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RESEARCH ARTICLE

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COMPARISON OF GRAPHICAL AND STATISTICAL METHOD TO SAFELY MANAGE CONSTRUCTION SITES

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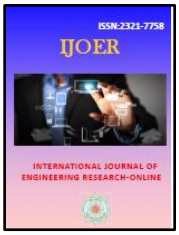

ABSTRACT
Construction sites are always hazard prone. Also, many activities are being carried out at the same time. Managing safety on site has always been a must for the construction industry. Preventive measures always have to be taken care of for the betterment of the employees and the workers. Hence, a questionnaire survey is carried out. The questions in the questionnaire are divided into different six categories which regard to a particular safety practice which should be followed on site. The "SPSS v -16.0" is used to analyze the data obtained from the questionnaire survey. For SPSS a few pre essential test are to be fulfilled so that the basic further analysis could be carried out. Principal Analysis is the method used of factor analysis to extract the major safety practices to be followed on site. A scree plot analysis have also been made to extract the important factors. A thorough comparison is made among the graphical method and the SPSS software Output
Key words – Safety Management; Principal Component Analysis; Safety Practices; Scree Plot, Graphical Method, SPSS.

I. INTRODUCTION

Construction industry is one of the largest employer in many countries. The extensive part is played is by the labours. Their contribution is very crucial to all construction projects. Because of lots of construction work taking place together a check on the sites is to be kept vigilantly. Therefore a proper preventive measures should be taken so that injuries on sites can be avoided. This would even result in reduction of accidents. Due to this there would be uniformity on the pace of the project. Hence, a questionnaire survey was carried out. The questionnaire contains 50 questions which are sub divided into 6 categories Both graphical analysis as well as SPSS is used to deduce results. These practices would aid in following safety management on site. A brief comparison is performed in this paper. A safety practices to be implemented on sites depend on the scale of site. The safety management on a particular site even differs from fro organization to organization. The organization safety policies even play a vital role in managing safety on sites. Not managing safety on site will not only causes losses but also there might be discontent among the clients.

II. LITERATURE REVIEW

The previous work on safety has been evolved a lot through past years. Firstly the accident data previously recorded was collected and OSHA postulate of incident ratio was used [7]. The safety rules followed in different countries is different. This also depends on the type of country i.e. developed or developing.. Elaborate study of various I. S. codes related to safety on site is studied along with the labour laws etc. Generally, the data of the accidents is not much preserved by the organizations. The

management of safety on site started by use of backup alarms for the accidents caused by the maneuvering trucks which loaded the materials on the site. The terms such as 'Safety Climate', 'Safety Cultures were even introduced [1]. Various methods to assess safety on site were highlighted. They mostly included 'Soft Computing Methods'. They have incorporated in them the methods such as the structural equation models, the artificial neural networks and even the statistical analysis. Various instrument can be used to measure different safety climate aspects. [1]. The questionnaire is devised by the use of previous research work itself. Factor analysis is generally to extract major factors [8]. Even a survey of the migrant workers was done. Their

III. METHODOLOGY

After reviewing the previous research work, a questionnaire is devised and a survey is carried out. The respondent in such a way that opinions from all classes of people working on Civil Engineering were taken into consideration. This was done in order to get the response from each class so that a completely experienced as well as the current drawbacks are taken care of. It contains 50 questions. These questions are classified into 6 categories which correspond to one site practice to be implemented on site. The responses to be given marked on a scale of 1-5(which go from strongly agree to strongly disagree) i.e. on 5 point likert scale. This is circulated amongst the people related to safety on site. A detail description of the respondent is given below in the table.

TABLE I DESIGNATION ALONG WITH NUMBER OF RESPONDENT

Sr.No.	Designation	Number of Respondents
1.	Junior Engineer	37
2.	Senior Engineer	05
3.	Deputy Engineer	06
4.	Assistant Civil Engineer P.W.D	01
5.	Developer	01
6.	Design Engineer	03
7.	Site Engineer	22
8.	Project Manager	09
9.	Planning Engineer	01
10.	Contractors	06
11.	Lecturers or Professors	03
12.	Builders	02
13.	Quantity Surveyor	01
14.	Officers (Volkswagen)	04
15.	Safety Officers	03
	Total	104

TABLE I does gives the complete information about the Respondents and the number of people. The basic steps involved in the methodology are

i. Literature Study
ii. Designing Questionnaire and data collection.
iii.. Plotting Frequency distribution charts.
iv. Understanding of the software (SPSS)
v. Data Analysis using SPSS
vi. Comparing the two results.

