**	**H**	**V H**
1	Working at elevated place	1	2	3	4	5	1	2	3	4	5
2	Improper earthing	1	2	3	4	5	1	2	3	4	5
3	Working on lines without taking proper safety precautions	1	2	3	4	5	1	2	3	4	5
4	Unguarded floor openings, and excavations	1	2	3	4	5	1	2	3	4	5
5	Exposed live wires.	1	2	3	4	5	1	2	3	4	5
6	Improper illumination	1	2	3	4	5	1	2	3	4	5
7	Constrained location	1	2	3	4	5	1	2	3	4	5
8	Unsafe design and construction such as poor scaffolding, structure, platforms.	1	2	3	4	5	1	2	3	4	5

9	Working on transmission lines.	1	2	3	4	5	1	2	3	4	5
10	Emergency work, leading to hurried working	1	2	3	4	5	1	2	3	4	5
11	ening and closing of switches without authority or warning	1	2	3	4	5	1	2	3	4	5
12	Working unsafety such as throwing materials or tools at another worker.	1	2	3	4	5	1	2	3	4	5
13	Using unsafe equipment, wrong tools for the job or using hands instead of right tools	1	2	3	4	5	1	2	3	4	5
14	Operating hoists and tracks without proper communication	1	2	3	4	5	1	2	3	4	5
15	Over confidence like working or live electrical equipment that could be conveniently re-energized	1	2	3	4	5	1	2	3	4	5
16	Taking unsafe position or posture too close to openings and lifting in an unstable position	1	2	3	4	5	1	2	3	4	5
17	Distracting, teasing, joking, quarrelling, annoying	1	2	3	4	5	1	2	3	4	5
18	Failure to use recommended safety protection equipment	1	2	3	4	5	1	2	3	4	5
19	Avoiding the use of guard rails and safety nets while working on higher Stories	1	2	3	4	5	1	2	3	4	5

6. RESULTS AND ANALYSIS

For the study of data and ranking of key variables, several researchers have chosen a relative significance index. The same approach is used in this research, with five-point data gathered from respondents transformed to a relative relevance index for each component. Due to relative relevance indicators, the variables sorted according to significance. The questionnaire was completed by a total of 50 respondents. Following procedures are taken to analyse the answers:

- After getting of all 50 responses, Total Score is determined based on Rating scale (1-5).
- Afterwards, Relative Importance Index for each factor are calculated by using Relative importance index (RII) Method. A calculation is shown in Table 3.

6.1. Relative Importance Index Technique

It's used to weigh the relative significance of different delays' causes and consequences. In this research, the same technique will be used in different groups (i.e. contractors, project safety, owner and site supervisor). For each component, a four-point scale ranging from 1 (very low affect) to 5 (extremely high affect) is used and converted into relative importance indices (RII) as follows:

$$RII = \Sigma W / (A*N)$$

Where W weighs the respondents for each element (1 to 5), A is the greatest weight (i.e. 5 in this instance) and N is the number of respondents overall.

The higher the RII number, the greater the delay.

6.2 Validity and Reliability of Questionnaire

Method to measure validity and reliability is given in methodology. Value of ACP is calculated as 93% which is well above the recommended value of 90% (Poham. 1978). The reliability of five-point scale responses was assessed by using Cronbach's alpha. Cronbach's alpha for occurrence, consequences and detectability was calculated by using SPSS software and given in Table: 2.

Table: 2. Cronbach's Alpha Values

	Occurrence	Consequences
Cronbach's Alpha	0.97	0.979

All the calculated values of Cronbach's alpha are well above the recommended value of 0.8 (Hair et al. 2014).

Ranking of risk factors was done on the basis of SRI which is given in Table: 3.

