RESEARCH ARTICLE OPEN ACCESS

Study of Internal and External Safety Audit by Gap Analysis Approach in Indian Construction Organizations

D.Sailendra [1], Awadhesh Shah [2]
Safety Engineer [1], Chief Consultant [2]
FS Academy of Excellence, Hyderabad
Telangana – India

ABSTRACT
Safety audit is a vital tool in the hands of top management to ascertain current status of safety scenario, for improving safety performance and for successful implementation of safety programs in construction organizations in India. Comprehensive code of practice of safety audit was developed in India to suit to the different types of organizations. Internal and external safety audits are conducted in construction organizations for verifying the system's ability to achieve defined safety objectives and it is observed that in many organizations wide gap exists in assessing the safety management system. The study focuses on exploring the reasons for variation between the audits. Twenty elements were identified from Indian standard applicable to construction organizations and the elements are validated by experts in the field of construction safety. The study was conducted in a large construction organization in India by utilizing five auditors each from internally and externally. Gap analysis was used to analyze the disagreements between the auditors. The study found that the fourteen elements of safety audit are characterized by the largest gaps and raising importance to these elements to desired levels would lead to narrowing the gap; results in improving safety performance of the organization.
Keywords:- External Auditor(EA), Gap Analysis, Internal Auditor(IA), Kappa Coefficient

I. INTRODUCTION

Safety audit is organized way to ascertain safety management in an organization. Safety audit is proactive tool to measure safety performance of an enterprise as against accident/injury rates are reactive but majority of the enterprises are still adopting [1]. A study conducted in construction organizations in Kenya indicated that most of the construction organizations are not conducting safety audits and violating the applicable legislation. Safety audit is to be conducted in construction organizations at least once in a year as per legislation [2]. Safety audit must take it consideration all factors which influence safety management system.

Safety audits are conducted in construction organizations in China by engaging auditors; the audit encompasses safety management, welfare and drawbacks in the system [3]. The focus of safety audit is to identify pitfalls at execution level, but not at managerial level. Over the years efforts are made to address the safety related issues in construction industry such as enforcing legislation, audits and awareness programs. Safety audit is a exhaustive way of assessing the organizations safety issues. A perfectly organized conducted safety audit will resolve its deficiencies [4]. Safety auditing should be integrated with management activities of an organization. Safety audit is the right mechanism in the hands of management to gauge safety scenario in construction sites at any point of time and it is to be reviewed periodically [5].Safety audit is the part of the measures initiated by the Thai Government to improve safety performance [6]. Conducting safety audits is a regular phenomenon, irrespective of size of the workforce and organization [7].

Safety audit is one among many programs that effect safety performance of an organization [8]. Safety audit is an index to measure safety performance and it is basing on current safety scenario in an organization but not on past data [9]. Nigerian construction industry recommended that conducting safety audits periodically makes safer workplace, free from hazards. Safety audit help to develop safety culture within an organization [10]. Few enterprises in India are conducting safety audits regularly and this is mainly due to lack of management commitment, safety budget; focusing mainly on targets [11]. In another study conducted in India, the construction organizations are mainly focusing on stabilizing the system through safety certification rather than on safety audits, incident analysis and management review [12].Site safety inspections and audits are consistently conducted and audits are capable to identify and to implement mitigation measures [13].

A study was conducted in Nigeria to find the significance of precursors of internal audit efficacy. Five precursors were identified and the data was

collected through a questionnaire survey. The results showed that all the five precursors have a positive impact on internal audit efficiency [14]. Globally very few researches have been conducted on internal audit effectiveness [15]. Management involvement is vital for success of internal audit [16]. Inadequate professionalism, shortage of qualified internal auditors and lack of coordination among various departments are challenges for effective implementation of internal audit function [17].Internal audit function is crucial to an enterprise to track the risks and depicting the areas to improve risk management [18].The objective of the safety auditing are to check applicable legal requirements and the existing safety measures are adequate [19].Safety audit should assess all the elements of Indian standard. Safety audits are of two types, external and internal. External audits are conducted by outside agencies while internal audits are conducted by the employees of the organization. Internal audit is purely based on inference and not have an effect on enhancing safety management system. The results of the safety audit must be consistent that is the assessment of external and internal auditors must be similar. The study was conducted in a large construction organization involved in metro rail construction in India to ascertain degree of importance towards the elements of safety audit as per standard code of practice.

