Journal of Advances and Scholarly Researches in Allied Education
Vol. XV, Issue No. 2, (Special Issue) April-2018, ISSN 2230-7540

Occupational Health Risk Assessment "T-Test"

Suresh R. Sawant[1]* S. S. Chavan[2]

[1] Assistant Professor, Department of Civil Engineering, NESGI, Pune Maharashtra, India

[2] Assistant Professor, Department of Civil Engineering, TKIET, Warana, Maharashtra, India

Abstract – The construction industry is recognized to be highly prone to risks and is characterized to be very complex, dynamic, and unique where uncertainties arise from various sources. The main objective of this research was to identify the factors affecting occupational health risk during construction of high rise building & to assess the risk during different construction activities. In the present study, field survey is done at forty two sites in western Maharashtra such as construction sites in Pune, Satara, sangli and Kolhapur city and data is collected for assessment of risk causes affecting occupational health in construction. In this study various risk causes were found out with help of questionnaire survey. These questionnaires were given to the experienced site engineers and data were collected. These data was then analyzed with the help of two different methods, named Relative Importance Index method and T-test analysis using SPSS. Results were calculated and shown with the help of graphical and tabular representation.

Keywords – Occupational Health, Risk Assessment, ORI.

----------X----------

I. INTRODUCTION

In general meaning of the risk can be defined as "action that endangers something what has a value". Construction sector is one of the most influenced segments of the unorganized labor in our country. Recently, Indian construction industry has experienced considerable growth in construction activities. The high rate of urbanization and Infrastructure development in India shows the demand of residential & commercial consumers. This results as increase in number of construction Projects by creating an employment opportunity for wide range of labor force such as skilled worker, semi-skilled worker & unskilled worker. The sector is labor-intensive and including indirect jobs, provides employment to more than 35 million men power. Throughout the world, most adults and many children spend much of their waking hours at completing task associated with work. Work gives a number of income sources and other remuneration. Despite its importance, construction sites have been regarded as very risky areas where construction workers are subject to fatalities and ill-health problems. Many building construction activities are inherently risky to health and safety of workers. It affects to productivity & overall performance of construction project & diminishing the workforce/labor force etc. Efforts are focused towards finding solution to assess risk at construction projects. Risk assessment is one of the integral parts of occupational health and safety management plan. Risk assessment helps to find out causes of risk as well as create awareness of risk and hazards and also finds who may be at risk. The idea to assess risk even at the comparatively smaller construction activities like construction of residential and commercial high rise building complexes is found new but important and determination of occupational health risk assessment is found essentially needed in future.

II. FACTORS AFFECTING OCCUPATIONAL HEALTH RISK

Factors affecting occupational health risk during construction are identified from literatures & also with the help of experts in the field of construction. Total 12 factors was identified, e.g. Workers instincts, workers capabilities, communication between the workers and between workers and supervisors, condition of tools & equipments, safety culture, etc. The factors are then listed & grouped in 12 factors. Then finally regrouped into 5 main groups as shown in fig 1.

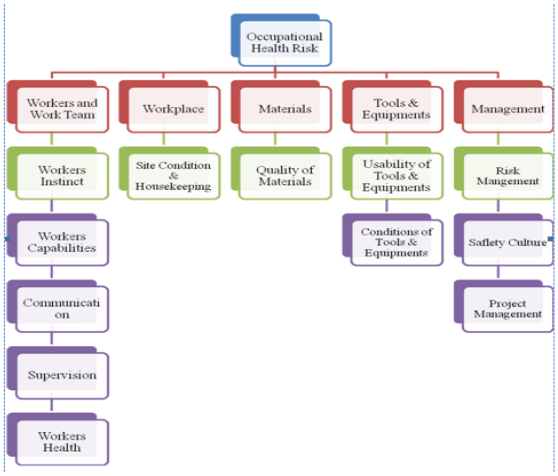


Fig 1:- Factors Affecting Occupational Health Risk

A. Workers & Work Team Oriented

Problems arising from workers or the work team, especially worker actions or behavior and worker capabilities, unsafe acts, safety being overlooked in the context of heavy workloads and other priorities, workers taking shortcuts to save effort and time, etc.

