



## **Analysis of Industrial Accidents: A Case Study of a Stationery Manufacturing Company**

Prabha JMDS\* and Prabodanie RAR

Department of Industrial Management, Faculty of Applied Sciences, Wayamba University of Sri Lanka

\*sachjayas@yahoo.com

### **ABSTRACT**

Industrial accidents are unexpected incidents occurred in industries which interrupt the routine work procedures. Accidents may occur due to negligence or lack of skills. This research was conducted on industrial accidents occurred in a stationery manufacturing company. The study focused on identifying the most vulnerable areas for accidents and how the demographic factors of employees affect industrial accidents. Accident records of the past year (2014-2015) were analyzed. The variables that have been taken into account are age, gender, occupation, place of accident, type of accident, nature of accident, PPE usage and machine details if the accidents were caused by machinery. Descriptive and inferential statistical methods were used. According to the analysis, the most vulnerable area identified was the Printing Plant. The machines such as, Polar Cutter, Three Knife, Sewing machine, and Packing machine cause accidents frequently due to the machine parts containing cutters, knives, needles and heat sealers. Hypothesis testing revealed that general worker category in printing plant was more vulnerable to accidents than the workers in writing instrument plant, refilling plant and logistic areas. Proper training and consultation, allocation of safety provisions, proper accident recording systems, ensuring of safety at working environment, allocation of rest times, job enrichment and team work are the suggestions given to reduce industrial accidents in Stationery manufacturing companies. The effectiveness of solutions can be enhanced further, by providing more PPEs for vulnerable areas and by conducting frequent safety audits.

**KEYWORDS:** Accident Recording System, Industrial Accidents, Personal Protective Equipment (PPE), Safety, Stationery Manufacturing.

### **1 INTRODUCTION**

Stationary manufacturing has several operations such as book printing, injection moulding, pen assembling, pastel and clay manufacturing, and glue and school bag manufacturing. These operations involve chemicals, equipment and machinery which are sometimes hazardous for the human. Health and safety at work place is an important topic where the production is carried out by large machineries and equipment. In this case it is essential to focus on safety practices of the workplace and employee's contribution to safety practices in the workplace. Lack of safety practices cause absenteeism and financial burden to the company. The main objective of this research is to make recommendations to minimize the accidents in a plant which manufactures stationary items by identifying the most vulnerable areas for accidents. By analyzing

the accident reports, it is easy to identify the risk and hazardous areas and solutions given by the company to minimize those risks and hazards. Then the hazards will be categorized according to the severity with their safety practices in order to observe the employee's participation in implementing those safety practices at the plant. In the observation stage, areas which can be furnished with the most appropriate health and safety practices were also identified. The reasons for accident occurrences and indicators for the lack of participation in safety practices will be then used to minimize the accidents and financial burdens for the company.

#### *1.1 Research Objective*

The main objective of this research is to make recommendations to minimize the accidents in the organization by identifying the most critical areas of accident occurrences.

## 2 LITERATURE REVIEW AND THEORETICAL BACKGROUND

The health and safety (H & S) of employees is a very significant issue to consider in relation to the attainment of organizational goals. Health and safety policies and programs are concerned with protecting employees and other people affected by an organization's activities, products and services against hazards. With limited resources to help reduce occupational injuries, companies struggle how best to focus these resources to achieve the greatest reduction in injuries for the optimal cost. Safety culture has been identified as a critical factor that sets the tone for importance of safety within an organization (O'Toole, 2002). According to the Workmen Compensation Commission (2013), About 268 work-related accidents are reported in Sri Lanka annually and about 141 of those are fatal accidents, a maximum of Rs. 62,594,000 compensation were given to the fatal accidents and for the non-fatal accidents Rs.11,263,000 compensation were given. Rahmani et al. (2013) concluded that the number of accidents increased with decreasing education level, type of employment was related to type of injuries, shift work considerably increased the risk of occupational injuries in the company, high accident rates among married workers, and highest rate of accidents among workers with experience of 1–5 years. Also, the lowest rate of accidents was found in workers with 16–20 years' and more than 25 years' experience. But in Halvani et al., the highest and lowest rates of accidents were seen for job experience of <1 year (34.8%) and >20 years (12.5%), respectively. Also the study found that lack of protective equipment, workers negligence, and unsafe work environment were main cause for accidents. Being male represented a higher risk of death in the event of an occupational injury, which could be explained by their occupations having a higher level of exposure to risks than women's occupations (Gonzalez-Delgado et al., 2015). Bhattacharjee (2002) have observed that training cannot reduce accidents when the level of hazards is high and there are few or no