Frequency Distribution for the responses

Histograms and bar charts are both visual displays of frequencies using columns plotted on the graph. Here Y- axis represents the frequency count and the X- axis represents the variable being measured. As mentioned earlier the questions in the questionnaire was classified into 6 category. They are mentioned as below

A. Basic Safety Regards. (1-6)

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Vol.6., Issue.4, 2018
July-Aug.

B. Enforcement Checks on Sites for Safety (7-14)
C. Training Programmes to be implemented on site (15-22)
D. Personal Protective Equipment (23- 28)
E. Sufficiency of adopted measures (29- 35)
F. Safety Auditing on site (36-50)

Each category is has been named as 'a', 'b' , 'c', 'd', 'e' and 'f'. the graphs are as plotted below for each categories-

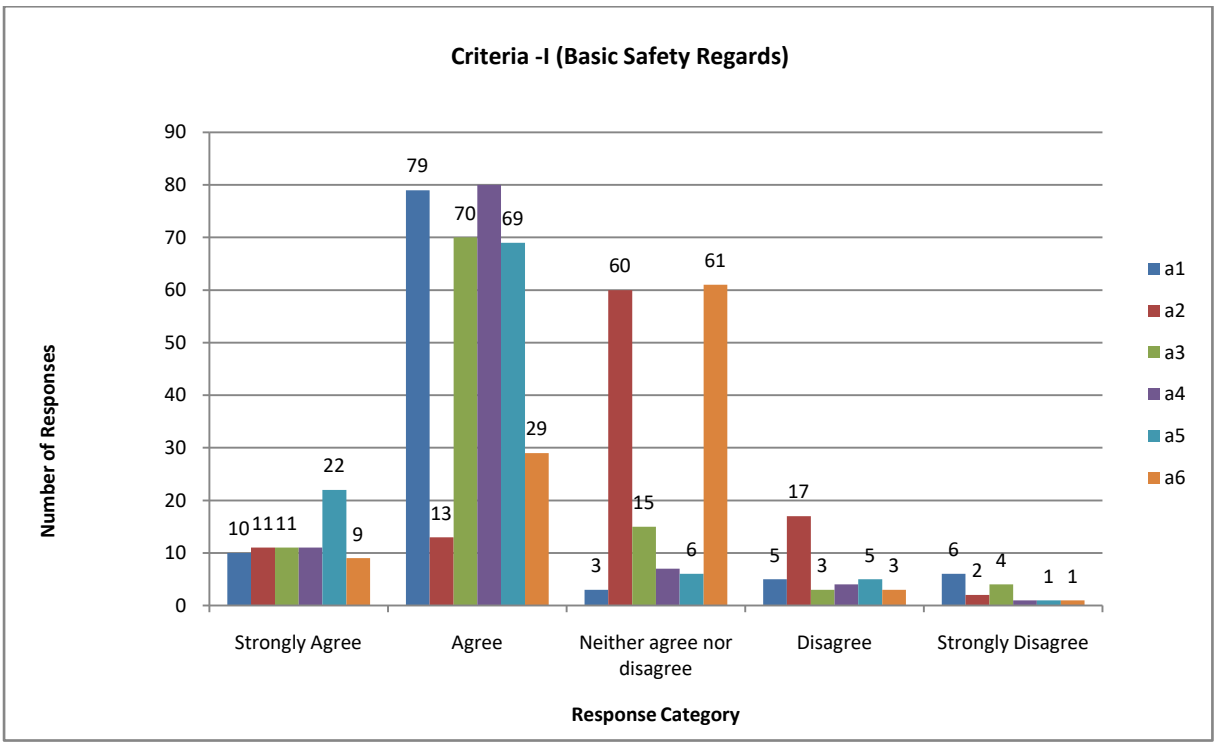

FIGURE I

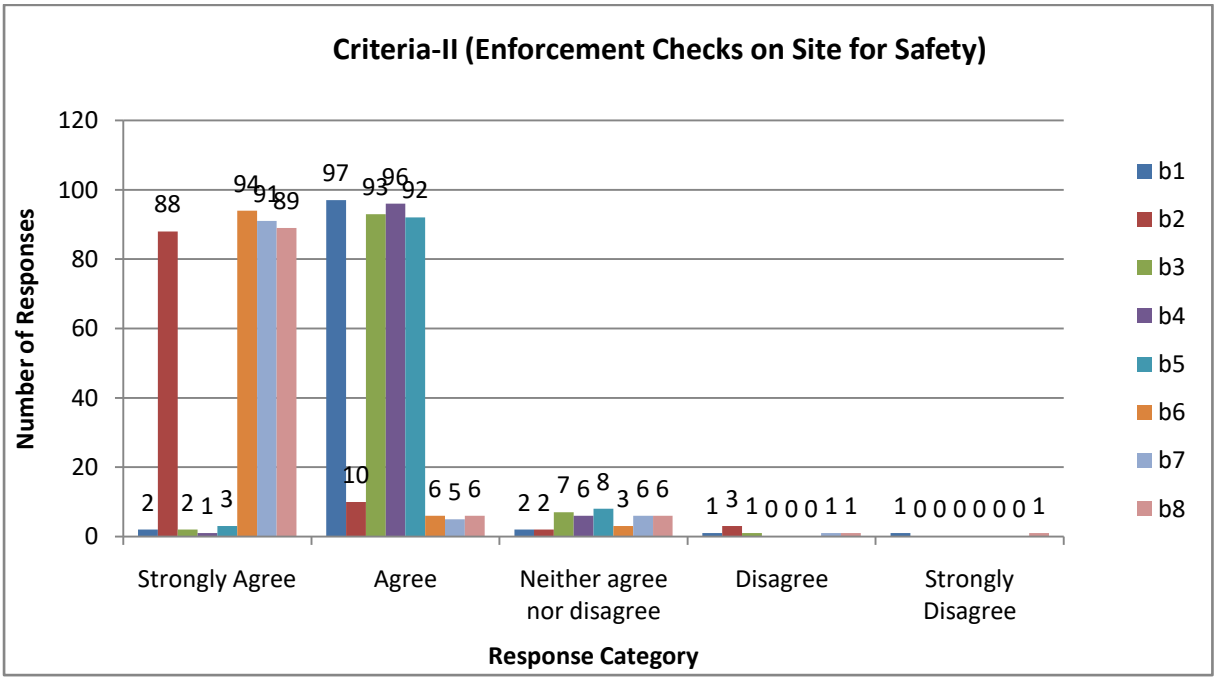

FIGURE II

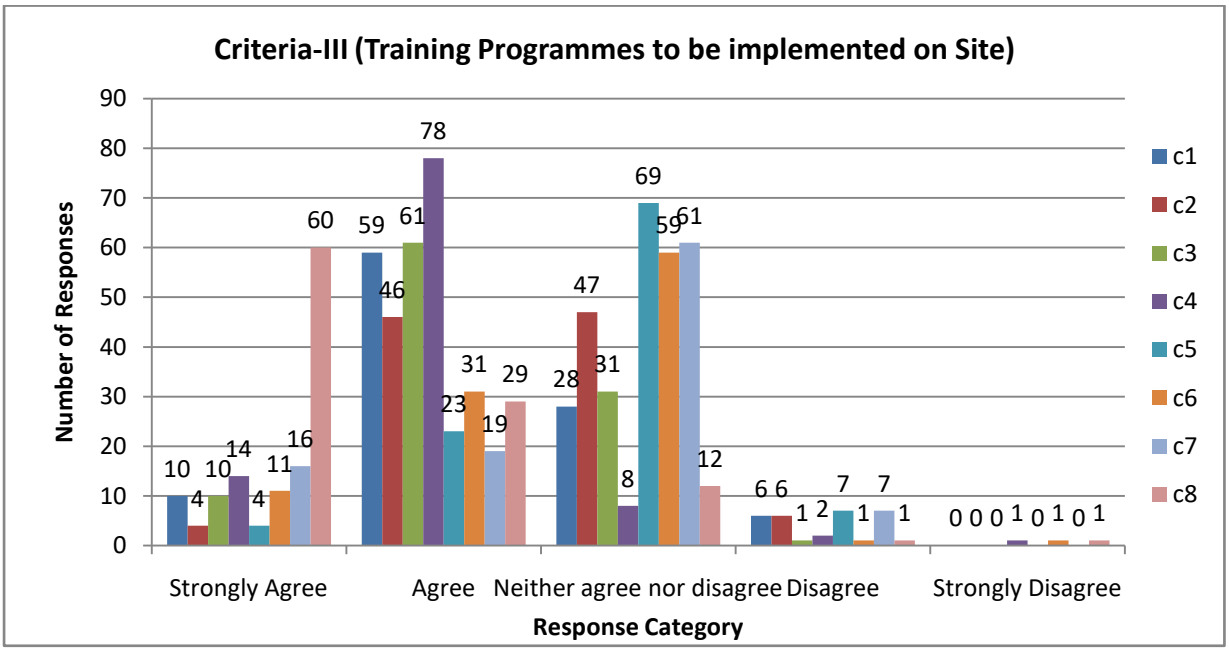

FIGURE III

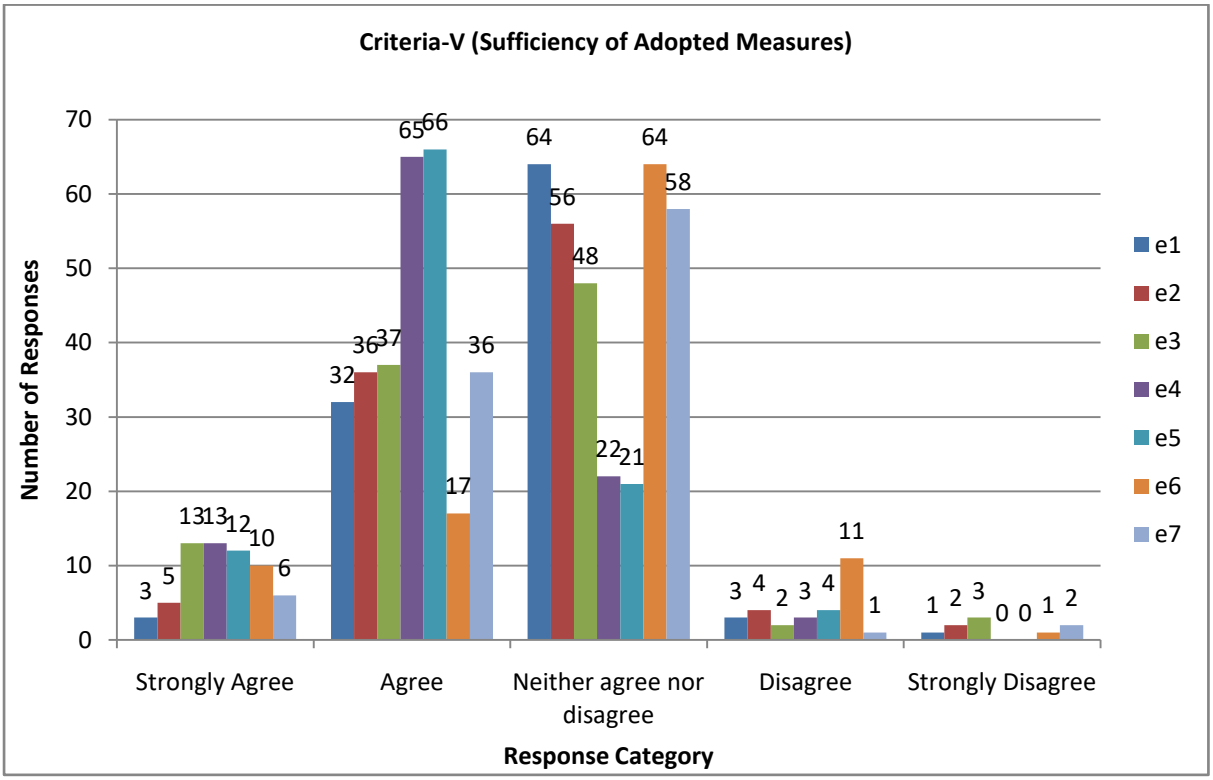

FIGURE IV

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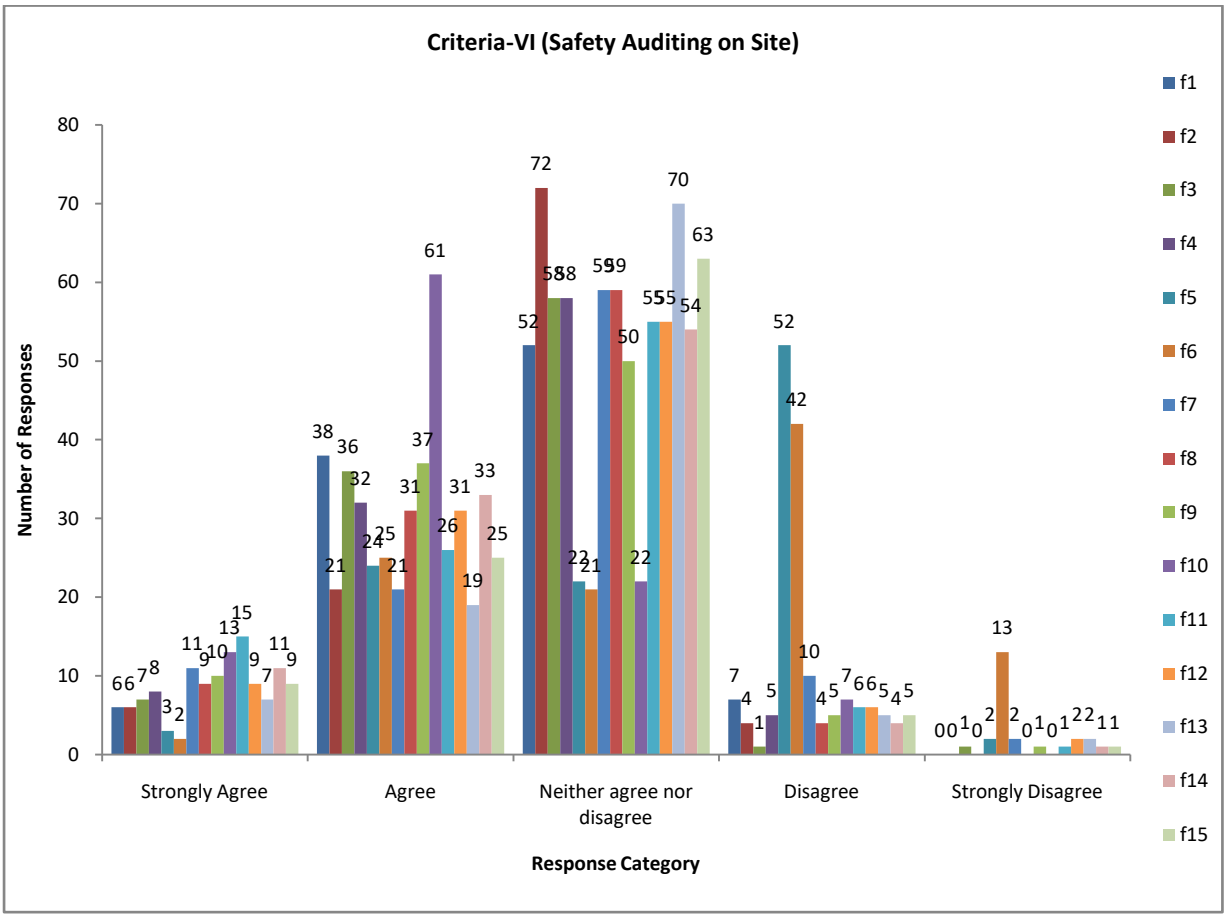

FIGURE V

A mixed result is obtained. The graphical method does not help us to draw proper conclusion. Hence, the data obtained has to be processed. So for further analysis SPSS is used. SPSS is the "Statistical Package for Social Sciences". It is very useful in statistically analyzes data. The Major tests to be performed are

I. Reliability Analysis
II. Factor Analysis
III. Scree Plot Observations

I. Reliability Analysis

The reliability Analysis is a pre requisite for checking whether Factor Analysis can be performed or not. The reliability Analysis checks whether the variables are interlinked upto what extent... This test gives us the internal consistency of the recorded results. It is measured in terms a co-efficient known as the "Cronbach's Alpha." The range of cronbach's alpha lies between 0-1. The range of the cronbach's alpha and it's significance is given as below

TABLE II RANGE AND SIGNIFICANCE OF CRONBACH,S ALPHA

Sr.No.	Range	Significance
1.	_ > .9	Excellent
2.	_> .8	Good
3.	_ > .7	Acceptable
4.	_> .6	Questionable
5.	_> .5	Poor
6.	_ < .5	Unacceptable

II. Factor Analysis

The SPSS is one of the user friendly Software. After the reliability test used the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (Kaiser 1970) and Bartlett's test of sphericity (Bartlett 1950) is the next step to assess the adequacy of correlation matrices for factor analysis. These tests are equally important for finding out

usability of data for performing factor analysis along with Reliability Test. Reliability test assesses only reliability of scale used while KMO test measures adequacy of sample and Bartlett's test of sphericity suggests relationships between variables.