B. Workplace Oriented

Workplace oriented factors includes poor housekeeping and problems with the site layout and space availability, lack of clearly defined walkways, constantly changing workplace and work activities, poor site conditions such as uneven ground or debris &muddy conditions, inadequate space or difficult access to perform a task & weather conditions during construction activities, etc. typically causes slip and trip hazards, etc.

C. Materials Oriented

Deficiencies with the suitability and condition of materials, including packaging, hazards were either inherent to the materials, as with the extremely heavy. Materials packaging can also cause problems with disposal, leading to other hazards introduced onto site (e.g. fall or fire hazards). Suppliers have to paid attention to the manual handling requirements of some materials, through the introduction of smaller cement bags, etc.

D. Tools & Equipments Oriented

A number of the hazards in past occurred due to tools & equipment's on construction site. Some of the incidents involved struck by machinery/vehicle, contact with hand held tools, vibration, etc. Injuries in several accidents arise from individuals striking their head or other body part against machinery. These hazards either due to poor configuration, site constraints or equipment limitations, etc.

E. Management Oriented

The management oriented causes of construction hazards are the high level source of the nature, extent and existence of immediate causes of accidents. Some researchers referred it as 'root causes'. It seems very clear that these causes do affect safety on construction sites. Many construction firms ignored risk assessment for the accident activities, despite this being a legal requirement, even for activities 'off-task'. Also, need of education & training exists across the industry, encompassing designers and suppliers, as well as site-based personnel, to raise awareness and understanding of the occupational health risks that are commonplace in construction.

III. METHODOLOGY

In present study of assessment of risk causes, field survey was conducted to get actual information regarding site situation, hazards occurred on site and factors affecting workers health. 42 sites in pune, satara, sangli & Kolhapur region selected for field survey and were conducted by distribution and collection of forms from experts for identification of important factors causing risk in construction and probabilities of various risk on site during construction activities and its impact also required data for this research taken from previous studies conducted on occupational health risk, risk assessment models, published papers and other related literature. five point rating scale were used in Data collected from experts in form of questionnaires for finding relative importance index and t-test analysis which consist of 1-very low impact,2-low impact,3-average impact,4-high impact,5-very high impact. Data obtained from experts was then analyzed using Relative importance index and T-test. Relative Importance Index method helps to determine the relative importance of the each factors affecting to occupational health risk which is given by

$$\text{R.I.I.} = \frac{}{5(n5+n4+n3+n2+n1)}$$

Where,

1, 2, 3, 4, 5, etc. are rating scale,

n1, n2, n3, n4, n5, etc. are no. of respondents.

T-Test decides which cause is more impacting on the project work. Mean of the population of 12 causes is μ nearly equal to 2.8 making on an average impact on construction project work due to occupational health risk for western Maharashtra. Here T-Test decides which cause is more impacting on the project work and it is calculated below.

Mean of population H_0 : μ =2.80

S.D of mean S.E of $\bar{X}$ = 0.14872

H_0 : Very nearly the average impact on the project

Case 1: $t = \left| \frac{\bar{X}-\mu}{S.E} \right| < 1.96$ then H_0 is true

Accept it at 5% level that means there is less impact of those cases.

Case 2: $t = \left| \frac{\bar{X}-\mu}{S.E} \right| > 1.96$ then H_0 is False

Reject it at 5% level of significance than risk factor is significantly dominant making effect.

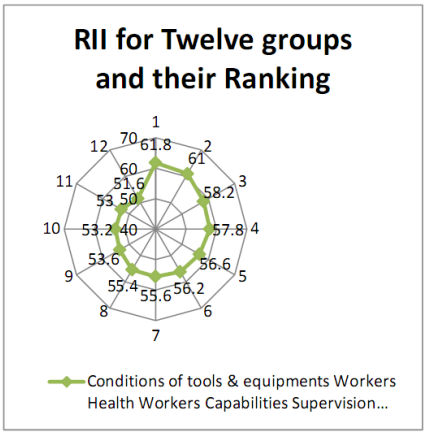
III. RESULTS

Data obtained from experts was then analyzed using Relative importance index and T-test. The results are tabulated as below