Table 3: Safety Risk Index and Ranking

Sr. No.	Safety Risk Factor	ROI	RSI	SRI	Rank
1	Working at elevated place	0.748	0.752	0.562496	2
2	Improper Earthing	0.724	0.724	0.524176	6
3	Working on lines without taking proper safety precautions	0.652	0.74	0.48248	16
4	Unguarded floor openings, and excavations	0.64	0.688	0.44032	19
5	Exposed live wires.	0.696	0.724	0.503904	10
6	Improper illumination	0.672	0.72	0.48384	15
7	Constrained location	0.696	0.728	0.506688	8
8	Unsafe design and construction such as poor scaffolding, structure, platforms	0.704	0.728	0.512512	7
9	Working on transmission lines.	0.736	0.716	0.526976	5
10	Emergency work, leading to hurried working	0.688	0.724	0.498112	12
11	Opening and closing of switches without authority or warning	0.68	0.744	0.50592	9
12	Working unsafety such as throwing materials or tools at another worker.	0.664	0.708	0.470112	18
13	using unsafe equipment, wrong tools for the job or using hands instead of right tool	0.688	0.716	0.492608	13
14	Operating hoists and tracks without proper communication	0.684	0.7	0.4788	17
15	Over confidence like working or live electrical equipment that could be conveniently re-energized	0.704	0.756	0.532224	3
16	Taking unsafe position or posture too close to openings and lifting in an unstable position	0.66	0.756	0.49896	11
17	Distracting, teasing, joking, quarrelling, annoying	0.636	0.772	0.490992	14
18	Failure to use recommended safety protection equipment	0.664	0.796	0.528544	4
19	Avoiding the use of guard rails and safety nets while working on higher stories	0.728	0.796	0.579488	1

Avoiding the use of guard rails and safety nets while working on higher stories is found as the most hazardous risk, whereas unguarded floor openings, and excavations is found as least hazardous risk.

Figure. 1: Safety Risk Index Column Chart

As shown in Pareto-Analysis Table 4, safety risk index is presented along cumulative index and cumulative percentage.

Table 4: Pareto-Analysis Table

Pareto-Analysis				
Sr. No.	**Factor**	**Safety Risk Index**	**Cumulative Index**	**Cumulative Percentage**
1	Unguarded floor openings, and excavations	0.44032	0.44032	4.58
2	Working unsafety such as throwing materials or tools at another worker.	0.470112	0.910432	9.47
3	Operating hoists and tracks without proper communication	0.4788	1.389	14.45
4	Working on lines without taking proper safety precautions	0.48248	1.871	19.477
5	Improper illumination	0.48384	2.354	24.5
6	Distracting, teasing, joking, quarrelling, annoying	0.490992	2.844	29.6
7	using unsafe equipment, wrong tools for the job or using hands instead of right tool	0.492608	3.336	34.72
8	Emergency work, leading to hurried working	0.498112	3.834	39.91
9	Taking unsafe position or posture too close to openings and lifting in an unstable position	0.49896	4.332	45.09
10	Exposed live wires.	0.503904	4.832	50.3
11	Opening and closing of switches without authority or warning	0.50592	5.337	55.55
12	Constrained location	0.506688	5.843	60.82
13	Unsafe design and construction such as poor scaffolding, structure, platforms	0.512512	6.355	66.15
14	Improper earthing	0.524176	6.879	71.61
15	Working on transmission lines.	0.526976	7.405	77.08
16	Failure to use recommended safety protection equipment	0.528544	7.933	82.58
17	Over confidence like working or live electrical equipment that could be conveniently re-energized	0.532224	8.465	88.12
18	Working at elevated place	0.562496	9.027	93.97
19	Avoiding the use of guard rails and safety nets while working on higher stories	0.579488	9.606	100

Pareto-Analysis chart is shown in Fig. 2.

