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# Development of a System Model for On-Site Accidents Ranking

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**Abstract:** Construction industry has accomplished extensive growth worldwide particularly in few decades. For any project to be successful, safety of the structures as well as that of the personnel is of utmost importance. The safety issues are to be considered right from the design stage till the completion and handing over of the structure to the belongs. This work includes many hazardous task and conditions such as working at height, excavation, noise, dust, power tools and equipment. The most common hazardous are caused by the fatal four: falls, being struck by an object, electrocutions, and being caught in between two objects. A proper coordination between contractors, clients, and workforce is needed for safe work conditions which are very much lacking in Indian construction companies. Management commitment towards health and safety of the workers is also lagging in following the policy and procedure in the safety as per the OSHA. A detailed literature study was carried out to understand the causes of accidents, preventive measures and development of safe work environment. This paper presents the results of on-site accident occurred and ranked according to their compensation to their respective injuries. And also develop a system model for the on-site accidents occurred in the site, suggested some remedial measure to the site to improve the safety issue occurred in the construction site.

**Keywords:** Safety, construction, factors and hazards, ranking, conceptual model.

## I. INTRODUCTION

Safety management refers to the cyclic process of planning implementation and reviewing control of work and manpower to reduce the accidents. At the start there is no importance for safety management. Years of go quantification of work levels involved in the project goes to a maximum, which makes the projects safety management more important. A safety management provides a systematic way to identify hazards and control risk while maintaining assurance that these risk control are effective. A safety management is woven into the fabric of an organization and becomes part of the culture the ways people do their jobs. In India, construction industry holds the seconds position next to agriculture industry. The annual turnover of the construction industry in India is about 4000 Billion Rupees. But the accidents occurring in India is very high compared to the foreign countries. Major safety hazards for construction workers include working at heights, in excavations and tunnels, on highways and in confined spaces; exposure to electricity, construction machinery, etc.

The safety pay program will

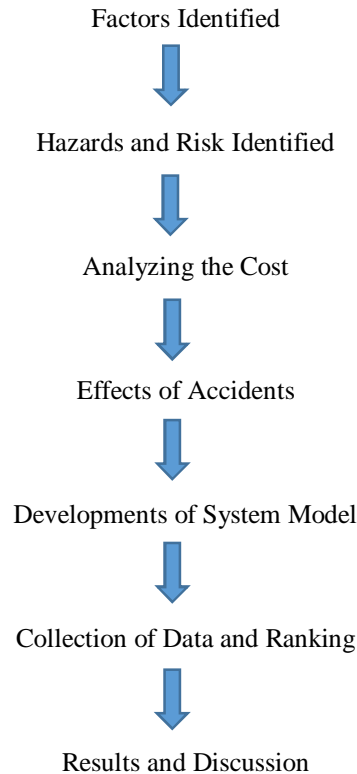
- A. Allow user to pick an injury type from a drop-down list or to enter their workers compensation cost
- B. Prompt user for information to do the analysis including their profit margin and number of injuries
- C. Generate a report of the costs and the sales needed to cover those costs

## II. OBJECTIVES

The main of the project is to study and to elevate the on-site accidents that occurring in the construction site and to rank the accidents according to the compensation and to develop a system model for the on-accidents

## III. METHODOLOGY

The study had been conducted through several phases namely literature review, factors and risk hazards identification, record collection, ranking system and result and discussion. Foremost objective was achieved through the various literature reviews. A literature review was conducted encompassing all various means available to obtain the widest range of the relevant information from the books, articles, and websites related to the cause of accidents in construction. After reviewing the different literature paper, a simple methodology has been scripted below based on the availability of the data to identify and analysis the accidents ranking and to develop a system model for the on-site accidents ranking.



#### A. Factors and Hazards Identified

- 1) *Factors:* The accidents in the construction sites give us a clear picture that the construction industry is one of the most critical sectors that need a huge and fast overhaul from the current site safety practices. Most accidents result from a combination of contributing causes and one or more unsafe acts and conditions. In order to improve the overall safety performance we need to investigate the root causes of an accident in the construction industry. The main factors that include work an environmental and organizational factor which leads to the most accidents in the site.
- 2) *Major hazards and risks:* Fatality accidents rates in the construction industry are double that of sector average, with rates of minor accidents almost incalculably more. In such an ever-changing working environment this is hardly surprising. But many employers are still unaware of their duty of care to employees, visitors, and even those not directly related to their activities. We've compiled a list of the top 10 most common risks associated with working on a typical construction site, and highlighted the steps you can take today to effectively manage those risks. Read on to find out more. The main hazards and risks of accidents in the construction sector can be categorized and described in the following way like risks of slips trips and falls, risks related to instability, risks related to traffic, risks related to construction machinery, risks of drowning, risks related to electricity, risks related to gas, fire and explosion risks, asphyxia risks, risks related to (sub) contracting, risks related to green jobs.