TABLE 1

Top Ten Risk Factors according to RII				
Sr. No	Factors	Mean	RII	Rank
1	Conditions of tools & equipments	3.09	61.8	1
2	Workers Health	3.05	61	2
3	Workers Capabilities	2.91	58.2	3
4	Supervision	2.89	57.8	4
5	Project Management	2.83	56.6	5
6	Safety culture	2.81	56.2	6
7	Communication	2.78	55.6	7
8	Usability of tools and equipments	2.77	55.4	8
9	Site Conditions & housekeeping	2.68	53.6	9
10	Workers instinct	2.66	53.2	10
11	Quality of Materials	2.65	53	11
12	Risk Management	2.58	51.6	12

RII FOR TWELVE GROUPS AND THEIR RANKING



Graph 1 RII for Twelve groups and their Ranking

TABLE 2

T-TEST ANALYSIS FOR RISK CAUSES

T Test analysis					
Risk Factor	Mean	SD	t-value	t abs	Impact
IRRESPONSIBLE_WORKER	4.07	0.648	8.5	8.5	High
LAZY_MOVEMOMENT_DUE_TO_LACK_OF_TRAINING	3.22	0.69	2.8	2.8	High
SATIESFACTORY_RESPONCE_TO_ACTION	2.29	0.68	-3.4	3.4	high
QUICK_RESPONCE_T0_ACTION	1.68	0.879	-7.5	7.5	high
NEW_WORKER_WITH_SOME_SKILL	4.07	0.755	8.5	8.5	high
NEW_WORKER_WITHOUT_skill	3.17	0.543	2.5	2.5	High
AVERAGE_WORKER	2.34	0.48	-3.1	3.1	High
EXPERIENCED_WORKER	1.41	0.499	-9.3	9.3	High
IF_NO_COMMUNICATION	4.07	0.932	8.5	8.5	High
LESS_CONICATIONMMU	3.49	0.675	4.6	4.6	High
AVERAGE_COMMUNICATION	2.73	0.549	-0.5	0.5	Less
GOOD_COMMUCATION	1.76	0.538	-7.0	7.0	High
EXCELLENT_COMMUNICATION	1.37	0.581	-9.6	9.6	High
WITHOUT_SUPERVISION	4.07	0.848	8.5	8.5	High
EXCELENT_SUPERVISION	2.78	0.909	-0.1	0.1	Less
SICK_HEALTH	1.54	0.596	-8.5	8.5	High
CHILD_AND_OLD	4.22	0.791	9.5	9.5	High
SATIESFACTORY_HEALTH	3.59	0.836	5.3	5.3	High
STRONG_HEALTH	2.85	3.135	0.3	0.3	Less
POOR_HOUSE_KEEPING	1.61	0.833	-8.0	8.0	High
INCONVENENT_LOCATION	3.66	0.617	5.8	5.8	High
PROPER_LOCATION	2.66	0.693	-0.9	0.9	Less
INFEROR_QUALITY	1.66	0.693	-7.7	7.7	High
FAIR_QUALITY	3.95	0.999	7.7	7.7	High
GOOD_QUALITY	3.2	0.558	2.7	2.7	High
VERY_GOOD_QUALITY	2.12	0.748	-4.6	4.6	High
IMPROPER_EQUIPMENT	1.41	0.591	-9.3	9.3	High
WELL_MAINTAINED_EQUIPMENT	3.93	0.932	7.6	7.6	High
SOPISTICATED_EQUIPMENT	2.66	0.794	-0.9	0.9	Less
OLD_EQUIPMENT	1.71	0.782	-7.3	7.3	High
EQUIPMENTS_USED_OCCASIONLY	4.27	0.633	9.9	9.9	High
MAINTAINED_EQUIPMENT	3.07	0.787	1.8	1.8	Less
NEW_TOOLS_WITH_CALIBRATION	2.27	0.672	-3.6	3.6	High
NO_CONSIDERATION	1.44	0.594	-9.1	9.1	High
FEW_STEP_FOR_HEALTH_RISK	3.68	0.934	5.9	5.9	High
RISK_MITIGATION_PLAN_READY	2.51	0.637	-1.9	1.9	Less
NO_SAFETY_AWRENESS	1.61	0.666	-8.0	8.0	High
UNAVAILABILITY_OF_PPE	4.46	0.596	11.2	11.2	High
AWARE_@_SAFETY_NORMS	3.59	0.706	5.3	5.3	High
AWARE_@_SAFETY_NORMS	2.8	0.872	0.0	0.0	Less
TRAINED_TO_USE_PPE	1.98	0.474	-5.5	5.5	High
MOTIVATED_WORKFORCE	1.24	0.435	-10.5	10.5	High
POORLY_MANAGED	4.12	0.812	8.9	8.9	High
UNPROFESSIONALY_MANAGED	3.29	0.559	3.3	3.3	High
PROFESSIONALY_MANAGED	2.29	0.814	-3.4	3.4	High
MANAGEMENT_WITH_LATEST_TOOLS	1.51	0.81	-8.7	8.7	High