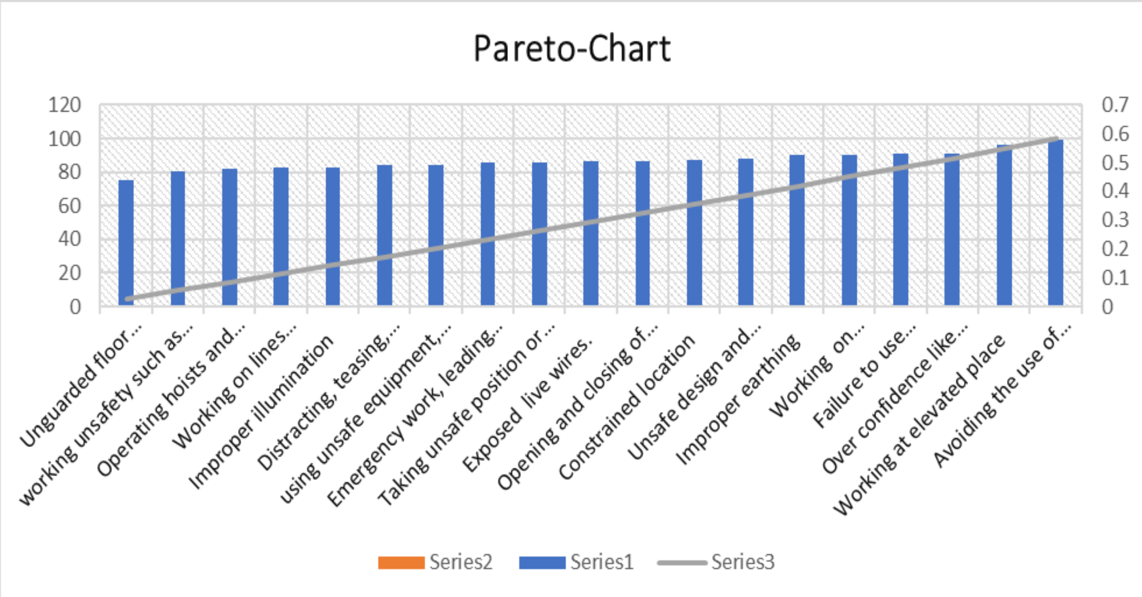

Figure 2: Pareto-Analysis Chart

Series 1 is for Safety Risk Index.
Series 2 is for cumulative percentage.
Series 3 is for 80% rules, presenting those factor which have cumulative percentage of greater that 80%.
Following factors have cumulative percentage of greater than 80%, as shown in Table 5.

Table 5: Factors have cumulative percentage of greater than 80%

Sr No.	Factor	Safety Risk Index	Cumulative Index	Cumulative Percentage
1	Failure to use recommended safety protection equipment	0.52854	7.933	82.58
2	Over confidence like working or live electrical equipment that could be conveniently re-energized	0.53222	8.465	88.12
3	Working at elevated place	0.56249	9.027	93.97
4	Avoiding the use of guard rails and safety nets while working on higher stories	0.57948	9.606	100

7. Critical Factor Analysis

Top five critical factors are given in Table 6.

Table 6: Critical Factor Analysis

S.NO	Unsafe act and unsafe condition	ROI	RSI	SRI	RANK
1	Avoiding the use of guard rails and safety nets while working on higher stories	0.728	0.796	0.579488	1
2	Working at elevated place	0.748	0.752	0.562496	2
3	Over confidence like working or live electrical equipment that could be conveniently re-energized	0.704	0.756	0.532224	3
4	Failure to use recommended safety protection equipment	0.664	0.796	0.528544	4
5	Working on transmission lines.	0.736	0.716	0.526976	5

Toolbox meetings, site meetings, placards, and informal verbal communication are among the techniques used to convey risk at construction sites, according to the findings. The importance of safety committees and gang supervisors in conveying health and safety concerns was also highlighted. When there is a clear distinction between health and safety communication and quality and productivity, however, power interactions and disputes emerge. "The research also shows that personal protective equipment (PPE) is the most often utilized tool for risk management. On the other hand, there was adequate PPE on the job sites. The research finds that the legal system plays a significant role in risk assessment, communication, and control, based on variables affecting risk management. Some dangers, such as falling from a height, are addressed in the rules, as are control methods. They also demand that health and safety risks be disclosed to employees and that personal protective equipment (PPE) be supplied".

Regular inspections, penalties, and compliance certifications by regulatory entities have a larger effect on risk management. "Another factor influencing risk management is company safety culture. Construction firms with a safety culture seem to priorities health and safety when selecting the site manager, the safety coordinator, and the safety officer. Work requires understanding about health and safety. Companies with a strong safety culture, on the other hand, provide resources for site workers, such as personal protective equipment (PPE) and training. Individual variables such as construction site experience, educational background, and knowledge of health and safety concerns may all have an effect on risk management in the workplace. It was found that risks were assessed based on experience and educational background. Furthermore, the study discovered that work environment variables such as site architecture and location, task type and size, working methods, and team composition had an effect on health and safety risk management".

8. CONCLUSION

The research also identifies variables that obstruct construction site health and safety risk management. Low public knowledge of rules, a lack of resources such as people and money, coverage of regulations, complexity of design, the procurement system, and a lack of education, site layout, and location are among the reasons. As a result, the primary 'mantra' is that every task on the building site must be completed with the greatest amount of activity possible.

- The obtained data was analyzed, and a comparative examination of the literatures accessible resulted in the identification of nine hazardous actions and ten unsafe situations.
- The obtained data is found valid and reliable on the basis of validity and reliability testing.
- The thesis concludes that there are five critical factors in the field of building construction: avoiding the use of guard rails and safety nets while working on higher stories, Working at elevated place, Over confidence like working or live electrical equipment that could be conveniently re-energized, Failure to use recommended safety protection equipment and Working on transmission lines..
- Mitigation methods for the above-mentioned 5 essential variables have been suggested in order to reduce the risks posed by them in the near future in the area of building construction.