II. MATERIALS &METHODS

2.1 Organization under study

Metros and mass rapid transport system are emerging as a major area for infrastructure development in major cities with population around 8 millions. The metro rail project, once completed will transform to preferred city. The present study was conducted in a construction organization involved in metro construction in a major city in India. The metro rail network will cover a total distance of around 72 kilometers across three corridors. The highlights of the project are elevated station buildings, connects major offices, integration with existing rail terminals and co friendly mode of travel. The organization was framed occupational safety and health policy with an objective to become leader in environment, health and safety. The management strongly believes that all incidents are preventable and committed to demonstrate better safety performance.

To fulfill the commitment of the management towards occupational safety and health, several initiatives have been considered to improve safety performance. Safety audit is one tool in the hands of management to have a glance of current safety scenario in the organization. The metro construction mainly involves shifting of pre cast segments/rail and lifting of segments rails. All the construction, shifting and lifting activities are to be carried out in public places and require advance planning. The management believes in proactive safety measures to provide conducive work environment to all stakeholders. External and internal audits are conducted at regular intervals so as to rectify the defects and it is observed that there is lack of consistency in the reports of auditors. The purpose of the study is to examine the reliability of auditors in conducting safety audit.

2.2 Gap Analysis Approach

In present context, gap analysis refers to variation in the opinions of internal and external auditors in assessing the elements of Indian standard on safety audit evaluation. The consistency in evaluation by both the auditors is essential for the management to have an idea about current safety scenario. Differences in the results furnished by the auditors will keep the management under confusion. For successful implementation of safety management system, the gap should be narrowed down to maximum possible extent. Therefore, it is necessary to investigate the degree of importance of each of that element between the auditors. The gaps between opinions of the auditors are useful for successful implementation of a safety program. Questionnaire survey was adopted in previous researches conducted on gap analysis [20, 21].

2.3 Codes of practice on OSH audit (IS 14489:1998)

Indian standard 14489 is a comprehensive code of practice of safety audit developed in India [22]. The standard was framed in general to adapt to the different types of organizations. The structure of the standard comprises of objectives and responsibilities, audit methodology, completion and action for implementation of audit findings. In the standard, it was mentioned preferably to have a both internal and external audit system for effective safety management system. The frequency of internal audit is at least once in a year and that of external audit is once in two years. The standard also defined the elements of OSH management system, types of reports to be examined and safety audit questionnaire for the elements of management system. All the organizations in India are following the standard as per safety audit is concerned, ignoring the elements of OSH management system which are not

applicable. The elements for construction sector are shown in Table 1.

TABLE I
Elements of safety audit

S. No	Elements	S. No	Elements
1	OS&H policy(OSHP)	11	Machine and general area guarding(MG)
2	Organizational set-up(OS)	12	Material handling equipment (MHE)
3	Education and training (ET)	13	Electrical safety (ES)
4	Motivational and promotional measures(MPM)	14	Illumination and noise (IN)
5	Compliance with statutory requirements(SR)	15	First aid facilities(FF)
6	Housekeeping(HK)	16	Personal protective equipment (PPE)
7	Accident reporting analysis investigation(ARI)	17	Safe operating procedures (SOP)
8	Hazard identification and risk assessment (HIRA)	18	Work permit systems (WPS)
9	Safety inspections(SI)	19	Fire safety(FS)
10	Safety in storage and warehousing(SW)	20	Emergency preparedness plans (EPP)

2.4 Validity and Reliability Testing for a Questionnaire

From the code of practice, a total of 20 elements with 160 questions were identified. As the code of practice was framed keeping in view of several organizations of different type, it is felt necessasary to check content validity. This validation was carried out by asking 25 experts (i.e. Corporate safety managers, safety managers and safety engineers whether or not the 20 elements were "1 = essential", "2 = useful but not essential" or "3 = not necessary". The data gathered were then calculated to obtain the content validity ratio based on Lawshe's formula [23**].** The ratio for all the elements is more than 0.95 and all the elements and questions under each element were considered for study.

