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Factors Influencing Safety in Construction Project and Behavior Based Safety Management Approach

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Abstract-Construction works all over the world pose serious threat to workers and non-workers. This study investigates the current scenario of labor's working in construction industry in terms of Health, Safety and Environmental issues. The factors influencing safety on construction sites are discussed. The impacts of the historical, economical, psychological, technical, procedural, frequency and the environmental issues are considered in terms of how these factors are linked with the level of site safety performance. A structured questionnaire is prepared and distributed to access the level of safety performance in the construction site. Relative important index is calculated to rank the factors. It is observed that psychological factor is highly influencing the safety behavior of construction industry. It was found to be that the workers have received a limited culture of safety awareness, which led to main cause of accidents. Behaviour based safety management is proposed to rectify the human ware failures. Improvement in safety culture is thus obtained by observing and Intervening frontline workers.
Keywords- Relative important index (RII), level of performance, Psychological factor, Behaviour based safety management (BBS)

I. INTRODUCTION

Construction industry is an important part of the economy and often seen as a driver of economic growth especially in developing countries. However in the construction industry the risk of a fatality is five times higher than in a manufacturing based industry.Construction activities are inherently health and safety risks such as working at height, working underground, working in confined spaces and close proximity to falling materials, handling load manually, handling hazardous substances, noises, dusts, using plant and equipment, fire, exposure to live cables, poor housekeeping and ergonomics. In an urban context, health and safety accidents are relatively higher due to the fact that high rise buildings remain predominant with fast-growing complexities of domain-wide construction projects to cope with modernizing cities arena and high demand for Housing and other infrastructures.

Construction is one of the important economic activities in India. In urban sector increasing numbers of workers have taken up construction work as a means of immediate employment, which provides cash earnings at the end of the day. These workers come from varied trades especially from rural areas and agricultural backgrounds, they do not have proper training in construction safety and also not literate enough to forecast the unknown dangers is discussed in [1].Factors were identified from various international literatures and significant level of factors influencing safety performance is analysed in [2].Major factors and their sub-factors is analyse utilizing the SPSS software (Statistical package for social science) ,two statistical techniques used namely Pearson's correlation coefficient (for linearity) and factor analysis (for non-linearity) is explained in [3].Hazard Recognition program elements with application to construction are discussed in [4].Roots causes of accidents are analysed and then strategies to be adopted to rectify the accident is explained in [5].Current situation of Indian construction industry with respect to safety, rules and regulations followed in India, Efforts taken to enhance safety in Indian construction project is discussed in [6]. Workers perception towards in habitual working environment is analysed and the major factor is prioritized using questionnaire survey is proposed in [7].

Risk in construction project is measured for each activity, PDCA cycle is formulated for risk management, failure modes and effects analysis is focused in integrating health, safety and environmental risk has been presented in [8]. Several construction safety techniques followed in India is explained in [9]. Behaviour based safety technique applied in a construction site in China and improvement is seen from base line phase to intervention phase is explained in [10]. A model (DO-IT) is proposed for matching the awareness and behaviour of an individual with a particular BBS intervention technique is discussed in [11]. Accident causation model is formulated, proximal factors and constraint response model is explained in [12]. Non-negotiable behaviours are identified for 4 major hazard categories like fall, struck by, caught in between; electrical hazard is explained in [13]. Goal setting, effect size measurement from base line phase to intervention phase is discussed in [14].

In this paper the major factor which influences safety performance in construction projects is prioritized by Rank sum test. Psychological factor highly influences the safety performance. Behaviour based safety management is introduced to enhance the perception of workmen towards safety.

The work of paper is presented as follows: 'problem formulation' includes the identification of major factor influence safety, 'methodology' for ranking the factor using rank sum test. Results are taken and analyzed by considering questionnaire survey and likert scale which is described in 'Results and discussions'. Behavior based safety management is applied to improve the workmen behavior and 'conclusion' which concludes the work of this paper.

II. PROBLEM FORMULATION

The objective of this paper is

To identify and prioritize the major factor that highly influences safety in construction project.

