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CONSTRUCTION INDUSTRIAL SAFETY ANALYSIS BY ARTIFICIAL INTELLIGENCE

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***ABSTRACT*:**

In India During the past years, clusters of the crushers are increased rapidly because of the significant expansion of the construction industry including industrial buildings, hotels, residential houses as well as roads and other infrastructural works. The stone crusher is one such industry that exists near almost all major cities/towns throughout the country in all the states because the construction activities go on throughout the country. Therefore, the different sizes of the aggregates are required for the construction project. The conventional process of stone crushing are viz. blasting, manual breaking i.e. primary crushing, manual loading, handling of materials during the feeding at the hopper, crushing , conveying, rotatory screening, reconvening , crushing of material, and Transportation of the material to the site, with this stone crusher runs with 65 % to 70% efficiency. The management and technical support gives the proper solutions for the Artificial Intelligence for the Prediction of Safe Work Behavior in Construction at every stage. Thus the improvement gives speedy breaking, loading, smooth's crushing process with reduction in time, energy, maintains & labor cost, etc. Thus, it has become an important task to develop the clusters of the crusher sector. These findings have significant implications for the conventional crusher plant. It appears that this method produces a best product to conventional plants, where it will be covered by studying and analyzing the crusher.

INTRODUCTION

Artificial neural network (ANN) is a mathematical model for predicting system performance (i.e., system output) inspired by the structure and function of human biological neural networks [13]. The ANN is developed and derived to have a function similar to the human brain by memorizing and learning various tasks and behaving accordingly. It is trained to predict specific behavior and to remember that behavior in the future like the human brain does. Its architecture also is similar to human neuron layers in the brain as far as functionality and inter-neuron connection. ANN has been successfully used in various applications. The life of heritage building is also more than the any other RCC buildings. The knowledge of previous treatments in cultural preservation becomes more important in conservation. To avoid implementation of an improper conservation strategy and/or evaluate suitable re-conservation, suitable materials should be chosen and criteria should be adopted. The conservation professional must strive to select methods and materials that, to the best of current knowledge do not adversely affect cultural property or its future examination, scientific investigation, treatment, or function‖. By using artificial neural network tool calculating the age of heritage building. For this ANN tool input parameters are required.

An expert system is relying on human experts existing knowledge based on set up knowledge system; the expert system develops the earliest, the most effective in the artificial intelligence research field. The expert system is widely used in road and bridge, construction engineering, geotechnical engineering, underground engineering, disaster prevention project, material engineering, geological exploration and petroleum chemical industry, and so forth. The application of artificial intelligence simulates human experts in solving the problem of the thinking process in the field and reaches or approaches the level of experts.

ANN in Civil Engineering

An Artificial Neuron Network (ANN) is a computational model based on the structure and functions of biological neural networks. Information that flows through the network affects the structure of the ANN because a neural network changes - or learns, in a sense - based on that input and output.

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An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of A large number of articles have been published on civil engineering applications of neural networks. A neural network can be trained to learn to perform a particular task. The approach is particularly attractive for hard-to-learn problems and when there is no formal underlying theory for the solution of the problem. Engineering design and image recognition are two such problems.

The great majority of civil engineering applications of neural net-works are based on the simple back propagation algorithm [15].

The most common application of ANNs in the construction management area is prediction.

Artificial neural networks have many advantages over the conventional methods of modeling due to their distinct features. The traditional regression methods require explicit representation of the relationship in statistical models. Further, they are not conducive for complex multi attribute nonlinear mappings.

Types of ANN

Here we discussed about some types of ANN there are below [15],
Feed Forward Neural Network. A simple neural network type where synapses (connections) are made from an input layer to zero or more hidden layers and ultimately to an output layer. The feed forward neural network type is one of the most common neural networks in use. It is suitable for many types of applications. Feed forward neural networks are often trained via simulated annealing, genetic algorithms, or via one of the propagation techniques. To illustrate, annealing is a term used in metallurgy. If a metal is heated to a very high temperature, the atoms move about at high speeds. Yet, if they are cooled very slowly, they settle into patterns and structures, rendering the metal as being much stronger than before. This principle can be employed as an optimization technique in computer science. More specifically, simulated annealing can be used to aid a neural network to avoid local minima scenarios in its energy function. Simulated annealing basically involves perturbing the independent variables (the ANN weights) by a random value and keeping track of the value with the least error.
Self-Organizing Map(SOM). Neural networks that contain two layers and implement a winner take all strategy in the output layer. Rather than taking the output of individual neurons, the neuron with the highest output is considered the winner. SOM's are typically used for clustering related problems where the output neurons represent groups that the input neurons are to be classified into. SOM's may employ a competitive learning strategy.

Hopfield Neural Network.A simple single layer recurrent neural network. The Hopfield neural network is trained via an algorithm that teaches it to learn to recognize patterns. The Hopfield network will indicate that the pattern is recognized by echoing it back. Hopfield neural networks are typically used for pattern recognition.

Simple Recurrent Network (SRN). Elman or Jordan Style.A recurrent neural network that has a context layer. The context layer holds the previous output from the hidden layer and then echoes that value back to the hidden layer's input. The hidden layer then always receives input from its previous iteration's output. Elman or Jordan neural networks are generally trained by using genetic, simulated annealing, or one of the propagation techniques. Elman or Jordan neural networks are typically used for prediction related problems.

Simple Recurrent Network (SRN). Self Organizing Map.A recurrent self organizing map that has an input and output layer, just as a regular SOM. However, the RSOM has a context layer as well. This context layer echo's the previous iteration's output back to the input layer of the neural network. RSOM's may be trained via a competitive learning algorithm (just as a non-recurrent SOM). RSOM's can be used to classify temporal data or to predict outcomes.

PROBLEM STATEMENT

To study and examine the current practices of the management of safety and health, at construction site. This goal is realized through the different questionnaire is prepared for worker. Questionnaire is circulated to the construction firms. Statistics analysis graphically represented in charts. Based on the statistics results suggestions are provided. Finally we evaluate all the survey from WEKA tool using ANN framework and predict the overall scenario for safe work.

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LITERATURE REVIEW

Literature Survey

Several authors have reported various successful safety performances at construction sites to improve safety in construction sites.

