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Study on the impact of human factors on health and safety performance

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Abstract--Although industries are showing a substantial progress in controlling occupational hazards, health and safety, recurrences of accidents and industrial disasters have caused studies related to enhancing the emergency responses and safety capability assessments across industries. This study emphasises primarily for the need for an increased attention associated with human factors and its association with organizational policies and practices in occupational safety and health management (OSHM) and the study furthermore proposes an effective approach for analysing its effects with goal for addressing on reinforcing the industrial safety protocols and regulations with regards to hazards assessment. The present study addresses on key concerns attributing on whether the present industrial policies, objectives, protocols, critical communication, safety culture, training and competency development programmes and facilities and services within the industry are in correlation with OSHM standards as it is pivotal for the safety department and improving standard protocol for further strengthening, coordinating and collectively monitoring the execution of all the actions intended to deal with an industrial accident and its impacts. The findings from the rendered cross-sectional regression data from the series of sessions were explored over the course of the study investigation.

Keywords—Occupational safety, health, training, competency development, critical communication.

1. Introduction

Occupational safety and health management (OSHM) practices are employed across industrial organizations with the responsibility of saving and protecting human life, and therefore the management associated with risk and hazards in the workplace is attributed as one of the essential attributes in performing operational activities [1, 2]. Regardless of such a preposition, risk and hazards management are employed in majority of the organizations, especially among those organization which are performing highly risky industrial tasks, which also differs in terms of their administration as well as its efficiency, hence, in order for achieving the functioning as well as systematic OHSM practices for such industries tend to differ based on the degree of risks involved [3, 4]. Industrial management systems regulating the safety and health have been influential in enhancing the employees' overall safety and quality of performance [5]. The vital principals of OSHM are often centred around hazard management and personnel training [6]. Whilst considering some of the key challenges namely, lack of commitment [7], or knowledge [8], minimal utilization of the financial resources [9], and the organizational priorities on decisions to focus more on production and operational activities and complete ignorance of workers' safety contribute for underlying industrial risks and hazards [10]. Several studies have observed in OSHM practices that successful implementations are entirely almost dependent on the degree of organizational commitment and support for standardized implementation rather than flaws during practice [11, 12]. Organizations that showcase strong management commitment for the betterment of OSHM practices are much less prone to safety hazards and accidents. It has also been argued that the human factor is also a crucial component in enforcing occupational safety regulations [13, 14]. Thus, observing on the key elements that are pivotal for successful OHSM practices, the present paper investigates on the impact of human factors and its association with organizational policies, practices (communication, safety culture) and management's role (involved with training, competency development programmes, facilities, and services).

The occupational safety management practices utilized in industries typically focus towards establishing safety guidelines, enforcing effective principles supporting enhancement of employee performance, physical and emotional wellbeing [15, 16]. In the present work, the perception of the employees over the safety measures, organization's commitment over protection against hazardous environmental conditions and overall satisfaction of employee concerning with the safety programmes and policies were explored. The accessibility employee protective gears namely, personnel protective equipment (PPE), provision of essential safety training inductions by organizations are also discussed. The present investigation involves modern holistic approach that encompasses the necessary insights while involving flexible personnel managing strategies that are both outcome-based and employee centric.

The subject pertaining to human factors serves to be one of the pertinent areas of interest in this paper. By observing the industrial accidents that occurred in the past, possibly implicates the fact for identifying the key underlying reason behind the accidents to occur. Also, it relates with both human behaviour as well as with factors that are affecting the course of events taking place in industrial sites for years. From the inferred data analysis from our investigations oriented with human factors and the organizational elements were further subjected to correlational analysis and determine their overall relationship and impact between both these factor in Indian industries.

Materials and Methods

1/ Design of the Study

In the present work, the approach followed an exploratory study that utilizes both qualitative and quantitative data. The primary focus emphasises on qualitative methods which is observed to be most adequate, considering on the human and personal nature on topic over integration. The proposed research forms discussion over current obstacles as well as future necessities pertaining with coping strategies associated with managing OSHM. The findings from the literature survey were correlated with a small-scale field survey conducted in the present work. The survey consisted of an organized questionnaire and semi-structured interviews conducted on employees working in privatized sectors. The advantage in collecting principal data is the qualitative factor due to the fact that it offers rich and comprehensive dataset while allowing the participants to express their perspective on the occupational safety front.