To introduce a suitable method of measuring safety performance of workers and to help the company to improve construction site safety.

A. Factor Identification

Factors are identified and categorized into their dependency through literature study. Totally 9 factors are identified, each factor consists of sub-factors. The identified factor covers all areas influences safety.

B. Preparation of Questionnaire

From the identified factors and sub factors through various literature 43 questions, are prepared and circulated to Owners, Project managers, Site engineers, Draftsman working in construction. The questionnaire was designed to achieve the objectives. The survey was conducted to access the perception of workers towards health safety and environment. The respondents were requested to answer the question based on their experience in construction field.

The respondents were asked to evaluate the degree of impact of the factor on safety performance based on a five-point Likert scale. Likert scales are a non-comparative scaling technique and are one-dimensional in nature. Respondents are asked to indicate their level of agreement with a given statement by way of an ordinal scale.

In the likert scale

1=Strongly Disagree

2=Disagree

3= neither agree nor disagree

4=Agree

5= strongly agree

Table1. Factors and sub-factors

FACTORS	SUB FACTORS
Historical factors	i)Operative's age ii)Operative's job experience iii)Operative's trade iv)Operative's background safety training

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Economic factors	i) Worker compensation insurance. ii)Safety investment on personal protective equipment iii)Increased budget allocation to safety awards iv)Monetary incentives v)Non-monetary incentives vi)Safety investment vii)Company safety expenditures. viii)Reduced project team turnover ix) Minimizing worker turnover.
Psychological factors	i) Upper management support. ii)Providing safety environment iii) Size of the crew. iv) Reckless operations. v)Type and method of construction vi)Contextual characteristics of workers
Frequency factor	i)Frequency of falls ii)Occurrence of struck by objects iii)Frequency of trenching and evacuation iv)Occurrence of electrical accident
Impact factor	i)Severity of falls ii)Impact of electrical incidents iii)Severity of trenching and evacuation iv)Lack of safety provision
Technical factor	i)Training regarding safe handling of tools and equipment ii)Training to workers iii)Complexity in design
Procedural factor	i) Length and detail of the company safety program. ii)Meetings with supervisors , specialty contractors , workers with respect to safety iii)Implementing employee drug testing iv) Provision of safety booklets. v)Provision of safety equipment vi)Implementation of safety management vii)Disciplinary action
Environmental factor	i)Site condition ii)Impact of environmental standards iii)Dust free site iv)Site layout

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General factor	i)First aid and welfare facilities ii)Trade union involvement iii)Employees language iv)Relationship between accident rate and company growth

III. METHODOLOGY

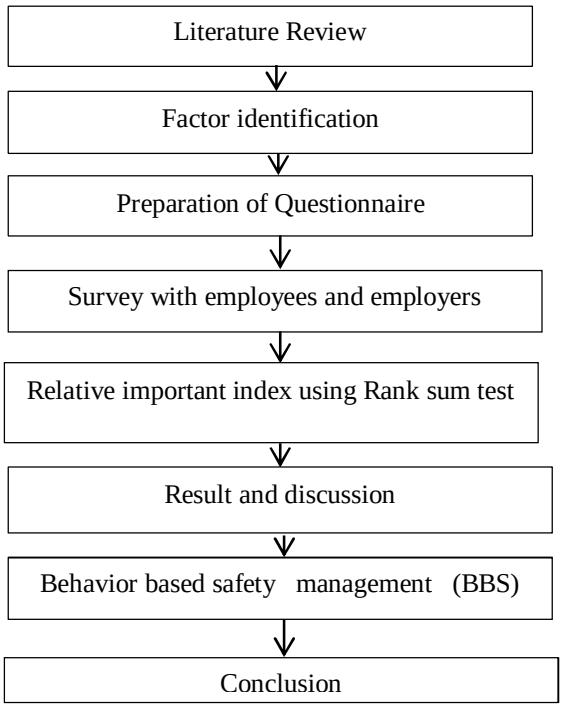

Fig .1 Flowchart of Proposed Methodology

Fig.1 Shows the Methodology of the thesis starts from factor identification to an implementation of behavior based safety management (BBS) approach.