Rafiq. M.Choudhry, Dongping, Fang, Sherif, Mohamed [1] presents a robust conceptual model that has its roots firmly entrenched in pertinent academic and applied literature. This study revealed a conceptual model that recognizes human, technical, situational, and organizational elements as well as their interactions. The model is anchored in three fundamental conceptual categories, namely safety climate, behavior-based safety, and safety system. The results of this study clearly indicate that the model serves as the logical basis for determining what and how to analyze and assess the different aspects of construction safety culture. It offers the opportunity to adopt a goal-setting paradigm by pursuing multiple sub goals. This gave them the conclusion that Employee perceptions, safety behaviors, and environmental or situational features could be accessed through safety climate surveys, peer observations, and systems audits/inspections.

Keith.R.Molenaar; Jeong-Il. Park; Simon.Washington [2] presents the results of a structural equation model SEM that describes and quantifies the relationships between corporate culture and safety performance. The SEM and the latent variables describe to constitute a powerful framework for defining, measuring, and improving upon corporate safety culture. The SEM is estimated using 196 individual questionnaire responses from three companies with better than average safety records. Analysis of data from the 54 measurable characteristics revealed that 19 could be used to describe a final set of five latent variables. This gave them the result and conclusion that these five latent variables can be considered characteristics of corporate safety culture and may be used as indicators of safety performance as measured through EMR. Based on the findings from the limited sample of three companies, author proposes a list of practices that companies may consider to improve corporate safety culture and safety performance. Sherif. Mohamed [3] discusses empirical research aimed at examining the relationship between the safety climate and safe work behavior in construction site environments. A research model was developed and tested using a survey, which contained multiple measurement items relating to each of the constructs in the model. A questionnaire survey was used in order to facilitate the collection of information from construction sites. This resulted and concluded that the empirical results indicate a significant relationship positive association between the safety climate and safe work behavior. Positive safety climates seem to result from management's showing a committed and non punitive approach to safety, and promoting a more open, free-flowing exchange about safety related issues. Contrary to the expectation, this study indicated that work pressure has no significant direct relationship with the safety climate. The results corroborate the importance of the role of management commitment, communication, workers' involvement, attitudes, competence, as well as supportive and supervisory environments, in achieving a positive safety climate.

Rafiq. M. Choudhry; Dongping .Fang; Helen. Lingard[4] determine safety climate that would enhance safety culture and positively impact perceived safety performance on construction projects. A safety climate questionnaire survey was conducted on the construction sites of a leading construction company and its subcontractors. Approximately, 1,500 hard copy questionnaires were distributed and the response rate was excellent, resulting in 1,120 valid questionnaires being collected from 22 construction projects. From FA, two principal components were established, management commitment, employee involvement and inappropriate safety procedure and work practices. These factors have been regressed with the perceived safety performance scores to establish the causal relationship between safety climate and perceived safety performance. This finally made them to come to the conclusion that the two-factor solution explained a total of 43.9% of the variance, with factor 1 contributing 27.62% and factor 2 contributing 16.28%. During the multiple regression analysis, the two underlying factors were used as independent variables in evaluating the relationship with perceived safety performance. The study concluded that management may be warned of potential safety system failures by measuring safety climate and can assess how safety is functioning in construction site environments. The results suggest that safety climate can be used as an effective measure of assessing and improving site safety for projects under construction.

Aviad.Shapira; F.Asce, BenyLyachin [5] presents the results of a study that identified the major factors affecting safety in tower-crane environments and evaluated the degree to which each factor influences ongoing safety on site. This study presented a list of 21 factors with an ongoing presence that affects safety in tower-crane environments. The list was generated and consolidated based on the experience and expertise of 19 senior safety

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managers and equipment managers from the top ten construction companies, which among them own and employ some 300 tower cranes. With a view to quantifying risk factors, the experts also assessed the influence of each of the factors, thus making it possible to distinguish between factors that exert a strong influence and those that exert a moderate influence on site safety. Overall we get to study in this paper that ,with the limited resources available for safety improvement and accident prevention, greater attention must be paid by all parties involved e.g. construction firms, regulatory and enforcement authorities to those factors evaluated as highly affecting site safety due to tower-crane work. The study reported in this paper constitutes the first phase of a broader research plan that aims to develop quantitative indices that objectively and realistically reflect safety levels on construction sites due to the operation of tower cranes. Alexander .

Laufer; M. Asce; William B. Ledbetter;F. Asce [6] deals with the effectiveness of the various methods and the extent of their use at construction sites are examined. The study is primarily based on a sampling of medium and large construction sites. Attributes that are investigated include efficiency, reliability, and validity and diagnostic capacity of the measure in order to identify the cause for success or failure, respectively, of the safety program at a site. Data were collected through the medium of a questionnaire mailed to safety directors of the 400 largest U.S. contractors listed in the Engineering News Record. The conclusion is drawn that for the successful safety performance at construction sites, the simultaneous employment of a number of measuring methods is required. The results of this study clearly indicate that the most effective and at the same time the most widely used employed measurement methods were lost-day cases, doctor's cases, and cost of accident. No-injury cases were least effective and least in use. Process methods were found to be effective as far as their validity and diagnostic capacity extends, though their efficiency and reliability are low.

Suchismita.bhattacharjee; somik.Ghosh [7] attempt to identify the limitation of the prevailing safety approaches which reviewed the major approaches that have been implemented to improve occupational safety in construction industry. Evaluating nine major approaches in terms of techniques and effectiveness which includes personnel selection, technological intervention, behavior modification, poster campaign, quality circle, exercise and stress management, near-miss accident reporting, safety climate, and zero injury technique, it was found that all the approaches transfer the burden of responsibility on the contractors. While the role of the contractors in the occupational safety and health risks of the workers is undeniable, yet the lack of improvement in the safety performance of construction industry in comparison to others have urged the practitioners and researchers to look for novel concepts. PtD (Prevention through Design) is such a concept, which if embraced by the construction industry and utilized properly can minimize occupational safety and health risks. This finally made them to come to the conclusion that the utilization of this concept calls for architects and engineers to participate in enhancing construction site safety. PtD concept utilizes the fact that architects and engineers are in a position to make decisions about construction safety and reduce or eliminate certain identifiable risks before those risks reach the construction site.

