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Employee perception of safety practices at large scale chemical industries in Tuticorin, Tamil Nadu

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ABSTRACT

Safety management involves setting up the work place in a manner where the employees work in a safe environment and in the worst case is protected from injuries. Most industries have an action plan to ensure an accident free operation that should start at the top of the hierarchy and permeate to the bottom and needs the understanding and involvement of all employees to be implemented successfully. Hence beyond the design and layout of the industry and the concern of the management, human factor has a major role to play in the safety record of that industry. Safety management in chemical industries has been discussed based on eight dimensions namely work infrastructure, personal protective equipments, work pattern, safety motivation, participative management, fire protection, safety training, and safety personnel. This paper focuses on safety management from the view point of employees and to develop a scale on how they perceive the safety factors of their industry.

Keywords: *Gender, Equality, Gender policy, Development, Economic Growth, Empowerment*

Introduction

Safety management in industries entails the protection of the physical, mental and social health of employees by creating a work environment devoid of industrial accidents. Safety management involves setting up the work place in a manner where the employees work in a safe environment and in the worst case is protected from injuries. Hughes and Ferret(2008) refer health as the as the safeguarding of employees from sickness resulting from resources and processes at work place while safety concerns safeguard of people from physical injury. An unsafe act or an unsafe condition can lead to an accident which may depending on circumstances have a long-standing impact on the industry, individual, other employees and society as a whole. Heinrich (1941) identified accident as an unexpected and unrestrained occurrence in which the action or reaction of an object, material, individual, or radiation results in personal injury. Hence the focus of safety management is the prevention of accidents which in turn augur the well being of employees. Modern industries are beset with mechanical, electrical,

chemical and physical (due to slippery conditions and ill conceived work areas) hazards which cause accidents due to human and technical error. This paper focuses on safety management from the view point of employees and to develop a scale on how they perceive the safety factors of their industry.

O'Reilly (2001) stated that death and injuries were accepted as a part of Industrial engineering in its earlier years but the advent of employee's liability law in 1911 put the onus of financial responsibility of injuries on the employers thereby necessitating the economic need to develop safety programs. However safety is a by-word in modern industries and every aspect of design and operation has a focus on safety. The industries are statutorily obliged to report to the prescribed authorities lost time accidents that prevent the employee to report for work within forty eight hours from the time of the accident. The cost of an accident is both tangible and intangible. The tangible costs include expenses due to medical treatment, absence of employee, statutory strictures and the intangible costs include lowering of employee morale and lowering of the image of the industry. Most industries have an action plan to ensure an accident free operation that should start at the top of the hierarchy and permeate to the bottom. This action plan is more pronounced when management takes a very serious view of safety. Wu, Chen& Li (2007) defined safety leadership as the practice of interaction between leaders and employees, through which leaders put forth their influence on employees to achieve organizational safety goals. O'Dea & Flin (2001) referred to safety concern as the degree to which senior management stresses the significance of safety equipment. Whatever the design of the industry and the concern of the management, human factor has a major role to play in the safety record of that industry. Barling, Loughlin & Kelloway (2002) recognized Safety consciousness as an individual's own responsiveness of safety issues.

Review of Literature

Margolis (1973) commented on the importance of recognizing worker behaviour and found that engineering remedies to accidents were in themselves inadequate in the prevention of accidents. Mortensen (1988) observed that hazards cropping up from workplaces could harm the health of the workers and makes it imperative to foresee, identify, evaluate and control such hazards. Hammer, (1985) highlighted the significance of management and their responsibilities for developing effective coordinated safety policies and procedures within the place of work. Cox & Cox (1991) emphasized safety culture as the ways in which safety is handled in the workplace, and tend to replicate the attitudes, beliefs, perceptions and values that employees share in relation to safety. Grantham, (1992) clarified the necessity for personal protective equipment when there is a probability of employees being in contact with a dangerous substance which may cause impairment to their health. Timpe, (1993) argued that occupational health and safety is a key constituent in achieving strong preventive safety cultures through sustained decent working conditions. Johnston, Catteledge & Collins (1994) identified safety training as

a means to assist employees to attain knowledge, create an attitude change and enable them to perform work in a safe manner. Cooper (1998) emphasized safety training as an attempt to change people's safety behaviour and attitude towards safety in the workplace