reliable techniques and safe working practices in organizations. (Velázquez, 2013) found that unsafe acts and unsafe conditions are the immediate causes of occupational injuries, implicating factors related to the workers themselves and their behaviors as well as to the environment and workplace. According to the studies reported worldwide there are limitations for measuring and evaluating variables. One is not having measurements of certain variables reported by other studies worldwide, such as the level of schooling of the worker, socioeconomic level, training for the tasks to be performed by the worker, existence or lack of ongoing training programs and preventive maintenance programs for machines and equipment (Sarmiento et al., 2004; Garduño, Pulido & Delgado, 2008; Benavides, Delclos, Cooper, Benach, 2003; Xia, 2000; Gyekye, 2010). In addition, the variables that measure the quality, time and overall conditions of the medical care provided for the injury and the variables related to the condition of the injury should be carefully considered since they are prone to differential information bias given that it is not possible to dismiss (and it cannot be evaluated with the available information) the possibility of more rigorously and detailed investigations of the circumstances involved in cases of fatal accidents (Gonzalez-Delgado et al., 2015).

## 3 METHODOLOGY

In this research both secondary and primary data were used. Technique of observation was used as the primary data collector to complete the missing data of secondary data collection and company's health and safety manuals, procedures, audit results of previous years and accident reports are used as secondary data.

The statistical tests and methods used here are Descriptive Statistics, Inferential Statistics and Chi-Square statistics. Hypothesis were tested to identify the vulnerability for accidents based on age, gender, occupation and also to check whether the no. of accidents caused have a significant relationship for the place of the accident.

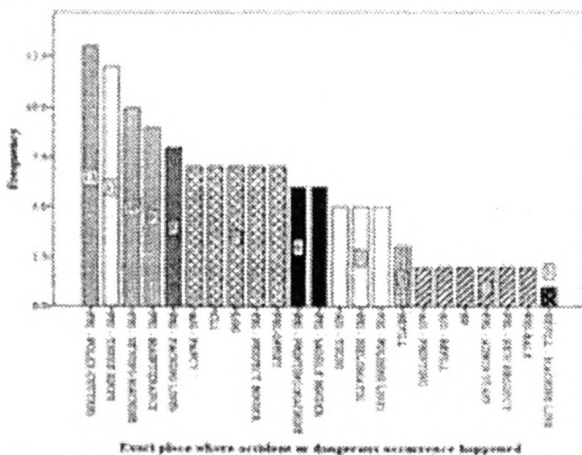
**4 DATA COLLECTION AND ANALYSIS**

Responses were collected from the Peliyagoda site which has main three plants namely Printing, Refilling and Assembly. Through observations, the missing data in the medical registry were filled. Details about the age, precise occupation and exact working place were taken from the company database. Sample of 130 records of accidents throughout a year were collected to prepare a full report of accidents.

**Table 1: Demographic Factors of Accident Victims**

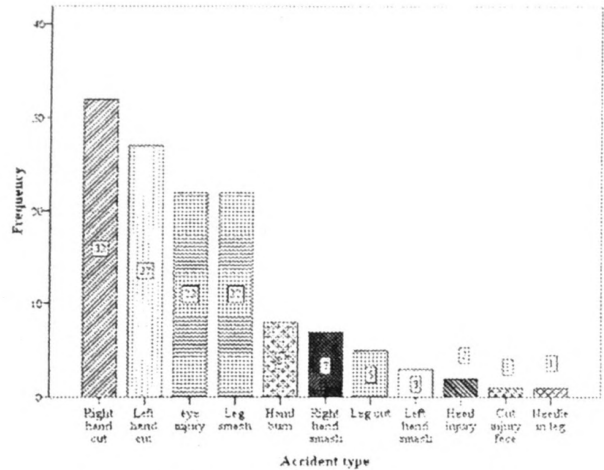
Percentage of accident victims (%)		
Gender	Female	22.85
	Male	76.15
Age	16-19	3.85
	20-30	75.38
	31-40	13.08
	41-50	7.69
Occupation	Operator	18.46
	Worker	74.62
	Supervisor	1.54
	Technician	5.38
Plant assigned	Printing	73.8
	Writing Instrument	18.5
	Logistics	5.4
	Refill	2.3

According to the analysis, 76.15% of victims were males and 22.85% victims were female. Further the analysis shows that more victims are between age 20-30 (75.38%) and the sample contains 74.62% of workers. Many victims were employed in the Printing plant (73.8%).