Qian.Chen; A.M.Asce, Ruoyu.Jin[8] presents a case study of an on-site safety management program launched by a general contractor. The initial research findings based on data analysis of incident rates (reactive measurement) and safety violations (proactive measurement) were presented to quantitatively assess the effectiveness of the program. By comparing various before and after incident rates and IRs during the 17-month study period, this research found that the Safety4Site program was effective in preventing and reducing jobsite accidents/incidents in the GC's organization. In contrast, Subs' incident rates were not significantly affected by the program. This gave them the conclusion that the top four most violated items, accounting for 82% of total violations, were all related to fall hazards. Besides safety, who reported around 33% of violations, project management personnel reported another 63%. This indicated strong participation and accountability among middle management personnel. Data showed that the program had a higher positive effect on the GC (with decreased SVRs) than on Subs in reducing unsafe behaviors. A co- relational study found no any linear relationships between IRs and SVRs for the GC, two uncorrelated measurements of safety performance. A lower incident rate does not necessarily mean a safer jobsite because some unsafe behaviors may not become an accident. Which overall gives the result that both reactive and proactive measure should be used to evaluate jobsite safety performance and the effectiveness of a safety program.

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METHODOLOGY

The subsequent steps were taken during the data collection and model development of this research work.
For achieving objectives of my research a methodology is proposed. The methodology has been schematically shown in Figure 3.1. This figure gives a clear and structured overview of the different steps that have been followed during the research.

A.I. is a branch of computer science that studies the computational requirements for tasks such as perception, reasoning and learning and develops systems to perform those tasks. The field of Artificial intelligence strives to understand and build intelligent entities. Artificial intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and reacts like humans. AI works with pattern matching methods which attempt to describe objects, events or processes in terms of their qualitative features and logical and computational Relationship. The branch of computer science concerned with making computers behave like humans.

Methodology Flowchart

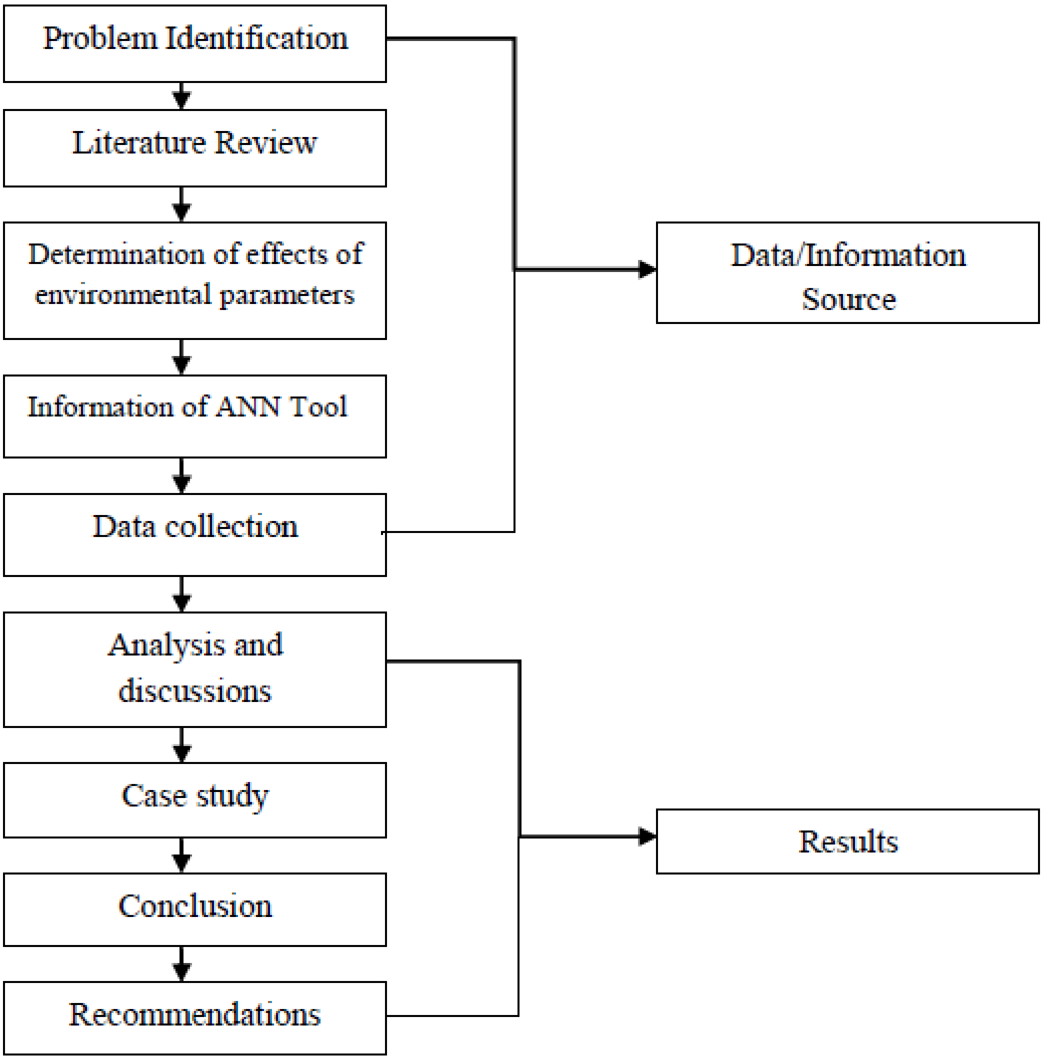

Figure 1: Proposed system flowchart

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Selection of Variables

Safe work behavior of workers depends on the safety climate constructs. As mentioned previously, 12 safety climate constructs, i.e.,

(1) Commitment

This indicates the perceptions of the management's commitment to health and safety issues in the whole organization and is often considered the main determinant of safety climate.