2/ Sample and Population

For the present study, the population was selected from 186 prominent industrial systems within India. The investigated industrial sectors were segregated into governmental establishments (both nationwide and state-wide) and multinational corporations. The activities represented by them are classified into several units with differing objectives associated with construction safety/engineering procurement and construction safety/project safety related procedures. The workers considered in the present study are only those with work responsibilities directly associated with construction safety and engineering procurement. Their line of work involved jobs with higher occupational hazards like construction, pipe layout and manoeuvre, drilling and heavy machine parts procurement and handling. Primary data sources include key participants for each case study. In this case, adult public participants were chosen. As a result, the data collected in the present work tended to be voluminous and detailed which in turn required systematic analysis of the data. In the present work, in-depth interviews were conducted to gain information relating to vital subjects such as employee values, perceptions and feelings towards the organizational practice towards health and safety.

3/ Sampling and data collection

Sampling is indispensable when performing qualitative assessments. Previous studies [17] iterate following a 'four-point approach', to handle sampling of interview backed qualitative assessments which involve forming sample universe by establishing criteria for focus groups and their exclusion and inclusion

content. Subsequently, framing an overall sample size of included participants by use of theoretical and practical responses. Then, a strategy is established based on sampling methods (quota, stratified, simple randomized, systematic, convenience, clustered, purposive or snowball sampling methods). Finally, by determining the sample source by variant methods namely, incentivizing, avoiding bias and ethical apprehensions and by promotional activities. Ensuring these four points enabled the present study to establish vital point of interest in assisting to approach potential participants for interviews by obtaining contact particulars. This process is illustrated in Fig. 1. The present work utilized snowball sampling method in recognizing the likely participants in which subsequent to collecting lead information, recruitment stratagem was carried out.

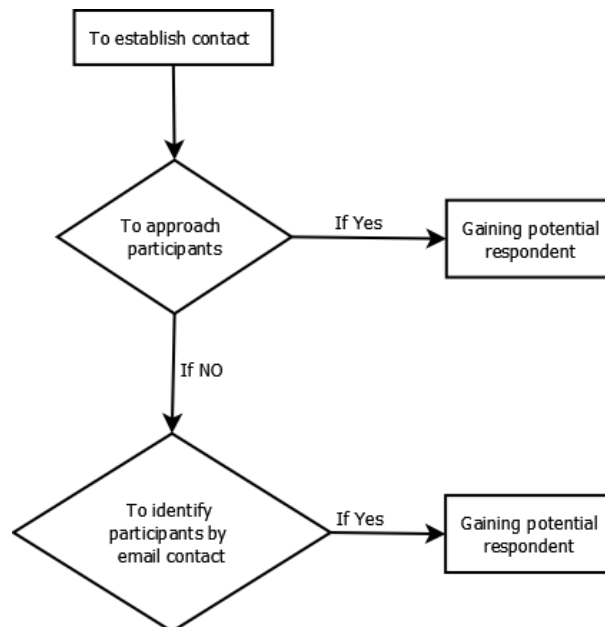


Fig. 1. Participant recruiting strategy

In the present work, the participants were interviewed by use of a pilot study to examine the situation without ambiguities during the questionnaire. This resulted in making sure the questions are in relation to the research problem and are properly answered by the respondents. It also further helped in establishing a set time limit for the respondents for giving their responses for the survey questionnaire in the pilot study to ensure evaluation of the responses effectively.

4/ Questionnaire based survey approach

Quantitative assessments conducted online are typically performed to circumvent generalization and causality [18]. The prime merit of using 'mixed methods research' is that it offered the benefits of both quantitative and qualitative research [19]. The collected quantitative data were analyzed before implementing qualitative phase to develop survey techniques for the quantitative analysis of the present study.

5/ Design of questionnaire

The research questions were formulated from the relevant motifs identified from the qualitative analysis of data and theory of planned behaviour [20, 21]; they were the foundation of the determining of notions and beliefs of data planning and management. The collection of related empirical data suitable for authentication required appropriation of terminology and definition of bounds. Therefore, prior to the online survey by questionnaire, the terms were elaborated for precise definition to contribute for better understanding of participating respondents. The developed questionnaire was communicated to the respondents by e-mail for the completion of the survey. The survey questionnaire was composed of questions that were based on factors such as employee psychological attachments and detachments towards strategies, relaxation methods, master training and control tactics. The questionnaire was structured to attain the present work's objectives and involved the themes illustrated in Table 1.