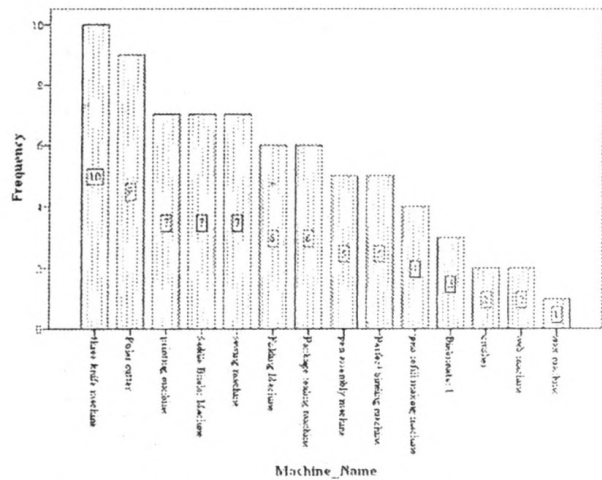
**Figure 1: Frequency of Accident Occurrences in Places**

Figure 1 shows the main locations at the plant which have at least two accidents, namely; Printing plant, Writing Instrument plant, Refilling plant and Logistic area. High percentage of victims was recorded in the Printing plant.



**Figure 2: Types of Accidents Reported**

Figure 2 graphically represents the types of injuries which were reported recently. And it clearly depicts that high percentage of right hand cut injuries were reported in accident records.



**Figure 3: Machines which Caused Accidents**

Figure 3 clearly interprets that machines at the printing plant such as Three Knife, Polar cutters and Sewing machines have the highest frequency of accidents. Three knife machines have a high tendency to cause an accident.

According to the Figure 4, accident occurrence was high from August to November, which is the peak season of the year for a stationery manufacturing company.

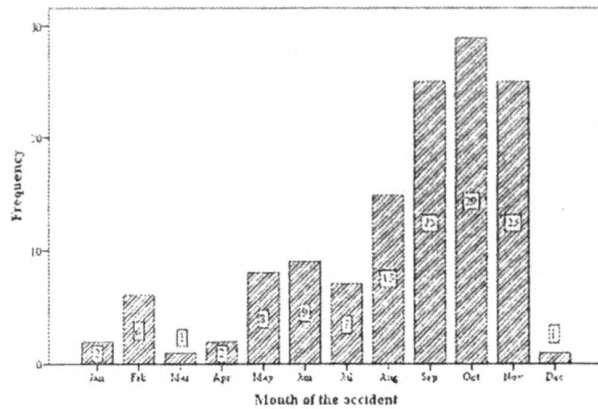


Figure 4: Accident Occurrences over the Year

Table 2: Safety Equipment Usage during the Time of Accident

Count	Safety equipments used by the injured person									Total
	Ear plugs	Ear plugs, safety shoes	gloves	none	safety kit	Safety kit	safety kit without helmet	safety kit goggles	safety shoes	
Coll. injury face	1	0	0	0	0	0	0	0	0	1
eye injury	4	0	12	6	0	0	0	0	0	22
Hand burn	5	0	0	2	0	0	0	1	0	8
Head injury	0	0	0	0	0	0	1	0	1	2
Left hand cut	8	7	0	9	1	2	0	0	0	27
Left hand smash	2	0	0	1	0	0	0	0	0	3
Leg cut	2	0	0	3	0	0	0	0	0	5
Leg smash	13	0	0	9	0	0	0	0	0	22
Needle in leg	1	0	0	0	0	0	0	0	0	1
Right hand cut	17	3	0	11	1	0	0	0	0	32
Right hand smash	2	0	0	2	3	0	0	0	0	7
Total	55	10	12	43	5	2	1	1	1	136

Table 2 illustrates the usage of safety equipment when an accident occurred. The main result was that nearly 33% did not wear the safety equipment during accidents. Also the safety equipment provided did not prevent the accidents due to their inappropriateness for the relevant scenario.

4.1 Hypothesis Testing

Table 3: Hypothesis Testing-Chi Square

Chi-Square Tests – Pearson Chi Square			
Hypothesis	Value	df	Asymp. Sig. (2-sided)
There is no age difference in the vulnerability for accidents	42.793a	30	.061
There is a no gender difference in the vulnerability for accidents	15.270a	10	.123
There is a no occupation difference in the vulnerability for accidents	54.120a	30	.004
No. of accidents caused and the place of the accident do not have a significant relationship	61.555a	30	.001

Results

The p value for gender, age is greater than 0.05, there is no enough evidence to reject the null hypothesis at 5% level of significance. Therefore, it can be concluded that there is no statistical significance in gender and age difference in the vulnerability for accidents. But p value for occupation difference and place of the accident are less than 0.05, there is enough evidence to reject the null hypothesis at 5% level of significance. Therefore, it can be concluded that there is a statistical significance in occupation difference and place of the accident in the vulnerability for accidents.

4.2 Two Proportion Testing

Proportion tests were carried out to conclude the results with respect to the population. Total population was 540 and the selected sample size was 130. Testing was carried out for each gender proportions, age group proportions and occupation category proportions. Results were summarized in the following Table 4.