(2) Communication

This is helpful in identifying safety related problems in advance. Many researchers have considered communication as an element of safety climate

(3) Safety rules and procedures

Workers need to perceive the necessity and efficacy of current safety rules and procedures in the organization since the comprehension of this promote safety in the workplace

(4) Supportive environment

This indicates the support of coworkers as well as the involvement of the workers themselves in the organization and it is related to the social environment of the workplace. The higher the level of support given by coworkers, the more positive will be the safety climate that prevails

(5) Supervisory environment

With respect to the supervisory environment, supervisors are safety role models for workers. Supervisors implement onsite safety rules and regulations which are framed by the management. Healthy supervisory environment motivates the workers to follow safety rules

(6) Employees' involvement

This addresses the extent to which the employees and workers are involved in hazard identification, safety planning, and safety activities such as inspections, accident investigations, developing safety interventions and policies, reporting injuries, and so on. A higher level of employees and workers involvement in safety matters promotes a better safety climate

(7) Personnel appreciation of risk

This refers to the overall attitudes toward safety. These are associated with personal perception of risks and individuals' willingness to take risks. Various researchers considered it as one of the determinants of safety climate in their studies

(8) Appraisal of physical work environment and work hazards

This represents the presence of hazards in the working environment and the need for proper site layouts. Workplace hazards were defined as tangible factors that may pose risks for possible injuries or ailments. Within this definition, hazards do not always result in accidents but they represent a potential risk in the work environment which may materialize at the combination of a particular set of circumstances. Previous research shows that an organized and well-planned site layout is more likely to provide a high level of safety performance

(9) Work pressure

As a construct of safety climate, work pressure refers to the degree to which employees feel compelled to complete work. This affects the time available for planning, execution of the construction work, and the following of safety rules

(10) Competence

As a construct of the safety climate, competence refers to the general level of employees' qualification, experience; skills, knowledge and training Thus, the previous 10 constructs of safety climate can be seen as crucial determinants of safe work behavior.

(11) Working hours

This parameter shows the how working hours are feasible for male as well as female candidates, and the work is night shift.

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(12) Life Cover
This parameters will provide how organization will provide life cover or any other dead , or critical illness base policy to employees. These teams can be cover also cover if lifetime body part disability.

Artificial Neural Network (ANN)
An Artificial Neural Network (ANN) is an information-processing system that has been established as overviews of calculated representations created on hominoid neural biology. An ANN is serene of nodes related by directed links. Each link has a numeric weight as shown in Figure 3.3. ANNs have many advantages over traditional methods for modeling due to their distinct features. ANNs determine complicated relationship among a set of data and where the relationship between data is highly unknown. ANNs are data obsessed and self-adaptive devices because they can seizure subtle purposeful contacts among the figures uniform if the causal affiliation is hard and complex. They can automatically adjust their weights to optimize their behavior unlike mathematical and statistical models. ANNs are bright to detain complex nonlinear relationship with better accuracy.

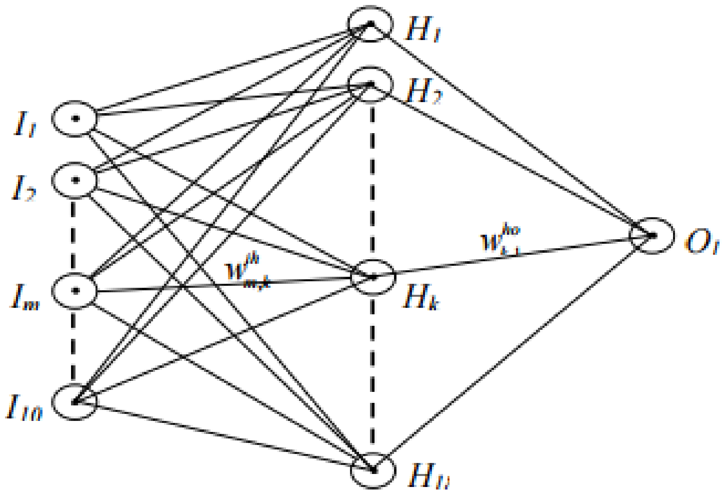

Figure 2. Configuration of the developed neural network (12-12-1)

ANN based models generate better prediction outcome than those obtained from regression models. Some existing surveys have been defined, it is not necessary that data should follow a specific statistical distribution. Also, there is no requirement as such to training the inter relationship among inputs and outputs before developing an ANN based model. ANNs consume been castoff for cataloguing, collecting, vector quantification, control, decoration suggestion, estimate, occupation calculation, and optimization. Due to its useful features, ANN is a popular research tool even in construction management. The connection among safety environment and their constructs is nonlinear and complex. Nevertheless, ANNs have the capability to expect shelter environment of a construction project.

For this survey we have collected around 12 parameters data from each site. These are below
(1) Commitment
(2) Communication
(3) Safety rules and procedures
(4) Supportive environment
(5) Supervisory environment
(6) Workers' involvement
(7) Personal appreciation of risk
(8) Appraisal of physical work environment and work hazards
(9)Work pressure
(10) Competence
(11) Working hours
(12) Life covers