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy provides a co-efficient between 0 and 1 of the proportion of variance among the variables that might be common variance (i.e., that might be indicative of underlying or latent common factors). The SPSS suggests that, KMO results near 1.0 supports factor analysis and that are less than 0.5 is probably not useful for prforming factor analysis.

For a large sample Bartlett's test estimates a chi-square distribution. The Bartlett test gives positive results for large sample size, but it is less reliable for small sample size. Very small values of significance below 0.05 indicate a high probability that there are significant relationships between the variables, whereas higher values that is 0.1 or above indicate the data is inappropriate for factor analysis To perform factor analysis few test should be performed and must show positive results initially along with reliability test. After appropriateness of using factor analysis is confirmed it will be used for further analysis. Here the test results for KMO & Bartlett Test which are essential to find out appropriateness of using factor analysis.

IV RESULT AND DISCUSSION

These safety site conditions which are to be followed crucially on site should have more than 60 responses as strongly agree. But in our case responses are mixed. They range from agree to neutral. Hence certainly the data has to be processed. Following are the results are obtained by processing the data using SPSS

I. Reliability Analysis

After performing Reliability Analysis we get the value of co-efficient as-

TABLE III VALUE OF CRONBACH'S ALPHA

Cronbach's Alpha	Cronbach's Alpha based on Standardized Items	N of Items
0.928	0.926	50

The Cronbach's Alpha thus shows excellent internal consistency according to the range.

II. Factor Analysis

The Table IV below shows the results for KMO and Bartlett's Test.

TABLE IV KMO AND BARTLETT'S TEST RESULT

Kaiser-Meyer-Olkin measure of sampling Adequacy		0.625
Bartlett's Test of Sphericity	Approx.Chi-Square	4.3863
	Df	1225
	Sig.	.000

TABLE IV shows the data adequacy to establish relationship between the variables.

III. Scree Plot and Observations

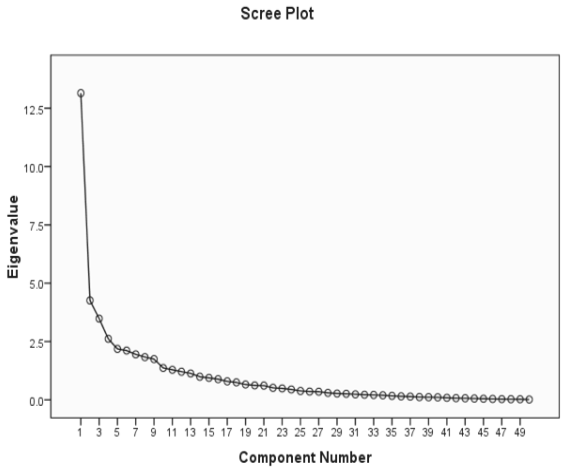

FIGURE VII

The above graph (Fig I) shows Scree Plot of the recorded data. The selection of factors is done till the point where the graph changes it's slope. The change in slope thus occurs prominently twice and slightly around component number 13. Hence, 13 factors are to be extracted. So for further analysis of data in SPSS Factor analysis is used in this work. The concept of factor analysis is explained already.

V. CONCLUSION

After graphically plotting the responses we get the frequency distribution histograms. These graphical representations do not give a clear idea of which safety practices are of maximum significance so as to extract major factors.

The reliability analysis Table III i.e. Cronbach's Alpha shows that the data has good internal consistancy and thus factor analysis can be performed.

Further, The Table IV below shows the results for KMO and Bartlett's Test. As the value for KMO test is 0.625 which is near to 1.0 it indicates that the sample size is adequate to perform factor analysis of data. Also in Bartlett's Test of Sphericity value of significance is 0.000 which is less than 0.05 indicates significant relationships between all variables. This result suggests that Factor analysis can be performed on this questionnaire survey data for further analysis.

Finally, the scree plot gives us the crucial factors to be retained. These extracted factors are nothing but safety practices and the situation corresponding them in the questionnaire. These factors cannot be deduced by graphical analysis.

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