Black and Lynch (2001) explained that workplace environment and implementation of workplace safety practices have constructive impact on firm performance. Mahadevan, H. (2009) identified safety and health as a concern for all employees on the work spot and is not restricted to just specialists and professionals. Subramani (2014) predicted that safety managers have a chance to persuade and augment a sense of safety and the quality to the work environment. Reilly,Paci, & Holl(1995) found that establishments with joint consultative committees exclusive for health and safety matters – and with all employee representatives chosen by unions – have, on average, have 5.7 fewer injuries per 1000 employees compared with establishments where management deals with health and safety matters without any form of worker consultation. Choudhry, Fang & Ahmed, (2008), found that management's commitment to safety is a vital factor influencing the success of an organization's safety programs. Becker and Morawetz (2004) accentuated safety training as an ongoing process to intended to educate employees in safety details to bring about positive outcomes in safety procedure and legislation within organisations

Objective

To develop a comprehensive scale and identify the employee perception dimensions of safety practices at large scale chemical industries in Tuticorin.

Method

The questions were based on the perception of employees concerning safety practices at large scale chemical industries of Tuticorin district. The main research instrument was an interviewer administered survey. The research instrument was developed using the conceptual base of the employee perception of safety practices and the contextual basis of the focus group outcomes. The resultant questionnaire comprised 41 questions on Likert scales (5 point scale) reflecting the different dimensions of perception of safety practices in industry. A total of 150 respondents employed on a permanent basis in large scale industries were taken for the study. The study was restricted to large chemical industries of Tuticorin with employee strength above 500. The industries were selected using convenience sampling method while the respondents were selected based on systematic random sampling technique while leaving the industries after the completion of their shifts.

Table 1: Exploratory Factor loading of employee perception of safety management in chemical industries

	Components of employee perception of safety factors in chemical industries	Dimensions	Loadings
SAF23	I am part of Frequent mock drills conducted on a regular basis	Work infrastructure	.961
SAF37	Coal storage areas are water sprayed to avoid spontaneous combustion		.955
SAF26	insulated vessels are frequently inspected for metal thickness at scheduled intervals		.942
SAF41	All equipments are provided with stop push button latch in push button box		.937
SAF36	A thorough off site emergency preparedness plan is maintained in the company		.934
SAF40	Proper lighting is available throughout the industry		.921
SAF28	All belt conveyors are provided with pull chord switches for emergency stop options		.919
SAF27	The plant maintains very good housekeeping through constant upkeep		.892
SAF32	I am satisfied with the comfort level of personal protective equipments	Personal protective equipments	.935
SAF29	I am satisfied with the quality of personal protective equipments		.933
SAF34	I am satisfied with use of common usage personal protective equipments such as goggles		.931
SAF31	I am satisfied with the replacement policy of worn out personal protective equipments		.929
SAF30	I am satisfied with the types of personal protective equipments		.908
SAF13	Areas where cutting / welding works are undertaken are cordoned off properly	Work pattern	.968
SAF16	Scaffolding are checked properly and can be used only after receiving work permits		.966
SAF15	Personnel working in hanging position should compulsorily use safety belts		.958
SAF14	Wet gunny bags are used to cover rubber items like belts during hot work		.954
SAF33	A line clear (removal of fuse) is initiated before handing over equipment for maintenance		.934
SAF5	Safety bonus is given for specific accident free man hours	Safety motivation	.960
SAF11	Employees are motivated to write in the half yearly safety bulletin brought out by company		.954
SAF10	I am happy with the frequent safety slogan contest conducted by the company		.950
SAF12	Once a year the department with maximum safety outcomes are felicitated		.945
SAF35	safety quiz contests are frequently carried out in the company		.922
SAF4	Workers part of quality circle can put forth safety suggestions taken from the field	Participative management	.919
SAF6	Department level safety reviews are held every month attended by employees		.911
SAF3	Modification that better safety are carried out once found feasible		.910
SAF38	Situations of near accidents are discussed for immediate action		.909
SAF2	Suggestions on safety practices can be put in a box which is evaluated every month		.888
SAF7	Employees have adequate awareness on procedures for usage of extinguishers	Fire protection	.945
SAF9	The fire hydrants and hose stations are provided at the right spot		.944
SAF1	The right type of fire extinguishers are provided at right location		.944
SAF8	Vantage areas are covered by fire and smoke detectors monitored by control room		.935
SAF21	Discussion of accidents in other industries through these training enlighten safety aspects	Safety training	.966
SAF20	I am satisfied with the way the trainers handle the class		.947
SAF17	I am satisfied with the first aid training arranged through professional organizations		.941
SAF19	I am satisfied with the safety films used in the company		.912
SAF25	Safety officer reprimands personnel involved in unsafe acts	Safety personnel	.927
SAF18	Safety department personnel provides hands-on training on usage of fire hydrants		.913
SAF22	Safety officer necessarily sign permits before taking a job		.912
SAF24	Safety officer visits the work spots frequently		.833