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Processing with Weka

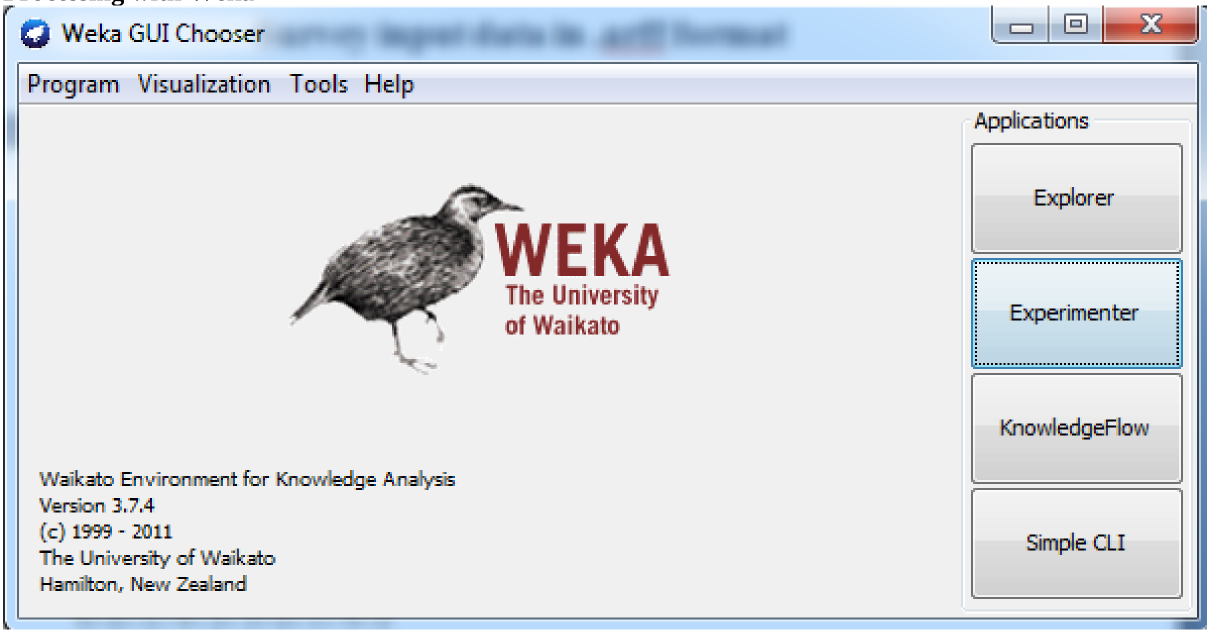

Figure 3 :Weka simulation creation page

```
@relation 'construction_survey'
@attribute 'Commitment' real
@attribute 'Communication' real
@attribute 'Safety_rules_and_procedures' real
@attribute 'Supportive_environment' real
@attribute 'Supervisory_environment' real
@attribute 'Workers_involvement' real
@attribute 'Personal_appreciation-of-risk' real
@attribute 'Appraisal_physical_work_environmentworkhazards' real
@attribute 'Work_pressure' real
@attribute 'Competence' real
@attribute 'Working_Hours' real
@attribute 'Life_Cover' real
@data
2,3,2,4,5,3,3,3,3,3,1,3
3,4,4,2,2,2,4,2,3,2,1,2
2,4,3,4,2,4,2,2,2,2,3,2
5,3,2,2,3,4,2,4,2,2,3,2
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4,4,3,4,2,2,3,5,3,2,1,2
4,2,5,3,3,3,3,5,3,2,2,2
4,5,2,3,2,3,4,3,3,2,3,3
5,4,2,3,2,4,2,4,3,2,2,2
```

Figure 4: input data file of survey

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In this survey first we collect around 60 site surveys from different zones, each survey having a start rating for each parameter. The all parameter file convert into .arff and .csv file, after that for first experiment done with and weka 3.8 , we given different hidden layers with 12 input neurons.

CASE STUDY

A) Vaishnavi Developers (Pune)

Company executed the works of building like residential and commercial complex in Jejuri near Pune. Vaishnavi Construction is an organization formed with the aim of handling large Civil Engineering. Projects with quality construction and time bound completion of work. Vaishnavi Construction is trusted for quality and is acknowledged for an unshakable commitment to excellence in every aspect of construction.

- Name of Project : Shri Ganesh
- Side Margins : Front Margin 3M, Rear Margin 1M.
- No. of Stories : G+5
- No. of Flats : 32 Flats
- Area of Flat (1BHK or 2BHK) : 570 and 810 Sq. Ft.
- Location-Plot No. Survey No. : 20/21, CST 1511
- Software used at site : NA
- Over all cost of Project : 4,57,06,020 INR
- Management team : NA
- Decision Support System : NA
- Organiser : A.B. Kalane
- Design: Mr.Prashant Nazarekar
- Planner : Mr.PrashantNazarekar

Table 1 : Resources description for conventional construction with general behaviours

Resources	Days	Rate/d	Total cost
Labour	5528	400	22,11,200
Skilled Labour	3210	600	1926000
Bhisti	3152	550	1733600
Mason	886	600	531600
Bar Bender	373	600	223800
Carpenter	541	700	378700
Electrician	28	650	18200
Total			70,23,100

Table 2: Resources description for conventional construction with general behaviors

Resources	Quantit	Rate per	Total cost
Chains and Harness (Providing safety from	20	3500	70000
Safety Vest	75	400	30000
Hard Hats	90	350	31500
Safety Gloves	60	150	9000

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Safety Shows	30	700	21000
Safety Glasses and	25	250	6250
Safety Earmuffs	25	250	6250
Safety masks	75	150	11250
Total			**185250**

Table 3: Conventional Construction Cost

	Description	Duration
	Sub Structure -(Excavation, Foundation,	58 days
	Super Structure – (Column, Beam, Slab,	506 days
	Painting and electricity establishment	68 days
Total Duration		632 days

Table 4: Safety Construction Cost

	Description	Duration
	Sub Structure - (Excavation, Foundation,	58 days
	Super Structure – (Column, Beam, Slab,	490 days
	Painting and electricity establishment	68 days
Total Duration		616 days