IV. RESULTS AND DISCUSSIONS

The factors identified were measured for their degree of impact on safety performance in the construction industry. Respondents were requested to respond on five-point likert scale of strongly disagree, disagree, neither agree nor disagree, agree, strongly agree. A scoring system was used to transform the likert scale into a quantitative variable, where very high scored 5 points and very low scored 1 point. Relative importance index (RII) was then computed for each factor to prioritize them.

A. Questionnaire Survey

The questionnaire is prepared and field survey, online survey is conducted. Finally 35 stakeholders respond the questionnaire survey they are from small, medium and multinational construction companies include owners, project managers, safety engineers, site supervisors.

B. Prioritization of Factors

The contribution of each of the factors towards Health, Safety and Environmental issues was examined and the ranking of the attributes in terms of their criticality as perceived by the respondents was done
by use of Relative Importance Index (RII) this was computed using equation (1)

$$RII = \Sigma W \div (A \times N) \quad (0 \leq RII \leq 1) \qquad (1)$$

W – is the weight given to each factor by the respondents and ranges from 1 to 5, (where "1" is "strongly disagree" and "5" is "strongly agree");
A – is the highest weight (i.e. 5 in this case) and;
N – is the total number of respondents. N=35 (in this case)

Table 2. ranking criteria

Strongly agree	Agree	Neither agree nor disagree	Dis agree	Strongly disagree
N5	N4	N3	N2	N1
5	4	3	2	1

Relative important index (RII) is calculated for all sub-factors and Relative important index mean is calculated for all factors, Ranking is given to all main factors according to the RII mean score. For example: In Historical factors there are 4 sub-factors, for each sub-factors RII value is calculated and then RII mean is calculated for the historical factor .The mean value of Historical factor is 0.69 and the rank of the factor is 4.
The detailed ranking of all the factors is given below

TABLE 3. Results

Factors	RII mean	Rank
Historical factor	0.694286	4
Economic factor	0.722857	3
Psychological factor	0.784762	1
Frequency factor	0.670204	7
Impact factor	0.361905	9
Technical factor	0.554286	8
Procedural factor	0.680204	5
Environmental factor	0.678204	6
General factor	0.76898	2

Psychological factor is the major factor highly influence safety in construction projects, worker from varied cultural background, uneducated, no awareness in safety reacts unsafely in the work environment and plays a main reason for the cause of accident. The operatives should have self-concern to improve personal safety in their course of work, Management attitude also play a major reason for the workmen behavior, the relationship between the co-workers, relationship between workers and safety supervisors improve safety performance.
Apart from psychological factor, trade union involvement, Lack of safety training to workers, Safety costs spent by the management to improve safety are the sub-factors influence safety performance in construction industry. To improve the safety environment, Perception of workers towards safety should be changed.

V. BEHAVIOUR BASED SAFETY MANAGEMENT (BBS)

BBS approach was developed by Skinner (1975). 90% of workplace accidents are due to unsafe behaviors. Theory of reasoned action explains that belief changed to behavior. The belief of the workmen should be changed. BBS is the best strategy for improving safety. Rather than changing the physical condition the management should try to improve behavior of the workmen.

Safety behavior measurements is taken for few weeks in the construction site, Goal setting session is conducted on site within workers to explain them about the BBS approach , feedback is given regarding the previous observation. Feedback chart and targets are explained to the workers. Weekly observation is conducted and weekly scores are discussed with workers and motivate them to reach the target .BBS approach thus provide way to achieve a better safety environment

