

Occupational Fire Safety in India: A Preliminary Study on Current Trends and Future Implications

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Abstract

Background

This study contributes to the area of applied forensic chemistry and fire safety and management. It focuses on the current trends of fire safety practices followed across four groups of workplaces in India. The motivation for this paper was to create awareness about existing lacunae in our current practices which lead to structural fire accidents; a large number of which are seen every year in India.

Results

The research helped to understand the current status of occupational fire safety practices in India and gain insight into lacunae for non-compliance. The relationship between fire safety training and employee confidence was also studied. This preliminary study found that compliance of workplace fire safety norms varied with the type of industry. Hence, suggestions for a more extensive industry based approach should be researched for better insight into this finding.

Conclusion

This research paper assessed awareness about the current loopholes in fire safety and suggested better management practices. Thus, it enables the management of industrial workforce to create better policies and employee safety strategies in cases of untoward fire disasters. This paper also highlighted the need for better risk identification and evaluation to mitigate future workplace fire incidents and promote occupational safety from fire hazards.

1. Background Section

Despite proactive fire safety measures being incorporated into the fields of engineering, construction and design of buildings; India continues to witness a large number of structural fire accidents every year. Injuries and deaths related to heat and fire raises concern into the current loopholes in the area of fire safety and management practices. Irrespective of its origin, fires result in widespread damage, fatalities and destruction. According to data collected by the Centre for Fire Statistics, Russia it was seen that in 2018, structural fires comprised about 37.4% of the total number of fires observed in about 65 different countries around the world; while the number of structural fires witnessed in global cities hovered around 31.5% [1]. According to Governmental statistics, the nation sees a large number of fires every year; mainly recognized as accidental fires seen in structural buildings [2, 3].

Work and occupational safety are fundamental for the development of a society and nation. It is often used to measure the progress and growth of a nation [4]. Fires at the workplace are harmful to any business. Without attention to the business size, type and number of employees; fires at the workspace

may result in widespread destruction of property, loss of lives and irredeemable damage [5, 6]. As most small businesses may never be able to completely recover from a catastrophic fire, prevention and safety strategies are absolutely necessary [7]. Fires result in direct or indirect losses to workplaces or factories in terms of production, profits, employment and exports. Thus, a concerted effort is required to reduce this wastage in terms of productivity by managing and controlling the risk posed by fires [6, 8]. This research study was undertaken to provide insights into the current trends in occupational fire safety practices and understand the reasons for non-compliance of norms within the industry.

Fire safety can be better discussed in terms of measurement of risk. Risk results from opportunity for hazard occurrence and thus, prevention of risk is measured as safety. Buildings may be classified as high-risk, normal-risk or low fire risk structures. High-risk structures are often regarded as those housing large amounts of combustibles and highly flammable materials; furthermore they may offer rapid spread of fire, heat or smoke throughout the building. Normal-risk structures are those characterized by sufficient amounts of combustibles or flammable materials but wherein the fires would likely remain confined to the place of origin and spread at a slower pace. However, low-risk structures are those wherein the potential for fire incidents are much lesser and there are minimal chance for loss of lives [9, 10].

Thus, if a building is declared as “low risk of fire”, this implies that it is relatively “safer” for occupancy. However, one should understand that there is no “absolute” safety as risk is not wholly avoidable [6, 10]. Management of fire safety includes the steps of risk evaluation, identification of hazards and risk-mitigation or reduction. Presently, fire safety is being integrated into engineering and construction of new buildings in terms of structural designs, construction materials, designated exit and entry points, etc. These structures also have fire safety provisions like active fire protection systems and fire safety manuals according to prescribed legal framework of the nation. In a step forward, as Chow suggested, building fire safety plans could be devised based on building size, functionality or purpose and number of occupants [7].