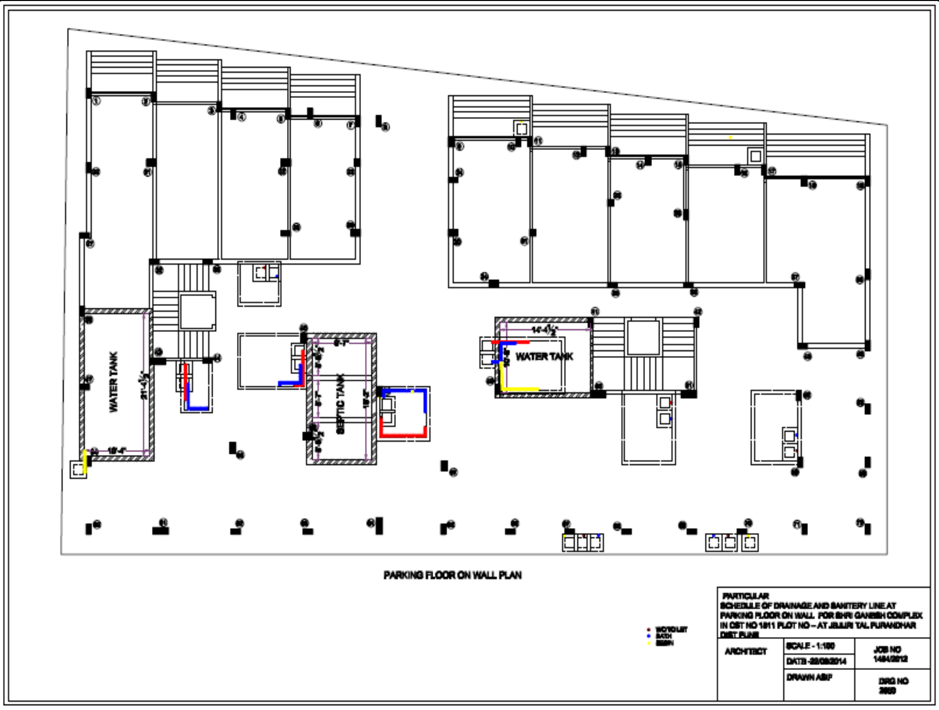

Figure 5 : Ground Floor Plan

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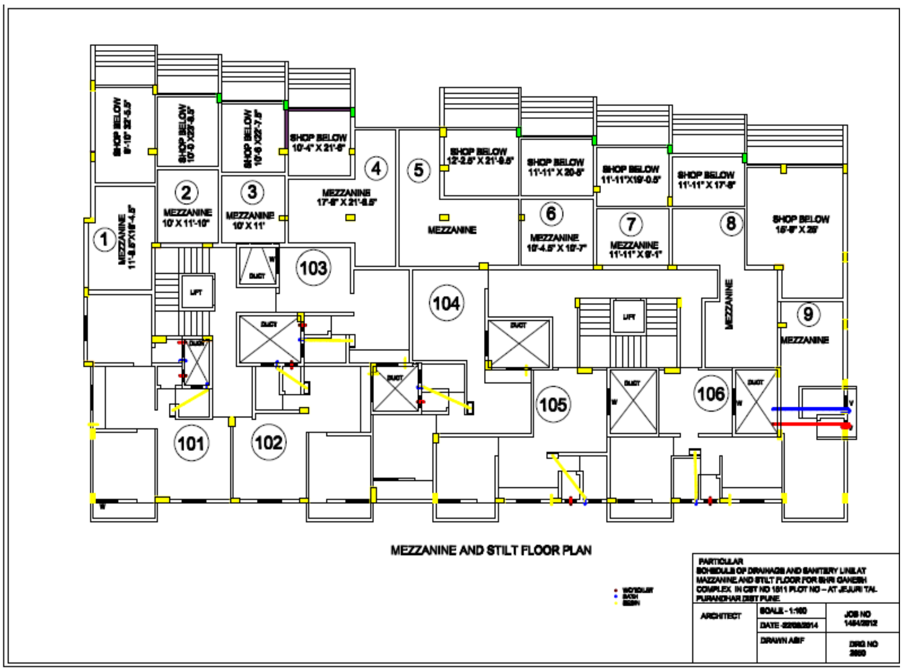

Figure 6 : First Floor plan

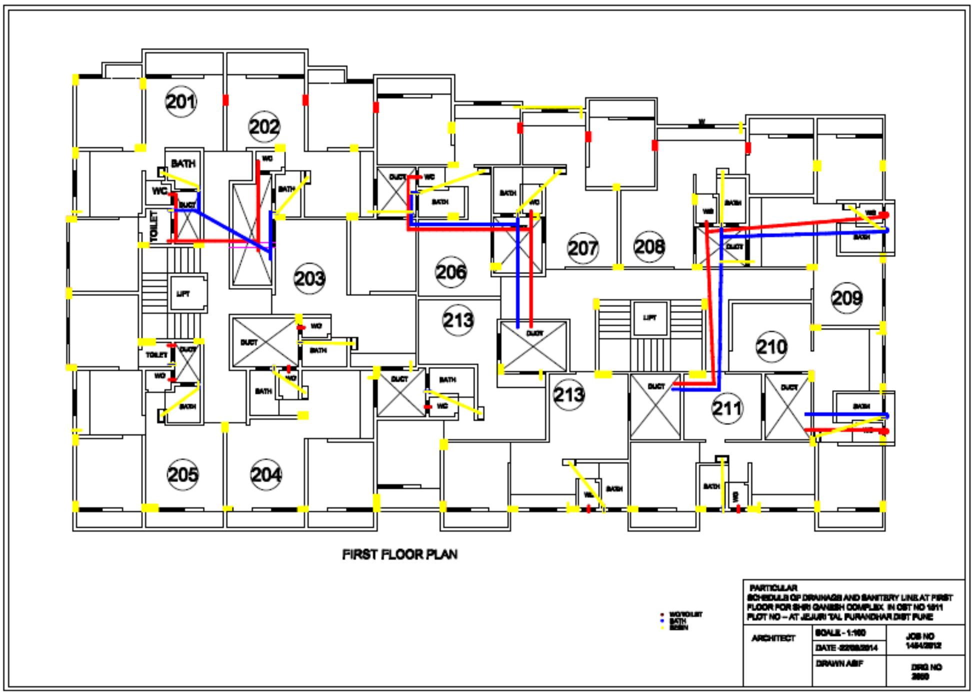

Figure 7: Second floor plan

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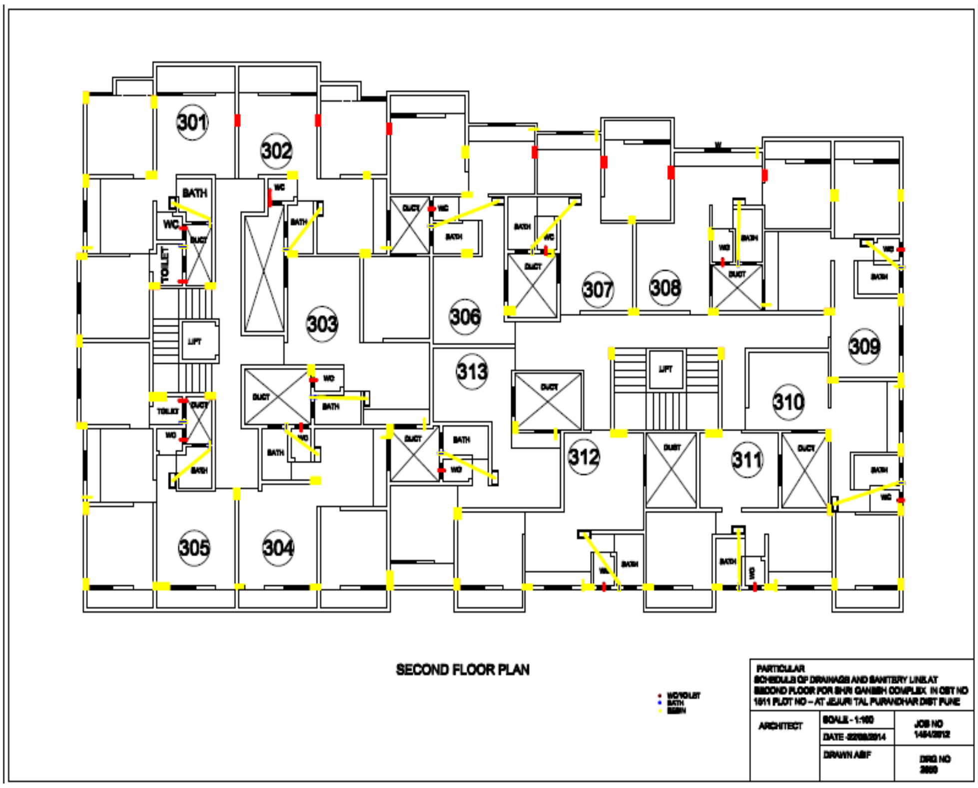