#### B. Cost Involved

The cost of construction accidents for the same sample of 100 constructions analyzed in this study has been estimated at a staggering R 32,981,200. Of this total, R 10,087,350 has been attributed to direct costs and R 22,893,850 has been attributed to indirect costs. The costs of construction accidents are based on four cost components: sick pay, administrative costs, recruitment costs and compensation and insurance costs. It should be noted that the estimates of the costs to employers presented in this study are reflective of the activities and incidents of the reviewed organization and may not necessarily represent another organization. The costs of construction accidents values presented in this study reveal that construction accidents present a substantial cost to employers and to the society at large, inclusive of both the direct and indirect costs.

- 1) *Benefits:* Benefits can be gained by contractors in reduced fatalities, major injuries and ill health through prevention of accident occurrences in the construction industry. According to these benefits can be perceived to offer both direct and indirect implications for the construction company's bottom line.

Table I: Direct and Indirect Benefits of Accident Prevention

Direct benefits	Indirect benefits
Protections in insurance premium	Productivity improvement
Protection on medical expenses	Protection on sick pay
Protection on compensation claim	Protection on working day lost
Protection on damage materials	Protections in lost time
Protection on litigation	Protection on cleaning/waste disposal
Protection on accident investigation	Protection on hiring of tools and plants
Protection on safety training	Protection on image improvement
Protections in loss of life	Staff morale Job satisfaction

2) *Costs of Accidents:* Accident statistics represent not only the terrible human tragedies but also substantial economic and psychological costs. Accidents can result in the following:

- a) Damage to plant and equipment,
- b) Damage to work already completed,
- c) Loss of productivity work time while debris is also cleared and damaged work rebuilt,
- d) Reduced work rate until normal site working rhythm and morale are restored, disruption while investigations are carried out by the company safety department, the insurers, inspectors from HSE and sometimes representatives from the trade unions,
- e) Legal costs and, in some case, fines,
- f) Loss of confidence and reputation.

Many employers believe that the insurer will pick up the costs of an accident, and that's why they pay their insurance. However the costs of an accident can be broken down into the direct costs and indirect (uninsured) costs.

3) *Direct Costs of an Accident:* Direct costs are those costs that are accrued directly from the accident. They are quite easy to calculate, and include the medical costs incurred and the compensation payments made to the injured workers. Direct costs are usually insurable by businesses.

4) *Indirect Costs of an Accident:* Indirect costs are the less obvious consequences of an accident that can be costed. While the indirect costs created by accidents are hidden, they too must be paid from profits from the sale of products. They are more difficult to calculate and tend not to be insured

5) *Ratio Analysis:* Pizzey de-scribed ratio as a comparison between two different things or between one and another that can be expressed as a fraction or a percentage. Relating this to the construction health and safety con-text, different sizes of contractors expend different amounts on accident prevention and derive different levels of benefits from these expenditures. The ratio was adopted to provide a uniform basis for comparing the costs and the benefits of accident prevention across the three sizes (small, medium, and large) of contractors when turn-over was taken into account.

The ratios were calculated by dividing the turnover by the relevant costs or benefits as follows

$$R = T / Y_i$$

Where

R = ratio;

T = turnover; and

$Y_i$  = ith cost or benefit.

This approach was applied to the data to establish the comparative economic costs and benefits of accident prevention across the various categories of contractors.



*C. Collections of data*

From the firm SLN CONSTRUCTION Bangalore the data have been collected according to the need of the project. They have provided the data of type of accidents occurred in the construction along with the percentage of the accidents happened in the organization.

1) *Type of Accidents*

- a) Falls
- b) Struck by falling object
- c) Stepping on object
- d) Caught in between object
- e) Over-exertion
- f) Exposed to extreme temperature
- g) Exposed to electric current
- h) Exposed to harmful materials
- i) Other type

*D. Ranking System for Accidents*

Accidents	Percentage	Ranking
Falls	22.2	1
Struck by falling object	17.1	3
Stepping on object	18.2	2
Caught in between object	6.8	6
Over-exertion	7.7	5
Exposed to extreme temperature	5.5	8
Exposed to electric current	10.8	4
Exposed to harmful materials	6.6	7
Other type	5.1	9

*E. Factors for Model Developing*

As the safety professional agreed that some variables could be used to assess safety but variables such as main influential characters and effective change needed to be considered too. The variables from organization model assessment that are going to use to assess the safety culture tools are

- 1) Individual need and values
- 2) Individual and organizational
- 3) Motivation
- 4) Task and individual skills
- 5) Organizational culture
- 6) Structure
- 7) Mission and strategy
- 8) System
- 9) External environment
- 10) Main influential characters
- 11) Managements
- 12) Work climate
- 13) Effective change
- 14) Pressure