IV. DISCUSSION

Table 1 shows RII for twelve risk factor. Factor Worker instinct has relative importance index value 53.20 and got rank 10th. It has mean score 2.66 in likerts 5 point scale it occupies place between low impact and average impact on construction. Factor Workers Capability has Relative Importance Index value 58.20 and got rank 3rd.It has mean score 2.91. In likerts five point scale it occupies place between low impact and average impact on Construction. Factor Communication has Relative Importance Index value 55.60 and got rank 7th.It has mean score 2.78. In likerts five point scale it occupies place between low impact and average impact on construction. Factor Supervision has Relative Importance Index value 57.80 and got rank 4th.It has mean score 2.89. In likerts five point scale it occupies place between low impact and average

impact on construction. Factor Workers Health has Relative Importance Index value 66.00 and got rank 2nd.It has mean score 3.05. In likerts five point scale it occupies place between average impact and high impact on construction. Factor Site condition and housekeeping has Relative Importance Index value 53.60 and got rank 9th.It has mean score 2.68. In likerts five point scale it occupies place between low impact and average impact on construction. Factor Quality Of material has Relative Importance Index value 53.00 and got rank 11th. It has mean score 2.65. In likerts five point scale it occupies place between low impact and average impact on construction. Factor Visibility of Tools and Equipment has Relative Importance Index value 55.40 and got rank *8th*.It has mean score 2.77 which is in between 2 & 3 place of likerts scale so it makes average impact on construction. Factor Condition of Tools and Equipments has Relative Importance Index value 61.80 and got rank ***1st***.It has mean score 3.09. According to likerts five point scale it has got high impact on construction. Factor Risk consideration Factor has Relative Importance Index value 51.60 and got rank *12th*.It has mean score 2.78. In likerts five point scale it occupies place between low impact and average impact on construction. Factor Safety Culture has Relative Importance Index value 56.20 and got rank *6th*.It has mean score 2.81. In likerts five point scale it occupies place between low impact and average impact on construction.

Factor Project Management has Relative Importance Index value 56.60 and got rank *5th*. It has mean score 2.83. In likerts five point scale it also occupies place between low impact and average impact on construction. Table 2 shows T-test analysis which shows that which risk factor has high impact on construction and which risk factor has low impact factor.

V. CONCLUSION

The first three causes at construction project that contribute for making construction site unsafe are conditions of tools and equipments is ***1st*** risk factor, Workers Health ***2nd*** risk factor and Workers Capability is 3*rd* risk factor. The severity of individual risk cause within twelve factors is given by T-test rated as high or low.

ACKNOWLEDGMENT

Authors are thankful to Prof. B. V. Birajdar for encouragement and valuable guidance all the time.

REFERENCES

Abel Pinto, Isabel L. Nuns, Rita A. Ribera (2011). "Occupational Risk Assessment in Construction Industry – Overview and Reflection", *Safety Science* 49, pp. 616–624.

Adane MM, Gelaye KA, Beyera GK, Sharma HR, Yalew WW (2013). "Occupational Injuries Among Building Construction Workers in Gondar City, Ethiopia", Occup Med Health Aff 1: 125. doi: 10.4172/2329-6879.1000125.