Figure 8: Third floor plan

Figure 9: site visit photo

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Figure 10: Site visit photo

In the final conclusion of system where apply our safety environmental parameters on vaishnavi construction. In traditional development we ahve illustrated conventional construction time estimation as well as cost estimation respectively. In the experiment we have seen, the safety environment should be reduced overall time consecutively, while it can be increase the cost respectively. According to above table 3.7.1 discuss about total cost estimation of complete project of Vaishnavi developers. According to overall discussion system also describe once we applied the safety parameters it can be increase around 2.63% cost in overall project cost which is define already, while it can reduce 2.53% in overall time estimation.

Based on the above calculations we can conclude the safety environment should be increased the cost as well as reduce the time. The basic benefit they have to apply the safety environment during the construction which will provide us safety environment to workers, where they can work with 100% commitment, and which reflect the reduction of time in wall construction.

ANALYSIS AND DISCUSSION

Design Process

In the remaining sections of this topic, you will follow the standard steps for designing neural networks to solve problems in four application areas: function fitting, pattern recognition, clustering, and time-series analysis. The work flow for any of these problems has seven primary steps. (Data collection in step 1, while important, generally occurs outside the WEKA environment.)

1 Collect data
2 Create the network
3 Configure the network
4 Initialize the weights and biases
5 Train the network
6 Validate the network
7 Use the network

Analysis

Step 1: To select the Artificial Neural Network Tool with multiple inputs.
Step 2: To select the data and train the tool. It is neural network or data set type.

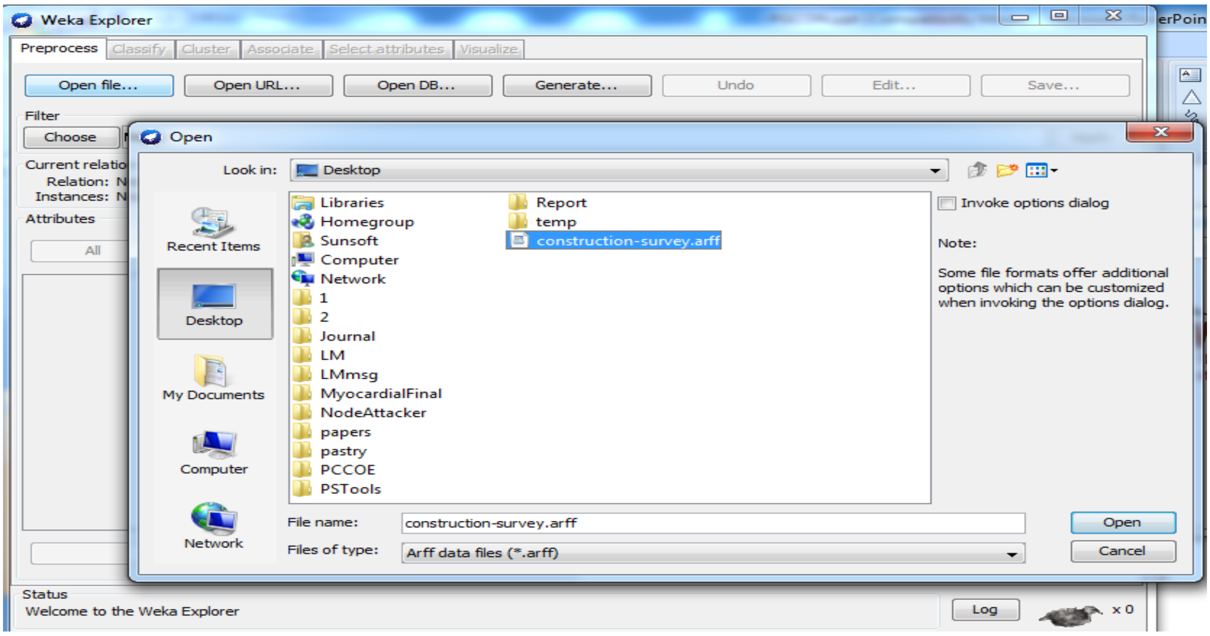

Figure 11: Select data set

Step 3: By training all the parameters get the output. The value of output is between 0 to 1. Each parameter is connected to the each hidden layer and apply multi layer perception from weka cluster.

ANN Ranking evaluation

Commitment

Table 5 :Commitment base factors evaluation and Ranking

Factors	ANN Weight	Rank
Management clearly considers safety to be equally as important as production (Commi 1)	0.510	**1**
Management expresses concern if safety procedures are not adhered to. (Commi 2)	0.487	**2**
Management acts decisively when a safety concern is raised (Commi 3)	0.455	**3**
Management acts quickly to correct safety problems(Commi 4)	0.425	**4**
Management acts only after accidents have occurred (Commi5)	0.417	**5**