9. Future Scope

A study and ongoing data collecting initiatives may reveal other variables. Examining case studies from existing initiatives may aid in the identification of additional variables. Other types of analysis, such as sensitivity analysis, scenario analysis, and other comparable techniques, may be used. The risks posed by hazardous circumstances in building construction were also addressed in the thesis. Using the thesis pattern, we can shift the point of view and inspection, just as we may at future dam building sites, bridges, and other mitigation measures.

REFERENCES

[1] Rizwan U. Farooqui "Designing for Construction Safety – A Construction Management Approach" 2018.

[2] Yousif Salam Saeed "Safety Management in Construction Projects" July 2017

[3] Kaushik Kayal and B. Srinivas "Construction Safety Manual for Works Contract" BARC/2011/E/006

[4] Jimmie Hinze Suezann Bohner Jeffrey Lew "Evolution of and Directions in Construction Safety and Health" Copyright © 2008Elyas

[5] Jazayeri , Gabriel B. Dadi "Construction Safety Management Systems and Methods of Safety Performance Measurement: A Review" Journal of Safety Engineering 2017, 6(2): 15-28 DOI: 10.5923/j.safety.20170602.01

[6] Geneva "Safety, health and welfare on construction sites A training manual" 1995

[7] "Construction Safety – A Monograph" Atomic Energy Regulatory Board Mumbai-400 094 India

[8] Kanchana Priyadarshani, Gayani Karunasena and Sajani Jayasuriya1 "Construction Safety Assessment Framework for Developing Countries: A Case Study of Sri Lanka" Journal of Construction in Developing Countries, 18(1), 33–51, 2013.

[9] Mengjun Zhong "Research on Safety Management Application of Dangerous Sources in Engineering Construction Based on BIM Technology" Volume 2019

[10] Devdatt P Purohit, Dr.N A Siddiqui, Abhishek Nandan & Dr. Bikarama P Yadav "Hazard Identification and Risk Assessment in Construction Industry" International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 10 (2018)

[11] Williams, OS, Hamid, RA & Misnan, MS 2018, Accident Casual Factors on the Building

Construction Sites: A Review. International Journal of Built Environment and Sustainability

[12] Ahmed, S, Sobuz, MHR & Haque, MI, 2018, 'Accidents on construction sites in Bangladesh' A review. In 4th International Conference on Civil Engineering for Sustainable Development, KUET, Khulna, Bangladesh, pp. 9-11.

[13] Carrillo-Castrillo, JA, Trillo-Cabello, AF & Rubio-Romero, JC 2017, 'Construction accidents: Identification of the main associations between causes, mechansims and stages of the construction process'. International journal of occupational safety and ergonomics, vol. 23, no. 2, pp. 240-250.

[14] Couto, JP, Santos, FJB & Rabbani, ERK 2017, 'How Time Constraints Affect safety Conditions at Construction Sites: Analysis of the Perception of Portuguese Construction Participants', Electronic Journal of Geotechnical Engineering, vol. 22, no. 02, pp. 563-576.

[15] Hola, B & Szostak, M 2017, Methodology of analyzing the accident rate in the construction industry. Procedia Engineering, vol.172, pp. 355-362.

[16] Douglas, KE, Goh, KC, Goh, HH, Omar, MF, Toh, TC & Zin, AAM 2016, 'Accidents preventive practice for high-rise construction', In MATEC web of conferences (vol. 47, p.04004).

[17] Adeloye, FT 2016, Pattern of accidents in building construction sites in Obio Akpor Local Government Area of Rivers State, Nigeria.

[18] Yilmaz, F 2015, Monitoring and analysis of construction site accidents by using accidents analysis management system in Turkey, Journal of Sustainable Development.

[19] Rowlinson, S., & Jia,Y.A.,2015.Construction accident causality: An instructional analysis of heat illness incidents on site.Safety science,78,179-189.

[20] Sribalaji.R "The Study on Impact & Improvement on Construction Safety Management Related Project Planning and Scheduling in India" International Journal of Engineering Research & Technology (IJERT) http://www.ijert.org ISSN: 2278-0181 IJERTV6IS030047 (This work is licensed under a Creative Commons Attribution 4.0 International License.) Published by : www.ijert.org Vol. 6 Issue 03, March-2017

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