Table 2 Eigen Value and Variance of dimensions of employee perception of safety aspects in chemical industries

Summary Statistics	F1	F2	F3	F4	F5	F6	F7	F8
Eigen Values	9.25	7.09	5.92	3.63	3.22	2.53	2.25	1.76
% of variance explained	24.34	18.65	15.58	9.56	8.46	6.67	5.92	4.64
Cum % of variance explained	24.34	42.99	58.57	68.13	76.59	83.26	89.18	93.82
N =200	Sample = All respondents				Unit = Factor loadings			

The first factor identified as work infrastructure includes statements such as frequent mock drills (on site emergency preparedness), control of coal auto ignition, inspection of insulated vessels for metal thickness, stop push button latch, off site emergency plan, safety provisions in equipment usage, adequate lighting and good housekeeping. An offsite emergency plan ensures the plant is ready in case something happens in the near vicinity other than inside the plant. Good housekeeping involves an attention to detail in ensuring everything in its place, keeping the premises dust free, skimming oil from drains and reprocessing spilled process material as per accepted procedure. The metal inside an insulated vessel is not visible outside and can pose a hazard if not inspected at regular intervals. The stop push button latch provides a visible reassurance to the maintenance man that the equipment does not get started. Bird and Germain(1990) indicated that the level of housekeeping in industry is understood to signify to some extent the heights of safety in that industry. Reber and Wallin (1983) studied housekeeping performance as a constituent of safety behaviour. Industries tend to stock a variety of coals as per availability and certain coals have a tendency for spontaneous combustion necessitating a careful vigilance on the part of industry. Duzy and Land (1985) said that fires originated by self-oxidation of coal can cause the loss of natural wealth and money which in turn leave a harmful effect on environment. The work place emergency is an unanticipated situation that can cause damage to the plant, employees and community at large and this is the reason for companies to concentrate on both the onsite and offsite emergency preparedness plan. This factor accounts for 24.34 percent of variance The second factor identified as personal protective equipments (PPE) included statements on comfort level, quality, types and replacement policy of personal protective equipments as also those personal protective equipments kept for common usage as per work requirements such as speciality gloves and goggles. PPE's happen to be the last line of defence where the employee by himself maximises the safety precaution possible for him. Joel (2007) revealed that protective devices are developed to interpose an effective barricade between harmful object or environment while Alli (2008) observed that usage of personal protective equipment (PPE) necessitates an active cooperation and acquiescence by the employees. This factor accounted for 18.65 percent of variance.

The third was classified as work pattern and included usage of wet gunny bags to avoid fire in rubber based items such as drive belts and conveyors, cordoning areas where work is undertaken above a certain height, scaffoldings being double checked, wearing of safety belts made compulsory for work without regular work platform and a line clear system before release of equipment for maintenance. Iverson and Erwin (1997) identified that occupational injuries can be ascribed to either of causes like the characteristics of the work environment (work practices) and the characteristics of the human being. Oliver, Cheyne, Tomas and Cox (2002) stated that initiatives intended at improving the safety of working environments have reached some success. The work pattern dimension accounted for 15.58 percent of variance.

The next dimension sorted was safety motivation and the components included safety bonus, contributing messages in safety bulletin, safety slogan, safety quiz contest and inter department safety outcome contests. Smith and Mustard (2007) stated that in order to prevent to prevent injury and it is mandatory for employers to inform employees the process of safe usage of machinery. This factor accounted for 9.56 percent of variance. Carraher, Gibbson & Buckley (2006) pointed out that motivation accompanied byrewards is of utmost importance in affecting employee motivation. Cabrera, Fernaud &Diaz, (2007) identified motivational patterns that organizations as intrinsic rewards when related to job content, and as extrinsic rewards when connected with economic rewards and social recognition. The motivation to act with a safety first approach should be imbibed in the minds of the employee by the way the management tunes the employee.