Adel Badri, André Gbodossou, Sylvie Nadeau (2012). "Occupational Health and Safety Risks: Towards the Integration into Project Management", Safety Science 50, pp. 190 – 198.

Ching-Wu Chenga, Sou-SenLeub, Ying-Mei Chengc, Tsung-ChihWud & Chen-Chung Line (2012). "Applying Data Mining Techniques to Explore Factors Contributing to Occupational Injuries in Taiwan's Construction Industry", Accident Analysis and Prevention 48, pp. 214–222.

Hyoung-June Im, Young-Jun Kwon, Soo-Geun Kim, Yong-Kyu Kim, Young-Su Ju, Hwa-Pyung Lee (2008). "The Characteristics of Fatal Occupational Injuries in Korea's Construction Industry, 1997–2004", Safety Science 47, pp. 1159–1162.

Jaya Prasad Tripathy (2014). "Occupational Health Hazard in India: Need for Surveillance and Research" Current Science, Vol. 106, No. 5.

Kania, M. Spilka, G. Cieśliński (2012) . "Occupational Risk Assessment at the Work Station in the Selected Enterprise", Journal of Achievements in Materials and Manufacturing Engineering 51/2, pp. 90-98.

Maria del Mar Casanovas; Jaume Armengou & Gonzalo Ramos (2013). "Occupational Risk Index for Assessment of Risk in Construction Work by Activity", ASCE J. Constr. Eng. Manage. 04013035-1 to 04013035-9.

Marta Gangolells, Miquel Casals, Núria Forcada, Xavier Roca & Alba Fuertes (2010). "Mitigating Construction Safety Risks Using Prevention Through Design" Journal of Safety Research 41, pp. 107–122.

Mohit Gupta, ANROEV Network & Jagdish Patel, (13/04/2014), "Status of Occupational Health in India",

Mohmd Sarireh,Sultan Tarawneh (2014). "Safety Concept, Value and Cost in Construction Projects in Jordan",International Knowledge Sharing Platform ISSN 2224-5790 (Paper) ISSN 2225-0514 (Online) Vol.6, No.5.

Noni Holmes, Helen Lingard, ZeynepYesilyurt & Fred De Munk (1999). "An Exploratory

Study of Meanings of Risk Control for Long Term and Acute Effect Occupational Health and Safety Risks in Small Business Construction Firms", Journal of Safety Research, pp. 251–261.

O.N. Aneziris, E. Topali & I. A. Papazoglou (2012). "Occupational Risk of Building construction", Reliability Engineering and System Safety 105, pp. 36–46.

Osama Ahmed Jannadi and Salman Almishari (2003). "Risk Assessment in Construction", J. Constr. Eng. Manage. 129: pp. 492-500.

Pellicer, E., Carvajal, G.I., Rubio, M.C., Catalá, J. (2014). "A method to estimate occupational health and safety costs in construction projects". KSCE Journal of Civil Engineering, 18(7), pp. 1955-1965

Professor N. Krishnamurthy (2006). "Safety in High-Rise Design and Construction", Build Tech – 2006, pages 19-34.

R.A. Haslama, S.A. Hidea, A.G.F. Gibbb, D.E. Gyia, T. Pavitt, S. Atkinsona, & A.R. Duff (2005). "Contributing factors in construction accidents", Applied Ergonomics 36, pp. 401–415.

Saman Aminbakhsh, Murat Gunduz & Rifat Sonmez (2013). "Safety Risk Assessment using Analytic Hierarchy Process(AHP) during Planning and Budgeting of Construction Projects", Journal of Safety Research 46, pp. 99– 105.

Sarah Phoya (2012). "Health and Safety Risk Management in Building Construction Sites in Tanzania", http://publications.lib.chalmers.se/records/fulltext/164071.

Sinan UNSAR, Necdet SUT (2009). "General assessment of the occupational accidents that occurred in Turkey between the years 2000 and 2005",Safety Science Volume 47, Issue 5, May 2009, Pages 614–619

Corresponding Author

Suresh R. Sawant*

Assistant Professor, Department of Civil Engineering, NESGI, Pune Maharashtra, India

E-Mail – sureshsawan@gmail.com