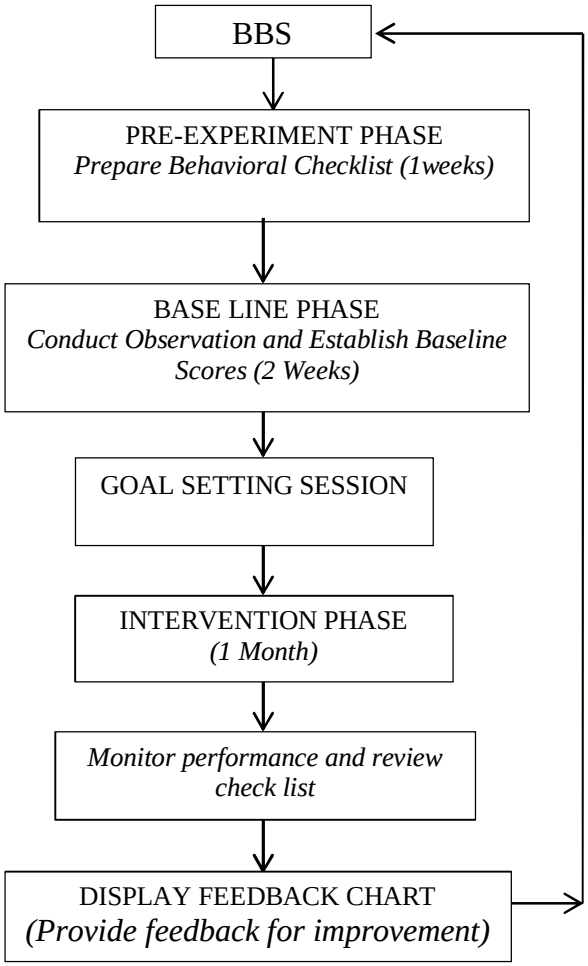

Fig 2: BBS Flowchart

VI. CONCLUSION

This research work provides methodology for prioritizing the factor influencing safety. RII is calculated to rank the factor, Psychological factor highly influence construction safety. To change the perception of workers towards safety, Behavior based Safety management is introduced. Therefore, the proposed method provides a feasible solution for improving the safety performance in construction industry.

VII. ACKNOWLEDGMENT

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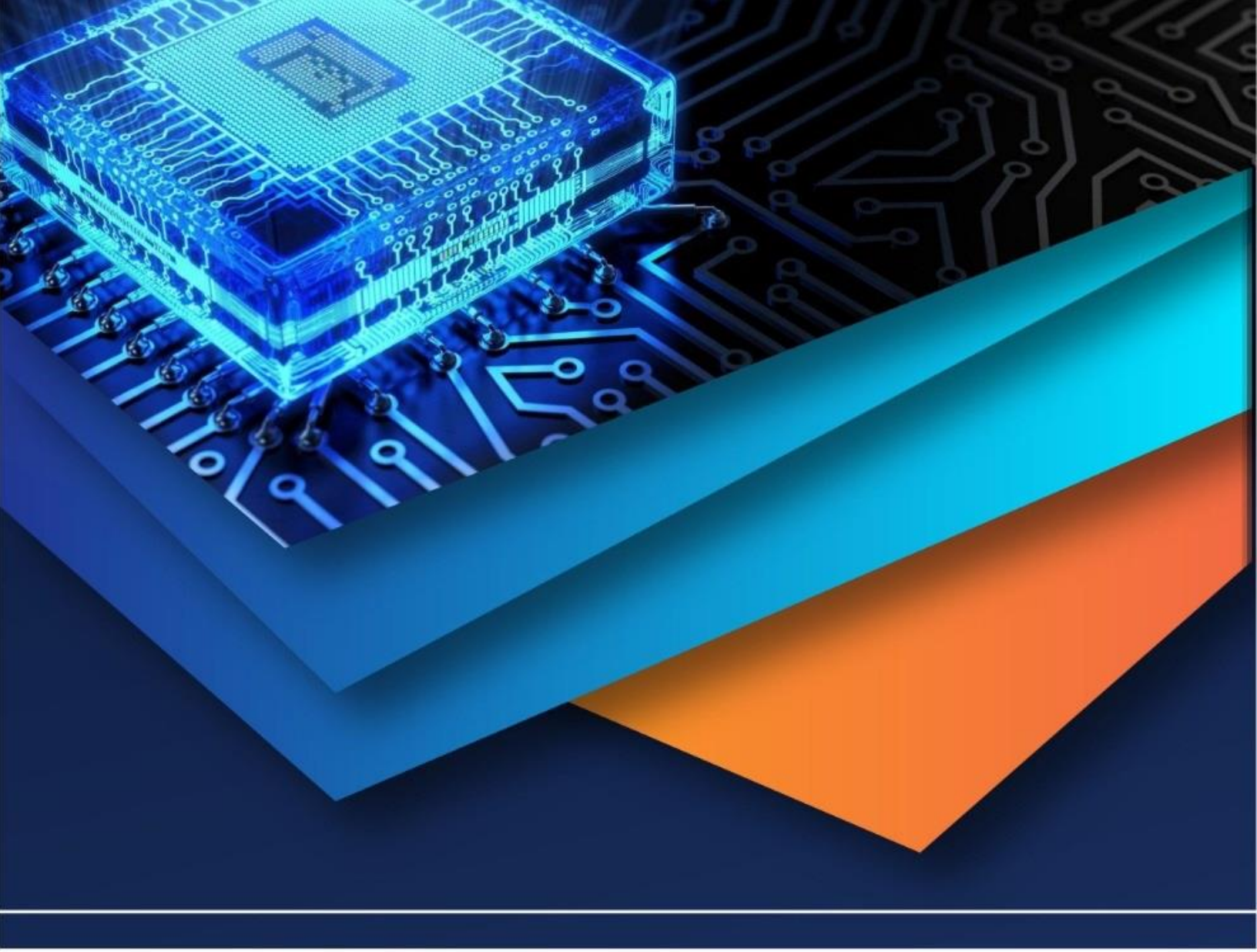
REFERENCES