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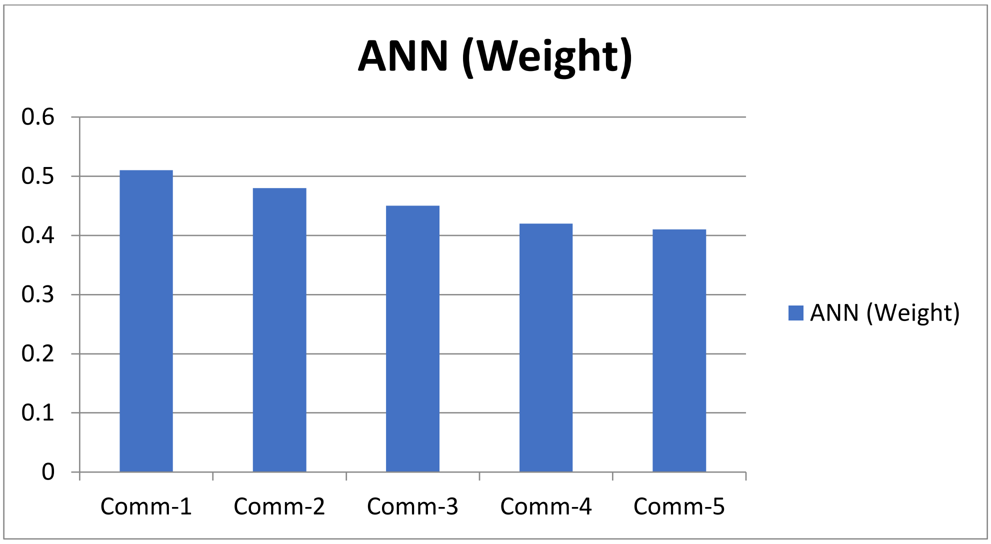

Figure 12 : Commitment base factors evaluation and Ranking

Communication

Table 6 :Communication base factors evaluation and Ranking

Factors	ANN Weight	Rank
Management clearly communicates safety issues to all levels within the organization (Communication) (Commu 1)	0.612	**1**
Management continues to bring safety information to site employees' attention (Commu 2)	0.558	**2**
Management operates an open-door policy on safety issues (Commu 3)	0.552	**3**
Management have provide any safety instruments to all the field employees (Commu 4)	0.540	**4**
Management encourages feedback from site employees on safety issues (Commu5)	0.510	**5**

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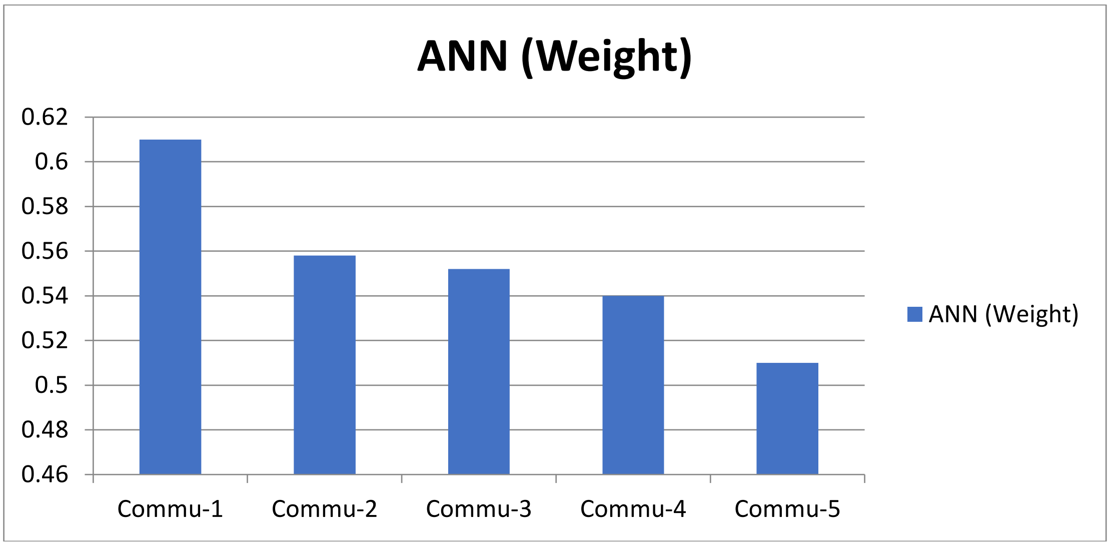

Figure 13 :Communication base factors evaluation and Ranking

Validation of results

For the validation of proposed study, we evaluate our results with real time construction projects. The finally we shows current scenarios for safe environment in real time construction. We have validate the results with Vaishnavi Developers, the tables 4.4.1 is the rank result with each parameter.

Table 7. Safety Parameters achieved from proposed study

Input	Rank
Supervisory environment	1
Workers' involvement	2
Appraisal of physical work environment and work hazards	3
Work pressure	4
Personal appreciation of risk	5
Communication	6
Competence	7
Supportive environment	8
Commitment	9
Life Cover	10
working hours	11
Safety rules and procedures	12

Table : 8 Safety Parameters followed Vaishnavi developers

Input	Rank
Supervisory environment	1
Workers' involvement	2
Work pressure	3
Appraisal of physical work environment and work hazards	4
Personal appreciation of risk	5
Communication	6
Competence	7
Supportive environment	8
Commitment	9
Safety rules and procedures	10
working hours	11
Life Cover	12

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The Table 7 and 8 show the comparison between two different systems, Table 7 is our achieved ranked parameters from proposed study, and 8 is the Safety Parameters followed Vaishnavi developers. The proposed study is around 85% truly recommend with real time environment. So, the proposed results can be 100% validate for safety environment parameter in construction projects.

CONCLUSION

The findings indicated that the relationship between perceived safety performance and inappropriate safety procedure and work practices was inversely correlated. The results suggest that safety climate can be used as an effective measure of assessing and improving site safety for projects under construction. The findings of this study and the methodology might be useful for research at other construction sites in other regions and countries. This work provides useful information for project managers and safety practitioners who desire to improve safety climate and safety performance on construction sites. The above survey show the how we can maintain the safe work into the construction environment. For end user precaution we must need to close immediately if current recommend is failed on construction site.

Finally we conclude with this study below

- This study found that safety rules and procedures, including around 12 different safety parameters.
- This research developed a model based on ANN to gauge the safety work on creation projects considering ten constructs of safety climate.
- We collect data from around 70 surveys and given input to weka tool and get recommendation using Artificial Neural network.
- Final re-rank all recommended parameters which is given by weka tool and apply the same recommended parameters on Vaishnavi developers for case study.
- Finally conclude the accuracy of recommended parameters and validate the proposed research.

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