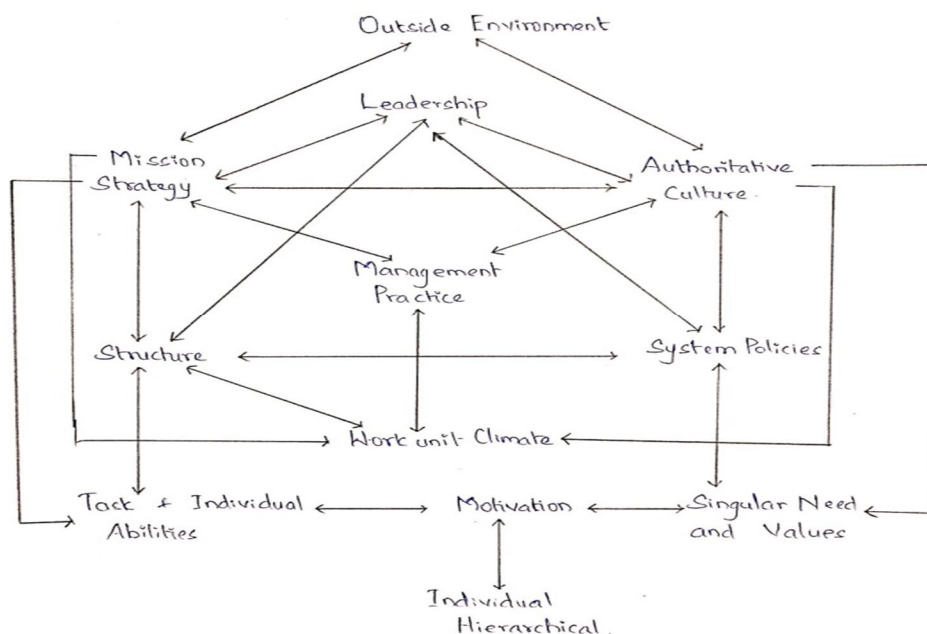


Fig. 1. Conceptual Model

#### IV. RESULT AND DISCUSSION

This finding further reinforced the notion that different categories of contractors incur different costs of accident prevention. The result of the study shows the facts about the ages, occupation and education level of the victims, injured parts of the body, severity of the injury, unsafe behavior that cause accidents and types of accidents. These have been no fatal accidents in the site during the research period. Only two severe injuries occurred. Nevertheless it is known that minor occupational accidents, which are not considered sufficient and even not registered cause great financial loss in workplaces.

In this paper present they notice that the different accidents hazards and risk assessment are identified from the construction site. And also find the different type of cost involved in the accidents and how they affect the construction site or firm. The cost involved in the accidents is analyzed by using different formula and find their ratio according to their records.

From the accidents happened in the firms the main factors and risk hazards are identified in the construction field is falls, stepping on the object and the struck between the object are the three major accidents occurred frequently.

From the data collected the highest percentage occurred accidents are falls (22.2%). These falls are high due to not following the tools provided to workers and not following in the proper way. The falls can be preventing by providing the catch nets, safety harness and proper hard barrication.

The lowest percentage of accidents occurred by other type like unsafe equipment, nature of industry and job site conditions (5.1%). These accidents are preventing by following the procedures of the equipment and knowing the nature of the industry.

The middle range of the accidents occurred in the site is over exertion (7.7%), it happens due to over pressure to the worker and over time working to complete the task. These accidents are controlled by using more workers to the industry.

#### V. CONCLUSION

From the current research it clearly understood that safety is important to all the firms, and also elevated the various factors influencing the safety measure in the construction firms. Among those factors the major hazards and the risk assessment are given priority. These factors may lead to severe economic issue both for the firm and labors.

The objective of this study was to determine whether Safety Culture Models consider organisation features and a model that combined both organisation and safety culture model variables was not found. Here lies an opportunity for further research that would enable complete analysis of the organisation safety culture, predicting the effect of enforcing a particular change and detecting any weaknesses in the organisation structure. This 'combined model' would aid risk management techniques such as Cost Benefit Analysis and in general, the overall process of measuring the health and safety performance of the organisation.

None of the reviewed literature or safety culture models addressed 'effective change' and 'detecting a weakness' as a variable that would aid safety culture assessment. The variable 'effective change' is important to the safety culture of an organisation because it promotes learning from past changes and encourages continuous improvement. 'Detecting a weakness' within an organisation is important for safety culture assessment because if a weakness cannot be detected then how will the organisation be able to prevent it causing a hazardous event.

My opinion is that variables such as pressure, work climate, motivation are not only important to organisational culture; these variables contribute to the safety culture of an organisation too. As none of the tools reviewed within the safety culture models included all the variables that were understood from a safety culture/organisation point of view, this indicates that a new model should be developed that addresses this wider scope.

Suggestions for aiding future work would be to research capability maturity models and developing a link/tool that could link organisational models, safety culture models and capability maturity models.

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