The national and state governments have enacted varied legislations for fire safety and management which include codes and standards, fire safety regulation and compliance laws, fire brigades and stations in localities and educational campaigns [6]. While general fire code regulations and permits are necessary for buildings during construction phase, the regular maintenance of these fire regulations is often questionable. Through existing literature, it is observed that structural building fires in India have resulted due to reasons viz. poor construction plans, illegal extension of structures violating building laws and fire codes; non-functioning fire escape plans; lack of preparedness to handle fire emergencies, lack of ascertaining responsibility and legal action [11]. Contemporary structures are constructed on prevailing floor plans by flouting conventional norms and fire regulations and pose maximum risk to fire safety initiatives, thus continuous monitoring is required [12]. These blazing disasters have resulted in loss of property, finance and human resource in different parts of the country – but have we learned any lessons? V.M. Ta *et al*/ stated that it is important to engage the public in order to achieve this goal by equipping them with knowledge on safety practices and risky behaviour leading to fires [13].

Thus, there is a need for research to better understand the ambiguities existing in the current scenario and assist risk management [14]. Globally, research in fire safety is focussed on prevention through risk assessment and safety audits. However, the trend is still nascent in India. This research study was undertaken to gain insights into the current status of workplace fire safety practices and recognize the lacunae for non-compliance of norms within the industry. This study offers better understanding of current practices in terms of occupational fire safety and elicits possible reasons for non-compliance with norms. The research paper helps identify some potential gaps in risk management at the workplace and suggests some measures for fire management in emergency situations.

2. Methods

The sampling technique used in this research study was simple random sampling. The study was conducted via disbursement of a prepared close-ended questionnaire distributed to random participants as a Google Form. No offline survey was conducted owing to the pandemic guidelines enforced at that time. The basic questionnaire comprised of a total of fifteen questions with replies in a two-point Likert scale format (e.g. Yes/No; Agree/Disagree). The survey collected demographic details of the participants after obtaining their consent for the present study. The questionnaire responses were tabulated using Microsoft Excel 2010 and statistically analysed using Statistical Package for Social Sciences v.25.

Sample and participant information

Participants were randomly selected through link distribution via different social media accounts viz. WhatsApp, Gmail and LinkedIn in order to obtain diversity of workplaces in sampling. Every respondent was made aware of the objectives of the study and individual consent was obtained before filling in the survey. A total of 70 responses were obtained. After checking the data for validity as per inclusion criteria and missing values, 56 samples were considered for the study. The organizations selected for data collection were grouped into (a) Education industry – colleges and university employees, (b) Private companies – Internet Technology/Computer/Multi-National Corporate employees, (c) Personal business owners/ Entrepreneurs and (d) Government Municipal Institution employees. The 56 participants considered in this study were 34 males and 22 females having work experience of more than one year in their current organizations.

Sample selection: (1) Inclusion criteria: Any employed individual in India with more than one year working experience in an organization was considered. The working experience of the person was considered in order to account for employees being aware of infrastructure and working of the organization. (2) Exclusion criteria: All non-working persons, students and persons with less than one year work experience were excluded from the study.

Research Hypothesis

There is no significant relationship between following workplace fire safety norms and type of industry.

3. Results

In this study, the total participants comprised of 34 males and 22 females. In terms of participant demographics with respect to their length of service in the organization, it was observed that 25 participants had working experience between one and five years, 19 participants had working experience between six and ten years, 7 participants had working experience between eleven and fifteen years, and 5 participants had working experience of sixteen and above.

It was seen that out of the total participants, 23% had personally experienced fire incidents at their workplaces while the majority, 77% had not witnessed fire incidents at their workplaces (Table 1).

Table-1: Personal experience of fire incidents at the workplace.

		Yes	No	Total
Sex	Male	10	24	34
	Female	3	19	22
Total		13	43	56

According to the industry grouping considered in this study, 31% of the participants whom had experienced fire incidents belonged to the educational industry, 23% participants whom had experienced fire incidents belonged to the private industry – Internet Technology/Computer/Multi-National Corporate, 31% were personal business owners or entrepreneurs who had experienced fire incidents at their workplaces and 15% participants whom had experienced fire incidents in government institutions.

In order to elicit the correlation between the type of industry and their adherence to workplace fire safety norms, a simple 1-tailed Pearson correlation was performed on the sample size of 56. The test was based on the research hypothesis that there was no relationship between industry type and adherence to workplace safety norms.