2.5 Inter observer Reliability

The results of an assessment should be reproducible under different conditions. In many cases, different observers or even the same observer at a different time may reach different conclusions. The concept of reliability provides an estimate of how consistently the studied behavior is observed and scored. Inter observer reliability measures the variation which occurs when an observer performs multiple judgments at different times. Inter observer reliability measures the variation that occurs when two or more persons make judgments independently.

Cohen has presented kappa (*k*) as a coefficient of agreement for nominal scales. The proportion of agreement corrected for chance is the following [24]:

$k = (p_o - p_c) / (1 - p_c)$

(i)

p_o is the observed proportion of agreement. p_c *is* the proportion of agreement expected by change.

The relative strength of agreement associated with kappa has been determined by Landis and Koch [25] and is shown in Table 2.

TABLE II
Relative strength of agreement with kappa.

Value of k	Strength of agreement
<0	Poor
0.00–0.20	Slight
0.21–0.40	Fair
0.41–0.60	Moderate
0.61–0.80	Substantial
0.81–1.00	Almost perfect

2.6 Questionnaire Survey

A questionnaire was framed by including the applicable 20 variables and 160 questions. The number questions in different elements varies as per code of practice and the total number questions for 20 elements are 160[22]. The number of auditors utilized in the study are 10, comprising of five external and five internal auditors.

It is intended at obtaining the status of each question under the elements of safety audit in the organization under study. To know the factual position, the auditors/respondents were asked to rate each question on the five-point Likert scale, varying from "not important" (1) to "extremely important" (5). The auditors/respondents are divided into five groups and each group comprises of one internal and external auditor. Each group is allotted with specific elements and questions .Group 1 is allotted elements 1to4,Group 2(5 to8),Group 3 (9 to 12), Group 4(13 to 16) and Group 5 (17-20).The purpose of making

groups is to conduct audit at micro level and also to reduce time duration. External and internal auditors of same group were not assigned the evaluation on same day to avoid overlap and schedule was prepared accordingly.

III. RESULTS

3.1 Reliability of the auditors

To ascertain inter observer reliability between internal and external auditors of elements of safety audit, the internal and external auditors are divided into five groups and allocated five elements of safety audit as per standard. The internal and external auditors have been asked to rate the questions under each element 1 to 5 likert scale ("not important" to "extremely important"). Based on the ratings of the auditors, inter rater reliability was calculated by using the MedCalc software, and the results are shown in Table 3.

TABLE III
Strength of agreement between external and internal auditors

Group	Auditors	Elements	No. of questio	k	Strength of agreement
1	EA 1 IA 1	1 to 4	50	0.10	Slight
2	EA 2 IA 2	5 to 8	28	0.16	Slight
3	EA 3 IA 3	9 to 12	29	0.48	Moderate
4	EA 4 IA 4	13 to 16	26	0.12	Slight
5	EA 5 IA 5	17 to 20	27	0.29	Fair

3.2 Degree of importance of auditors

The results of the study shown in Table 4, implies that the both groups of external and internal auditors rated high mean scores for elements of safety audit to seven elements, namely OS&H policy, accident reporting & investigation, machine and general area guarding, material handling equipment, safety in storage and warehousing, first aid facilities and fire safety.

TABLE IV
Degree of importance of auditors towards audit elements

S. No	Elements	Importance of EA	Importance of IA	Gap	Rank	p-value
		Mean SD	Mean SD			
1	OSHP	4.54 0.48	4.64 0.39	0.10	20	0.318
2	OS	3.20 0.68	4.09 0.71	0.89	2	0.000 *
3	ET	3.10 0.57	4.12 0.41	1.02	1	0.000 *
4	MPM	3.40 0.61	3.95 0.51	0.55	12	0.000 *
5	SR	3.00 0.71	3.87 0.67	0.87	3	0.000 *
6	HK	3.23 0.40	4.09 0.51	0.86	4	0.000 *
7	ARI	4.11 0.86	4.32 0.69	0.21	15	0.072
8	HIRA	3.16 0.61	3.99 0.63	0.83	5	0.000 *
9	SI	3.71 0.71	4.46 0.71	0.75	7	0.000 *
10	SW	4.10 0.56	4.29 0.67	0.19	16	0.084
11	MG	4.17 0.88	4.44 0.68	0.27	14	0.057
12	MHE	4.29 0.73	4.43 0.64	0.14	19	0.129
13	ES	3.48 0.65	4.26 0.69	0.78	6	0.000 *
14	IN	4.09 0.89	4.25 0.71	0.16	18	0.098
15	FF	4.34 0.69	4.64 0.50	0.30	13	0.000 *
16	PPE	3.64 0.71	4.31 0.81	0.67	11	0.000 *
17	SOP	3.71 0.81	4.45 0.82	0.74	8	0.000 *
18	WPS	3.56 0.56	4.27 0.45	0.71	9	0.000 *
19	FS	4.28 0.60	4.46 0.51	0.18	17	0.092
20	EPP	3.71 0.46	4.40 0.52	0.69	10	0.000 *