Table 1. Discerning occupational safety and health management

1	The organization is dedicated to employee wellbeing by integrating safety and health policies with other human relations activities.
2	To all the employees, the management provides a written declaration stating their responsibilities and commitments towards employee safety, objectives and principles.
3	The management drafted guides detailing the safety measures and participations in drives and responsibilities to all the members.
4	The establishment of safety policy encourages employee and organizational commitment to improve their practices continually and set improved objectives in time.
5	Offering employees regular incentives for practicing indicated safety principles and procedures (e.g., Use of proper protective gear).
6	Scheduling of regular meetings among management and employees in making organizational decisions.
7	Formation of teams within organization based in various internal functions to approach department specific problems.
8	Provision of adequate training to employees when joining the organization or when changing onto production methods.
9	Provision of training materials and follow-up of employees post training to observe its effects.
10	Formulating integrated safety training plans and procedure within regular equipment training and operating procedure.
11	Preparation of specific training plans fitting the specific job characteristics.
12	Devising training plans by joint discussions held among the management and employees.
13	Conducting occupational safety and health procedures during workdays.
14	Aiding employees to attend occupational safety and health training on-site.
15	Provision of instructing guidebooks detailing work procedures and emergency protocols to be followed in during standard workdays and emergency situations.
16	Communication of safety principles and rules in organizational meetings,

	drives and presentations.
17	Provision of instruction manuals to employees when joining work, about standard operating practices followed in the organization.
18	Informing workers about potential occupational risks and preventive measures against accidents by brochures and guides.
19	Development of risk evaluation and assessment systems.
20	Placement of risk assessment and identification tools in place for all organizational jobs.
21	Formulating information based prevention plans by evaluating the potential risks.
22	Specification of hazard prevention and action plans.
23	Establishing action and work standards evaluated under risk management procedures.
24	Circulation of developed prevention plans among employees.
25	Periodic evaluation of disaster prevention plans and updated accordingly with reference to current employee job conditions and health policies.
26	Establishing elaborated emergency plans for critical risks.
27	Informing all organizational employees about planned emergency measures.
28	Conducting periodical inspections on executing accident preventive measures and compliance to safety regulations.
29	Comparing pre-meditated strategies and actual safety measures.
30	Allocation of managers to check objective achievements.
31	Conducting regular inspections to confirm effective safety system functions.
32	Any occurrences of incidents regarding to safety and hazards are properly reported and documented for subsequent incident analysis and investigation.
33	Comparison of the organization's accidents occurrence rates with those of other industrial organizations from similar sectors and productions companies.
34	Establishing new ideals and frameworks from results of cross organization comparison study.

Assumptions while assessing occupational safety and health performance of organization:

- Degree of potential injuries are low.
- Degree of property damage is low within the organization.

Through conducting semi-structured interviews with the participating respondents, their individual opinions, views and experiences with the occupational practices were identified. This, in turn, has collectively provided in-depth social phenomena with regards to their concern on working population and their influence with regards to OSHM. With the participant's willingness in sharing their views and experiences freely is quite significant when performing a qualitative study.

6/ Data analysis

The objective of the present work is to evaluate the safety framework, collected data from questionnaire involved in the interview. The detailed data analysis were analyzed with the help of specialized statistical analysis software package (IBM® SPSS® Statistics v.24). the software was used to analyse the data and for

validation. The methodology framework was proposed based on the observations from the existing literature on research methodology.

Results and Discussion

1/ Respondents description

The respondent population for the present study were predominantly inclusive of skilled male workers between the ages with work experience averaging between 3 and 5 years. The skill level of the respondents involved in the present study was indicative of their familiarity with the nuances of the job, knowledge regarding occupational risks, technical capability, capacity to comprehend challenges involved and ability to solve them and their knowledge of usage of job tools. The detailed information of the respondent population involved in the present study is listed in Table 2. The results of the statistical correlation analysis of the data by the software tool are listed in Table 3.

Table 2. Demographic summary of respondents

Gender	Frequency (Nos.)	Percentage (%)
Male respondents	177	95.2
Female respondents	9	4.8
Total respondents	186	100.0
i. Age (years)		
22-30	75	40.3
31-40	87	46.8
41-50	12	6.5
51-60	6	3.2
61-70	4	2.2
71-80	2	1.1
Total	186	100.0
Working Locality		
Rural	55	29.6
Urban	131	70.4
Total	186	100.0
ii. Work experience in occupational safety and health management		
Between 0-5 years	66	35.5
Between 6-10 years	62	33.3
Between 11-15 years	34	18.3
Between 16-20 years	12	6.5
Between 21-25 years	4	2.2
26 years and above	8	4.3
Total	186	100.0
iii. Total experience in construction safety/engineering procurement and construction safety/project safety		
Between 0-5 years	112	60.2
Between 6-10 years	48	25.8
Between 11-15 years	12	6.5
Between 16-20 years	5	2.7