Table 4: Two Proportion Test Results

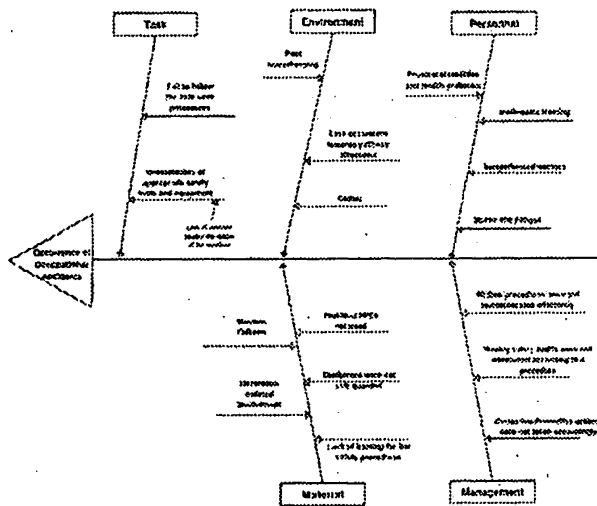
Alternative Hypothesis description (p=Proportion of workers)	p-value
1. p(male who face accidents)>p(male who do not face accidents)	0.021
2. p(age 16-19 who face accidents)>p(16-19 who do not face accidents)	1.000
3. p(age 20-30 who face accidents)>p(age 20-30 who do not face accidents)	0.000
4. p(age 31-40 who face accidents)>p(age 31-40 who do not face accidents)	0.984
5. p(age 41-60 who face accidents)>p(age 41-60 who do not face accidents)	0.635
6. p(operator category who face accidents)>p(operator category who do not face accidents)	0.991
7. p(supervisor category who face accidents)>p(supervisor category who do not face accidents)	0.552
8. p(technician category who face accidents)>p(technician category who do not face accidents)	0.000
9. p(general worker category who face accidents)>p(general worker category who do not face accidents)	0.008
10. p(proportion of general worker category who face accidents)>p(proportion of technician category who face accidents)	0.000

The p value of hypothesis no. 2,4,5,6 & 7 shown in Table 4 is greater than 0.05. Therefore, there is no enough evidence to reject the null hypothesis at 5% level of significance. So, it can be concluded that proportion of workers among ages 16-19, 31-40, 41-60 do not face accidents and workers who faced accidents is equal. Also operator and supervisor category workers

who do not face accidents and who faced accidents are equal. The p value of hypothesis no. 1,3,8,9 & 10 shown in table 4 are less than 0.05. Therefore, it can be concluded that proportion of females who faced accidents is greater than the females who do not face accidents, proportion of workers between ages 20-30 who face accidents are greater than the workers who do not face accidents, proportion of technician and general worker category that face accidents is greater than the employees that do not face accidents and also proportion of general worker category that faces accidents is greater than the technician category workers who face accidents.

**5 RESULTS AND DISCUSSION**

**5.1 Identification of the root causes**



**Figure 5: Identification of the Root Causes**

Alternative solutions were discussed to prevent the accidents in the Stationery Manufacturing sector. They were to provide training and consultation, establish accident recording system, ensure safety at working environment by the use of administrative or engineering controls, substitute of less hazardous materials or conditions, or by the use of personal protective equipment and to introduce ergonomically safe work practices and equipment. Also the provisions should be made for appropriate emergency responses and penalties should be imposed for each safety practice violation.

**6 CONCLUSION**

This research is focused on identifying the most critical areas of industrial accidents and how the demographical factors of the employees cause accidents by aiming a Stationery Manufacturing Company. Identification of critical accident areas in the company will lead to modify the safety conditions. The analysis has found that the high proportion of males have faced industrial accidents from the whole population. Past studies also have found that being a male makes a higher risk of death in the event of an occupational injury. Type of the employment also increases the occupational accidents. In this case general workers and technicians were more vulnerable to industrial accidents. Place of accident is also significant in causing an accident. Therefore, here, high frequency of accidents has occurred in the printing plant. The descriptive suggests that more of cut injuries are caused by machineries in the printing plant which have cutters and knives. Furthermore, the results concluded that the time period of working also shows a tendency to occur accidents. In this case study, the seasonal periods show a high accident rate. Lack of protective equipment usage is also a main cause for accidents. Allocation of appropriate personal protective equipment is a major point to be considered for a plant where the production is mainly done using manpower and machineries.

According to this case study, the accidents can be minimized if the machinery and equipment were safe guarded to protect employees from cut injuries. And also the safety audits should be conducted to enhance the personal protective equipment usage, before allocating provisions.

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