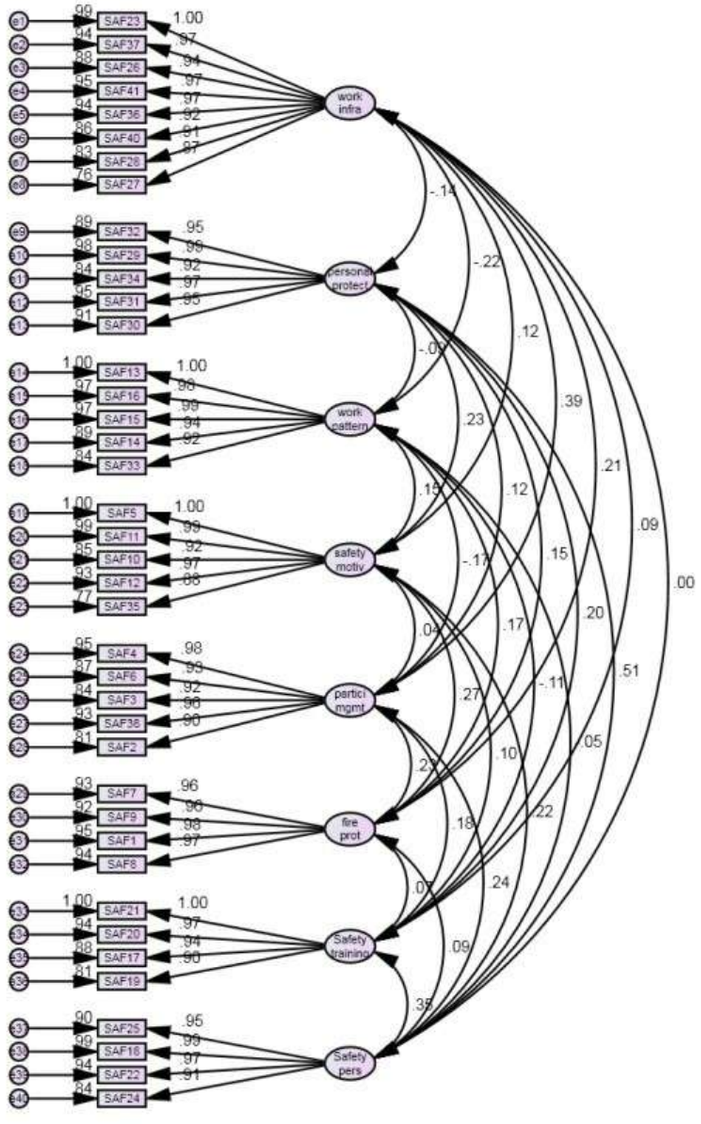
The next dimension that emerged was participative management and included statements such as workers being part of quality circle, department level safety reviews, minor modifications, situation of near accidents for immediate action and usage of safety suggestion boxes. The quality circle provides employees a forum to discuss their suggestion. The involvement of employees on issues affecting their safety and health can take advantage of their unique and relevant experience. Most of the inconvenience in operation like having valves in pipe rack instead of having it at operating level will be known only to hands on employees rather than higher management and hence worker involvement in safety discussions are inevitable. Near accidents involves scenarios like ripping of water cooler fan blades after the material of construction was changed over to fibre reinforced plastic from cast aluminium to save on power where in that case inspection was increased to avoid such calamities. Cascio (2006) explained that employees are the life line of an enterprise and there will be a direct bearing on the production of the organization when suitable safety measures are not maintained. Vredenburgh (2002) identified that safety committees are presently a standard feature of workplace safety programs and the committee tends to be effective when its members are in positions where they make a constructive impact on the committee's work in addition to being well trained..

The sixth dimension was categorized as fire protection and included statements such asadequate awareness in usage of extinguishers, fire hydrants and hose stations at right spot, fire extinguisher of the correct types and usage of fire and smoke detector. It is necessary to have the right type of fire extinguisher at the right place. The procedure of using each type of extinguisher will be different and requires skill on the part of the user to use it properly in case of emergencies. Huda & Ahmed (2011) in a study on garment factory workers of Bangladesh found a considerable number of fatalities occurred because of fire incidences caused by panicked stampede and locked and blocked exit doors that are ascribed to lack of proper fire management practices.