Between 21-25 years	7	3.8
26 years and above	2	1.1
Total	186	100.0

Table 3. Results of the statistical data

Functions	Correlation	Instances				
		1	2	3	4	5
Policies/ Objectives/ Procedure	Pearson Correlation		.894**	.832**	.870**	.782**
	Sig.(2- tailed)		.000	.000	.000	.000
	N	186	186	186	186	186
Communication	Pearson Correlation	.894***	1	.835**	.870**	.805**
	Sig.(2- tailed)			.000	.000	.000
	N	186	186	186	186	186
Safety Culture	Pearson Correlation	.832**	.835**	1	.837**	.737**
	Sig.(2- tailed)				.000	.000
	N	186	186	186	186	186
Training and Competency	Pearson Correlation	.870**	.870**	.837**	1	.800**
	Sig.(2- tailed)	.000	.000	.000		.000
	N	186	186	186	186	186
Facilities	Pearson Correlation	.782**	.805**	.737**	.800**	1
	Sig.(2- tailed)	.000	.000	.000	.000	
	N	186	186	186	186	186

** Correlation is significant at the 0.01 level (2-tailed).

From the analysis, it was concluded that all the variables possess strong positive correlation among them. The significant value is less than 0.05 at 95% confidence interval. Policies / Objectives / Procedure and Safety Critical Communication has the correlation value of 0.894, Policies / Objectives / Procedure and Safety Culture has the correlation value of 0.832, Policies / Objectives / Procedure and Training and Competency Development Programmes has the correlation value of 0.870, Policies / Objectives / Procedure and Facilities and Services has the correlation value of 0.782, which means Policies / Objectives / Procedure has a highly positive correlation between the other variables. Safety Critical Communication and Safety Culture has the correlation value of 0.835, Safety Critical Communication and Safety Culture has the correlation value of 0.870, Safety Critical Communication and Training and Competency Development Programmes has the correlation value of 0.870, Safety Critical Communication and Facilities and Services has the correlation value of 0.805, shows the strong

positive correlation of Safety Critical Communication with other variables. Safety Culture and Training and Competency Development Programmes has the correlation value of 0.837 and Safety Culture and Facilities and Services has the correlation value of 0.737, indicates that Safety Culture has a high positive correlation among Safety Culture and the other variables. Training and Competency Development Programmes, and Facilities and Services has the correlation value of 0.800, which defines the highest positive correlation between Training and Competency Development Programmes, and Facilities and Services. The analysis of variance was performed to develop the correlation among the between and within groups as shown in Table 4.

Table 4. ANOVA presenting the interrelationship between and within groups

		Sum of Squares	df	Mean Square	F-value	Sig.
Policies / Objectives / Procedure	Between Groups	239.692	2	119.846	1.373	.256
	Within Groups	15969.303	183	87.264		
	Total	16208.995	185			
Communication	Between Groups	167.396	2	83.698	1.293	.277
	Within Groups	11848.889	183	64.748		
	Total	12016.285	185			
Safety culture	Between Groups	65.724	2	32.862	1.070	.345
	Within Groups	5618.899	183	30.704		
	Total	5684.624	185			
Training and Competency	Between Groups	90.420	2	45.210	1.372	.256
	Within Groups	6028.914	183	32.945		
	Total	6119.333	185			
Facilities and services	Between Groups	10.951	2	5.475	.216	.806
	Within Groups	4647.286	183	25.395		
	Total	4658.237	185			

From the One-Way ANOVA, the F value and significant values show the significant difference among the independent variables with respect to dependent variables, as the individual attributes that are regarded as human factors observed among respondents were evaluated between and within the groups. From the rendered findings it could be inferred that the significance was reported as less than 0.05 at 95% confidence interval. However, when considering no significant difference between different attributes of Human Factor (communication, safety culture, training and competency and facilities and services) concerned with that of and Policies / Objectives / Procedure, $F(2,183) = 1.373$; $p < 0.05$; Safety Critical Communication, $F(2,183) = 1.293$; $p < 0.05$; Safety Culture, $F(2,183) = 1.070$; $p < 0.05$; Training and Competency Development Programmes, $F(2,183) = 1.372$; $p < 0.05$; and Facilities and Services, $F(2,183) = .216$; $p < 0.05$. The T-test was performed to determine the

significance of difference between the human and occupational safety and health factors against auditing (Table 5).

Table 5. T-test presenting the impact of human factors on OSHM performance with that of auditing practices.