* denotes that it is significantly different at 95% level of confidence.

3.3 Gap Analysis

The hurdle for the safety audit in the organization under study is lack of focus in adhering to audit guidelines and standards. The objective conducting gap analysis is to ascertain the degree importance between internal and external auditors towards safety

audit elements. For each element, the gaps are computed by subtracting the mean of internal auditor from that of external auditor. The result of the gap analysis was shown in Table 4 for each of the 20 elements of safety audit and it also gives the results of t – test. The results of the analysis show that there were significant differences in 13 out of 20 elements.

IV. DISCUSSION

Among the 13 elements, the elements that have the largest gaps (more than 0.80) between degree of importance of internal and external auditors are as follows:

(i) Education and training (gap = 1.02): Safety is a continuous education to all levels of employees within the organization. The external auditors are opined that less emphasis was given towards safety training, sufficient budget was not allocated to conduct trainings by experts from outside agencies, lack of training need assessment and failure to appraise to the management about importance of safety training by the safety department are the root causes.

(ii) OS&H organization (gap = 0.89): The building and other construction workers act,1996 is the act applicable for health, safety and welfare of the employees working in construction organizations[26]. Detailed guidelines were mentioned in the act about safety organization that is formation of safety committees, qualifications and responsibilities of construction safety officer/medical officer. Both the auditors stated that the safety officers who plays advisory role in the organization were not fulfilling the requirements of the act.

(iii) Legal Compliance (gap = 0.87):In India, majority (more that 90%) of the state Governments have not implemented the building and other construction workers act,1996.Due to lack of enforcement from authorities, the construction organizations are not adhering to the compliance of applicable legislations and standards.

(iv)Housekeeping (gap = 0.86): Majority of the accidents in any industry is mainly due to poor housekeeping practices. There is no end for good housekeeping .The experts are of the opinion that the culture of good housekeeping practices was not inculcated among employees, results in housekeeping in some areas extremely poor.

(v) Hazard identification &risk assessment (gap = 0.83): The organization is maintaining the documents pertaining to hazard identification and risk assessment but not reviewing and updating the documents. Assessment was conducted only at the beginning of the project but subsequently a system was not developed to monitor the implementation part of it.

V. CONCLUSION

Due to lack of consistency in the audit reports of external and internal auditors, the management is often under confusion regarding genuineness of the defects pointed out. Audit results must assist management to initiate measures for continual improvement. Comprehensive code of practice was developed in India and auditors need not do much exercise in developing questionnaire or checklists for the purpose of safety audit .The study was conducted to identify degree of agreement between external auditors and internal auditors.

The results of the study showed that the mean scores of internal auditors are considerably high for all audit elements when compared to external auditors. This is mainly due to lack of professionalism, qualification, experience in conducting audit and biased approach on the part of internal auditors. The organization is not maintaining separate internal audit department and deputing employees for internal audit as and when required.

The crucial elements of OSH management system, education and training, safety organization, legal compliance, housekeeping and hazard identification &risk assessment are having large gaps; this is mainly because of micro level observation by external auditors. The value of kappa coefficient also indicates the strength of agreement for three groups is slight; other two groups are under fair and moderate. Not a single group is maintaining perfect agreement in evaluating audit elements and management must rely upon the observations of external auditors for continual improvement.