[1] Karan Singh, "Safety in Indian construction" International Journal of Engineering research and technology, Vol. 3 Issue 11, November-2014
[2] Ibrahim Abdul-Rashid, Hesham Bassioni, Faez Bawazeer "Factors Affecting Safety performance in large construction Contractors in Egypt" Procs 23rd

Annual ARCOM Conference, 3-5, Belfast, UK Association of Researchers in Construction Management, 661-670, September 2007,
[3] Edwin Sawacha, Shamil Naoum, Daniel Fong , "Factors affecting safety Performance in construction site'' International journal of project Management, Vol. 17, No. 5, 1999
[4] Alex albert, Matthew R Hallowell, Brian M Kleiner, "Emerging strategies for Construction safety and health Hazard recognition", Journal of safety, Health and Environmental research, Vol 10, Issue 2,2014
[5] M.M.K Sardana , " Health and safety at workplaces in India" ISID Discussion notes, 2010
[6] Shrishail Shirur, Suwarna Torgal, " Enhancing safety and Health Management Techniques in Indian construction Industry", International Journal of Engineering and Technical Research, Volume-2, Issue-4, April
[7] Romel G. Solis- Carcano, Ricardo J. Franco-Poot, "Construction workers Perception of safety practices : A Case Study in Mexico, Journal of Building Construction and Planning Research, 2014, 2, 1-11
[8] Sai X. Zeng, Chun M Tam, Vivan W Y Tam, " Integrating Safety, Environment and Quality risks for Project management using FMEA Method" , Inzinerine Ekonomika- Engineering Economics (2010)
[9] Aref Charehzehi, Alireza Ahanhooh, "Enhancement of safety Performance In construction site' 'International Journal of Advances in Engineering and technology, Nov2012
[10] Rafiq M Choudhry, " Behavior based safety Management : A Case Study Accident analysis and Prevention, (2014) 14-23
[11] Scott Geller, " Behavior based safety and Occupational risk management" Safety and risk management journal, (1995)
[12] Akhmad Suraji, A. Roy Duff, Stephen J Peckitt, " Development of Causal Model of Construction accident Causation" Journal of Construction Engineering and management, 2001.127:337-344. Qian Chen, Ruoyu Jin, " Safety for Site to enhance Job site safety
[13] Management And Performance", Journal of Construction Engineering and Management 2012.138:509-519.
[14] Iain Cameron , Roy Duff, " Use of Performance Measurement and Goal Setting to improve Construction Managers Focus on Health and Safety" Construction Management and Economics, 14 August 2007



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