Group Statistics					
	Lead or Internal Auditing occupation	N	Mean	Standard deviation	Standard error mean
Policies / Objectives / Procedure	Yes	116	31.5172	9.16466	.85092
	No	70	30.1286	9.68028	1.15702
Communication	Yes	116	26.0431	8.08691	.75085
	No	70	25.0857	8.03569	.96045
Safety culture	Yes	116	17.4224	5.68469	.52781
	No	70	16.9571	5.32817	.63684
Training and Competency	Yes	116	19.0517	5.60411	.52033
	No	70	18.0286	5.97330	.71395
Facilities and services	Yes	116	14.9569	4.91739	.45657
	No	70	13.6429	5.11048	.61082

The independent sample T-test describes the impact of human factors on health and safety performance with Lead auditor or any other relevant occupation, prospective. Policies / Objectives / Procedure $t(184) = 0.980$; $p > 0.05$; Communication $t(184) = 0.784$; $p > 0.05$; Safety culture $t(184) = 0.554$; $p > 0.05$; Training and Competency $t(184) = 1.177$; $p > 0.05$; and Facilities and services $t(184) = 1.740$; $p > 0.05$; it confirms that the significant value is more than 0.05 for 95% confidence interval. Thus, there was insignificant difference in the impact of human factors on health and safety performance with Lead auditor or any other relevant occupation. Similarly, a T-test was performed to determine the significance of difference between the human and occupational safety and health factors and types of organizations (Table 6).

Table 6. T-test presenting the impact of human factors on OSHM performance to that of organizational types or categories

Group Statistics					
	Category of the organization	N	Mean	Standard deviation	Standard error mean
Policies / Objectives / Procedure	National/Domestic/Local	63	30.1746	8.51287	1.07252
	Multi - National Corporation (MNC)	123	31.4146	9.77277	.88118
Communication	National/Domestic/Local	63	24.7937	7.32904	.92337
	Multi - National Corporation (MNC)	123	26.1382	8.40114	.75751
Safety culture	National/Domestic/Local	63	16.9048	5.39030	.67911

	Multi - National Corporation (MNC)	123	17.4228	5.63363	.50797
Training and Competency	National/Domestic /Local	63	18.5238	5.13639	.64712
	Multi - National Corporation (MNC)	123	18.7398	6.06094	.54650
Facilities and services	National/Domestic/ Local	63	13.8095	4.66924	.58827
	Multi - National Corporation (MNC)	123	14.7967	5.17396	.46652

The independent sample T-test describes the effect of human factors on the safety performance with the type of organization perspective. Policies / Objectives / Procedure $t(184) = -0.854$; $p > 0.05$; Communication $t(184) = -1.077$; $p > 0.05$; Safety culture $t(184) = -0.602$; $p > 0.05$; Training and Competency $t(184) = -0.242$; $p > 0.05$; and Facilities and services $t(184) = -1.272$; $p > 0.05$; it confirms that the significant value is more than 0.05 for 95% confidence interval. Consequently, there were no significant differences in the effects of human factors on the safety performance with the type of organization perspective. The mean ranks of importance and the performance of the samples are listed in Table 7.

Table 7. Tests for several related samples

Related Samples	Mean Rank
Policies / Objectives / Procedure	4.93
Communication	3.95
Safety culture	2.16
Training and Competency	2.64
Facilities and services	1.31

Organization is regularly updating health and safety policies/guidelines/procedures, planning, implementing, monitoring and maintaining relevant health and safety management programmes for achieving health and safety, has realistic/reasonable/appropriate objectives and targets for improving health and safety performance and has proper guidelines and systems in place for organizational change (job rotation/job transfer, health and safety procedures/guidelines of the organization are usable and easy to understand, existing health and safety procedures/guidelines of your organization are suitable and very effective, roles and responsibilities (pertaining to health and safety) are well defined and very clear for each and every employee of the organization, and overall, there are appropriate Health and Safety policy/procedures/guidelines/objectives and targets established, implemented and maintained in the organization ranking first according to the participants.

Conclusion

Employees occupational safety and health management (OSHM) in workplace could be defined both psychological as well as emotional concern among worker

and is directly in association with their quality of their career. The employees who are active and are inclined towards rational development are typically eager in pursuing personal betterment and are innate attracted towards adhering safety and health practices. The present study illustrated the that the human factor is a vital link towards significantly enhancing the presence of safety-performance among the engineering and construction industries. The human factor not only empowers the development of efficient and systemic safety practices accosts the sector, it is also important in establishing and controlling of risk assessment practices. It is also influential in employees' behaviour and attitude for working environment. Whilst considering OSHM practices, employees' behaviour correlated with organizational practice alluded with employee's human factor. The present study highlighted the need for organizations to associate safety commitment, administration and leadership across all the industrial setting.

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