Table 2
Relationship between adherence to workplace fire safety code and type of industry.

		Type of industry	Adherence of fire safety code at your workplace
Type of industry	Pearson Correlation	1	- .229*
	Sig. (1-tailed)		.045
	N	56	56
Adherence of fire safety code at your workplace	Pearson Correlation	- .229*	1
	Sig. (1-tailed)	.045	
	N	56	56
*. Correlation is significant at the 0.05 level (1-tailed).			

The relationship between following of safety norms and the type of industry was found to have a p -value of 0.045 which is significant at the p -value level of 0.05 and showed a significant correlation of -0.229 in the given study (Table 2). Hence, we rejected the null hypothesis.

After analysing the data from industries where fire safety protocols were followed, the upkeep and maintenance of protocols was evaluated by assessing these three criteria: (i) Presence of designated exits at the workplace in case of fire emergencies. (ii) Presence of a fire safety evacuation plan. (iii) Regular servicing of fire extinguishers at the workplace.

Table 3
Correlation between fire safety regulation and maintenance of devices at the workplace.

		Is the fire safety code followed at your workplace?	There are designated fire exits at your workplace.	Does your workplace have a fire safety evacuation plan?	The fire extinguishers at your workplace are serviced regularly.
Is the fire safety code followed at your workplace?	Pearson Correlation	1	.390**	.560**	.394**
	Sig. (2-tailed)		.003	.000	.003
	N	56	56	56	56
There are designated fire exits at your workplace.	Pearson Correlation	.390**	1	.503**	.346**
	Sig. (2-tailed)	.003		.000	.009
	N	56	56	56	56
Does your workplace have a fire safety evacuation plan?	Pearson Correlation	.560**	.503**	1	.558**
	Sig. (2-tailed)	.000	.000		.000
	N	56	56	56	56
The fire extinguishers at your workplace are serviced regularly.	Pearson Correlation	.394**	.346**	.558**	1
	Sig. (2-tailed)	.003	.009	.000	
	N	56	56	56	56
** . Correlation is significant at the 0.01 level (2-tailed).					

There was a positive relationship between all the variables. The Pearson correlational factor was found to be $r = 0.39$ for existence of fire exits in the workplace with significance level of $p = 0.003$ which is significant at $p = 0.01$ level. The Pearson correlational factor was found to be $r = 0.56$ for presence of fire safety evacuation plan with significance level of $p = 0.000$ which is highly significant. The Pearson correlational factor was found to be 0.394 for regular maintenance of fire extinguishers at the workplace with significance level of $p = 0.003$ which is significant at $p = 0.01$ level. This association was found to be significant (Table 3). Hence, we established that there is no significant relationship between adhering to fire safety protocols and regular upkeep or maintenance of safety devices at the workplace.

The study found that there was no relationship between experiencing workplace fires and need for training of employees (Table 4).

Table 4
Relationship between experiencing fire incidents at workplace and training of workforce on use of fire extinguishers.

		Personally experienced fire incident at workplace	Been trained on usage of fire safety devices in fire emergencies
Personally experienced fire incident at workplace	Pearson Correlation	1	.016
	Sig. (1-tailed)		.453
	N	56	56
Been trained on usage of fire safety devices in fire emergencies	Pearson Correlation	.016	1
	Sig. (1-tailed)	.453	
	N	56	56

The correlational factor was found to be $r = 0.016$ with significance value of 0.453 which is much greater than $p = 0.05$ level, hence we concluded that there was no association between experience and training. Out of the 56 participants, 38 respondents had received training at their workplace towards handling fire emergencies while 18 respondents had no formal training conducted. From the 38 trained individuals, only 20 respondents claimed to be confident in using the fire extinguisher for an emergency while 18 respondents were found to lack self-confidence in using the extinguisher. Alternatively of the 18 untrained individuals, 10 respondents claimed to be confident in using the fire extinguisher for an emergency while 8 respondents claimed they were not confident about the same. This proved that individual thinking cannot be changed only by training and education in terms of fire safety preparedness; and showed that this depends on individual ability and self-confidence to handle emergencies.