The next dimension categorized was safety training dimension and included statements such as case studies on industrial accidents, trainer capabilities, first aid training by professional organizations and safety films. Oberman (1996) identified safety training as the first line of defence against accidents and perilous situations and as well the cost associated with these occurrences. Safety as a way of life in industry is ingrained in the mind of the employee right from the orientation training stage. Employees before being absorbed have a training schedule where safety is a major topic other than training concerning operation and equipments. Roughton, (1993) highlighted that in order to develop the quality of safety and health of all employees, organizations should maintain a methodical and all-inclusive safety and health training program for fresh employees and use a buddy system to ensure the orientation of new employees in the safety and health quality systems. Vredenburgh and Cohen (1995) underlined that when employees perceived a higher danger their compliance was more and hence it was imperative for the employees to be trained to identify a hazard. Zohar (1980) identified training as a feature of positive safety culture. Safety discussion has the double benefit of enlightening the employee as well as to prevent over confidence in job that can dampen the safety attitude of the employee. Goetsch (2005) found that all employees required appropriate and adequate amount of safety training to advance their safety awareness. The approach towards accidents is influenced by prior experience of having either seen or being near one and this often contributes to the attitude towards them, and has potential to initiate an attitude change. This dimension accounted for 5.92 percent of variance

The final dimension separated was safety personal attributes and included statements on safety officer reprimanding errand workmen, hands-on training on fire hydrant usage, safety officer's necessity to sign permits and frequent visit of safety officer. The fire hydrant training is vital as for an untrained handler that itself can turn out to be an accident considering the high outlet pressure of water hydrant pumps. Blair(2004) revealed that the challenge for safety manager is to streamline management roles and capabilities into action plans.

Fig 1 - Confirmatory Factor Analysis with the eight dimensions of employee perception of safety in chemical industries



The above measurement showed a suitable data fit. The CMIN/ DF ratio was 2.816, which is within the agreed range of less than 3 which is indicative of an acceptable fit between the sample data and hypothetical model. The values of the fit indices are given in the table below and the values confirm the model as adequate.

Table 3 Model fit indices for the eight dimensions of employee perception of safety practices in chemical industries

Index of fit	CMIN	DF	CMIN/DF	GFI	AGFI	NFI	IFI	CFI	RMSEA
Value	2005.318	712	2.816	.639	.584	.846	.0.895	.895	.110

From above table Bollen's (Bollen, 1989) incremental fit index (IFI) values close to 1

indicate a very good fit. Bollen's (Bollen, 1986) relative fit index (RFI) values close to 1 indicate a decent fit. The GFI(goodness of fit index) identified by Joreskog and Sorbom (1984)value is less than 1 where a value of one indicates a perfect fit.

The reliability of the eight dimensions were established through Cronbach's alpha calculation and they varied from 0.903 – 0.987 and were considered adequate as they are above 0.70

The above study brings out the perception of employees on the safety aspects of chemical industries in Tuticorin region. Safety has to be incorporated in every aspect of design of the plant though the cooperation of employee is imperative as human error can undo any aspect of safety design. This brings out the importance of safety training and the role of safety department who need to play a proactive role. Industries often make it compulsory to wear certain personal protective equipments. In that case, industries need to have a proper replacement policy as PPE's tend to get worn out after a period of time in which case their function is redundant. The wear and tear of PPE varies with individuals and hence companies need to have a flexible policy regarding the same. Companies do tend to save on lighting loads at night times by switching of alternative light in conveyor walk ways and areas which are sparsely used or are used only during day shifts without compromising on the safety aspects of industries.

Safety in industries is more like the hygiene factors devised in Herzberg's (1959) motivation theory. People do not talk about safety in an industry as far as there is no such incident but when an accident occurs it results in plenty of negative publicity. Even small accidents can have huge consequences as it can cause injuries to employees, damage equipments, can cause production loss and lower the morale of employees. Hence industries should leave no stone unturned in their effort to maintain a safe environment. Safety in industries can have a repercussion on the whole environment as an accident like a gas leak does not stay contained in the industry and tends to spill over into areas beyond the industry and often into neighbourhoods.

Conclusion

The above scale takes a look at the safety management in industries across eight dimensions. Safety management is a critical entity of any industrial operation and the scale developed above will be highly useful to industries to check whether the steps taken towards safety has been properly understood by the employees or if there is any short fall in case of which the industries will be in a position to make

corrective steps. In future the scale may be developed individually for each of the seven dimensions identifies as also for industries in domains other than chemical industries where the safety dimensions can be very different.

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