REFERENCES

[1] Steven Yule, Rhona Flin and Andy Murdy. *The role of management and safety climate in preventing risk- taking at work.* IJRAM 2007; 7: 137-151.

[2] Grace Muiruri and Cornelius Mulinge. *Health and Safety Management on Construction Projects Sites in Kenya A Case Study of Construction Projects in Nairobi County*.FIG Congress 2014 Engaging the Challenges – Enhancing the Relevance Kuala Lumpur, Malaysia; 2014.

[3] Tam CM ,Zeng SX and Deng ZM. Identifying elements of poor construction safety management in China.Safety Sci 2004; 42: 569–586.

[4] Kavianian HR and Wentz CA. Occupational and Environmental Safety Engineering and Management. New York: Van Nostrand Reinhold, 1990.

[5] Waqas Ahmed and Malik Muneeb Abid. Development of aFramework for Implementing Safety on Construction Sites.IJOAR 2013; 1:32-55

[6] Thanet Aksorn, and Hadikusumo BHW. Gap Analysis Approach for Construction Safety Program Improvement. JCDC 2007; 12:77-97.

[7] Law WK, Chan AHS and Pun KF. Prioritising the safety management elements a hierarchical analysis for manufacturing enterprises. IMDS 2006; 106:778-792.

[8] Morteza O, Shahram V and Mohammad K. Ergonomics Issues in the Construction Safety. Iranian Rehabilitation Journal 2012; 10:47-51.

[9] Flin R., Mearns, K., O'Connor P and Bryden R, Measuring safety climate: Identifying the common features. Safety Sci 2000; 34: 177–192.

[10] Okechukwu Agwu MBA and Hilda Enoh Olele. Fatalities in the Nigerian Construction Industry:a Case of Poor Safety Culture. BJEMT 2014; 4(3): 431-452.

[11] Seema Unnikrishnan, Rauf Iqbal and Anju Singh, Indrayani MN. Safety Management Practices in Small and Medium Enterprises in India. SH@W 2014; 21: 1-10.

[12] Rajaprasad SVS and Prasadarao YVSSSV and Chalapathi PV. Prioritizing the Elements of OHSAS-18001 in Construction Segments in India – AHP Approach. IJOH 2013;5: 159-165.

[13] Chockalingam S and Sornakumar T. An Effective Tool for Improving the Safety Performance in Indian Construction

[14] Industry. European Journal of Scientific Research 2011; 53:533-545.

[15] Mu'azu Saidu Badara and Siti Zabedah Saidin. Empirical Evidence of Antecedents of Internal Audit Effectiveness from Nigerian Perspective. MEJSR 2014;19: 460- 471.

[16] Endaya K and, Hanefah MM. Internal audit effectiveness: An approach proposition to develop the theoretical framework. RJFA 2013; 4: 92-102.

[17] Cohen A and Sayag G. The Effectiveness of internal auditing: An empirical examination of its determinants in Israeli organizations. AAR 2010; 54: 296-307.

[18] Sultan A and Adel G. Evaluation of the Quality of the Internal Auditing Position in the Public Sector in Saudi Arabia: An Applied Study. GRAF 2014; 5 93 – 106.

[19] Goodwin-Stewart J and Kent, P. The Use of Internal Audit by Australian Companies. MAJ 2006; 21:81- 101.

[20] Glendon, I.Safety auditing. Journal of occupational health and safety –Australia and Newzealand 1995; 11:569-575.

[21] Hwang LJ, Eves A and Desombre T. Gap analysis of patient meal service perceptions. IJHCQA 2003;16: 143–153.

[22] Chen McCain, Jang and SL, Hu C. Service quality gap analysis toward customer loyalty: Practical guidelines for casino hotels. Int. J. Hosp. Manage 2005; 24: 465–472.

[23] Indian standard (14489) .Code of practice on occupational safety and health audit, 1998.

[24] Lawshe CH. A Quantitative Approach to Content Validity. Pers Psychol, 28: 563–575.

[25] Cohen A. A coefficient of agreement for nominal scales, Educ Psychol Meas 1960; 20: 37–46.

[26] Landis JR and Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977; 33:159–

174.

[27] Government of India. The Building and Other Construction Workers (Regulation of Employment Conditions service) Act 1996.