4. Discussion

Fires at the workplace typically arise due to unattended or defective cooking equipment, electrical and electronic related malfunctions, smoking materials in the office place, damaged lighting and heating material as listed by the National Fire Protection Association report [15]. Risk evaluation methods involving life risk reduction, property protection and appropriate safety actions during accidental fires vary with type of workplaces [6]. Nevertheless, if the risks of fire were evaluated and identified, many fire disasters may have been mitigated to a larger extent, thereby increasing productivity of the nation in terms of better workplace productivity. Risk at workplaces can be evaluated and managed by employing tools available such as probabilistic determinants, regression analysis and stochastic models [16]. On a

general note, this study helped to create awareness on the need for fire safety and prevention methods in all types and sectors of the industry. In the government sector especially, respondents decided to engage with their management for preparation of an incident management plan.

The study found that fire safety regulations were followed differently depending on the type of industry, thus leading to practice of non-compliance in some workplaces in India. While majority of the offices followed the norms, some fell short in terms of regular servicing and maintenance of the safety devices, conducting fire drills and training their employees. It was found that a few spaces did not have designated fire exits for emergencies. There is a need for constant vigilance of illegal constructions and extensions of existing buildings done by unscrupulous elements of the society in order for maximising profit or gain. Violation of construction policies due to space constraints, mixed occupancies and human greed for profit are prevalent reasons for most urban fire accidents. Negligence and apathy in the enforcement of building regulations often lead to undesirable workplaces, thus posing a high risk for hazards [11, 17].

A lack of training and procedures to be followed in that instance amongst workplace employees can lead to considerable psychological strain on individual coping mechanism in dealing with the fire [18]. Crawford and McGee have also highlighted the need for fire safety awareness at the community level to better tackle and mitigate fire accidents [19, 20]. It was suggested that employees should be trained in advance to initiate fire-fighting methods in the event of an occupational fire accident. The employers should plan fire drills and train their staff on the use of fire extinguishers enabling better assistance to other occupants in the buildings to reach safety spaces in the event of a fire [6]. The employees should also be familiarised with the location of fire safety systems like fire extinguishers and exits. Fire safety information should be displayed in clear language and signage at observable locations throughout the office [10].

Thus, it is strongly advocated that fire safety training and programs should be conducted in all industrial institutions, which will enable employees to benefit in terms of preparedness and acquire a life-saving skill. Nevertheless, it would largely depend on the mentality of individuals in terms of practicing learned skills in the event of a fire. The study had participants who had received training but lacked confidence to face fires and *vice-versa*. Conversely, no research exists to support the assumption that imparting knowledge regarding fire safety may lead to change the behaviour of individuals as stated by V. Hwang *et al* and S.M. McCaffrey [21, 22].

5. Conclusion

Workplace fires lead to widespread destruction and damage resulting in irrecoverable losses. After a fire, one can only replace material, repair parts of the damages to buildings, salvage material which remained unaffected, and submit claims for insurance compensation. While fire code regulations for buildings and structures exist in all countries, it is important to review their efficacy periodically and amendments considered when required. Given the unpredictable nature of fires, one should be always be prepared: i.e.

know the possible causes of fire at our workplace, how to fight them and how to escape. For better fire prevention and management of incidents, all workplaces should have fire detection systems, designated fire exits and emergency plans; also, employees should be trained in using fire extinguishers and deciphering fire safety signage. Fire Wardens should be appointed to monitor situations in events of an emergency evacuation and regular fire drills should be held [5]. The Directorate of Fire and Emergency Services needs to be revamped as it is currently facing a shortage of manpower and lack of equipment which adds to the poor management of crisis [23]. There is a requirement for better funding of innovative projects related to fire safety and prevention along with awareness programs to mass audiences of the community. The annual incident statistics should be further studied for improved understanding of patterns regarding fire causes and establishing safeguards to mitigate future incidents. The study can be furthered by incorporating more industries into the survey and increasing the sample size. Also, a comparison between the organized and unorganized sectors of the industry can aid future policy making.

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