

ACCIDENT RISK FACTORS: CASE OF A MANUFACTURING PLANT

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Abstract

Despite scientific progress in human factors engineering (ergonomics) among other means to prevent injuries, the occurrence of occupational injuries and work-related illnesses are daily facts in most industries especially in manufacturing related enterprises. This work examines manufacturing accident investigation as a suitable way to plan and manage safety program in a manufacturing industry. An accident investigation register was administered to gather data for a period 12 months. Three hundred and twenty-eight injuries were investigated among the 293 workers for the study duration. The anatomical sites of injury were the hands and the wrists with 169 (52%) instances, while the feet and the ankles, legs and other sites accounted for 81 (25%), 62 (19%) and 16 (5%) of these injuries respectively. The most effective solution for eliminating complex multiple risks were carefully investigated and analyzed based on the existing programme. Probable best solution to ultimately benefit both the worker and the employer was then established. It was found that the accidents investigated were predictable due to the synergistic effects associated with repetitive production and hand intensive stress, age and work experience.

Keywords: Manufacturing accident investigation, hazards, risk, safety programme, performance

Introduction

Despite enormous advances in technology, human factors engineering (ergonomics), preventive medicine and other means to prevent accidents, an estimated 120 million occupational injuries occur annually at workplaces worldwide (Apurna *et al.*, 2004; ILO, 2002; Saari, 1998). In lower income countries such as those of the south Asia and Africa, injuries are one of the leading causes of adult mortality and a major contributor to disability (Brahmapurkar *et al.*, 2006; Murray and Lopez 1996; Zwi, 1993; Feachem *et al.*, 1992; Smith and Barss 1991). Death, illness and injury on such a scale impoverish individuals and their families, and challenge attempts to improve working conditions.

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Occupational injuries and work-related illnesses are work-related musculoskeletal disorders as a result of bad match between the worker, the work they perform and the equipment they use (State Compensation Insurance Fund, 2008).

Nearly every type of work or industrial occupation has the potential for causing injury. To prevent these injuries, it is important to understand the factors that contribute to them. Research works have depicted that the major risk factors that contribute to the development of MSDs/injuries can be associated with a whole set of physical-ergonomic (force, frequency, awkward postures, extreme temperatures, vibrations etc), hazardous exposures, workplace and process design, psychosocial, individual and work-organizational factors (National Institute for Occupational Safety and Health [NIOSH], 1998).

Efforts towards prevention of accident at workplaces must be driven by data that identify the pattern, frequency and severity of these injuries. Charles-Owaba and Adebisi, (2006) identified critical manufacturing safety prevention activities as training, personal protective equipment, guarding, awareness and accident investigation. In their work, the aggregate effect of these activities was considered. The challenge is to find out the extent of the significance contribution of each of these activities to manufacturing safety programme. Thus, the aim of this study was to examine manufacturing accident investigation as a suitable way to planning and managing safety program in manufacturing industry.

Materials and Methods

This study was conducted at a bottling plant in Ilorin, Nigeria. An accident investigation register was used to gather information on injuries over a 12 months period. This was established at the dispensary with the paramedic workers. The paramedics were educated for this purpose and the register's entries were checked at least thrice in a week.

Oral interviews were also conducted after the review of the register. A description of occurrence of the accidents and the causes as obtained from the injured worker and register review were recorded. These were analyzed using the accident investigation procedure that utilizes the most effective systematic risk management solution for reducing complex multiple risk factors by carefully investigating and analyzing what being done.

Afterwards, the primary method of risk assessment in an observational checklist was completed during a walk-through review of job or task to identify obvious risks concerns and primarily characterize the job functions and constraints of the workers. The checklist, which facilitated the identification of mismatches between applied force, frequency, and assumed postures, provides a systematic risk screening method for job analysis and were given a number ranking or a yes/no or true/false response.

Results

Incidence and Pattern of Injuries

Incidence of Injuries: A total sum of 328 injuries were recorded for the study duration among the 293 workers with injury incidence (rates) of 1119.5/1000 workers/year. These injuries, in reality happened to 192 (66%) workers and 128 (67%) of those injured had more than one injury.

Work shift and Injury: The plant operates four shifts- the morning shift (Ms) 6am to 2pm; the afternoon shift (As) 2pm to 10pm; the night shift (Ns) 10pm to 6am and a general shift (Gs) 8am to 5pm. The observed data presented in Table 1 depicts that all shifts had a higher number of injuries in the second half of the shift except for the night shift. However, injury per worker is highest during the morning shift and lowest during the general shift.

Table 1: Distribution of Injury with Work Shifts between two Proportions
(1st Half of Shift and 2nd Half of Shift)

Shift	No. of Worker s per Shift	1 st Half of the Shift	Injuries per Worker	2 nd Half of the Shift	Injuries per Worker	Total	Injuries per Worker (Total)
Ms	60	57(17.4%)	1.0	74(22.6%)	1.2	131	2.2
As	60	48(14.6%)	0.8	60(18.3%)	1.0	108	1.8
Ns	50	39(11.9%)	0.8	30(9.1%)	0.6	69	1.4
Gs	123	07(2.1%)	0.1	13(4%)	0.1	20	0.2
Total	293	151(46%)		177(54%)		328	

Relationship of injuries with Days and Month: Time series analyses of injuries hit the climax of injuries in the latter half of the week; Thursday to Saturday as depicted in Figure 1 and, during the first and the last quarters of the year; January and April and September and December as depicted in Figure 2.

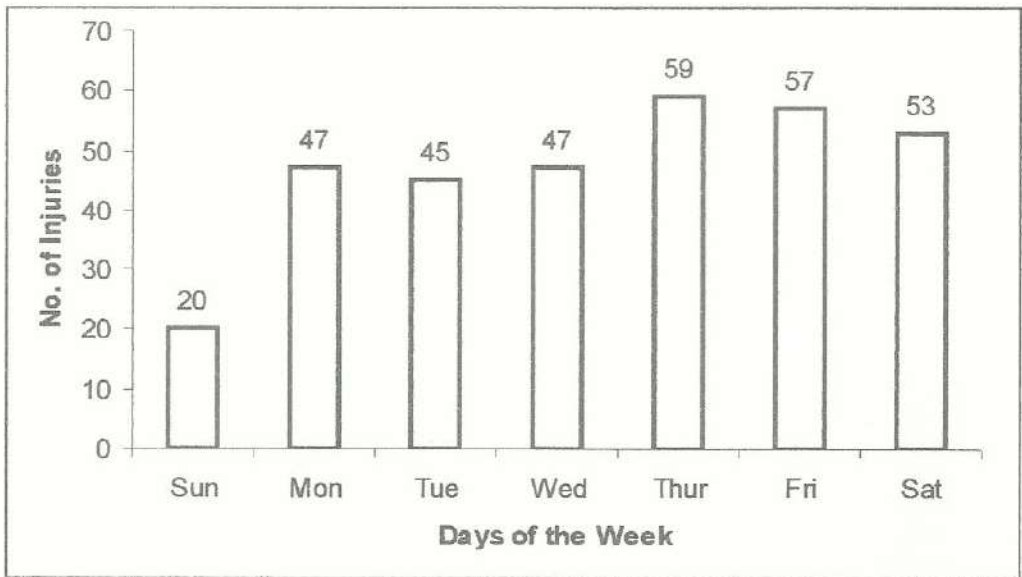


Figure 1: Variation of Number of Injuries with Days of the Week

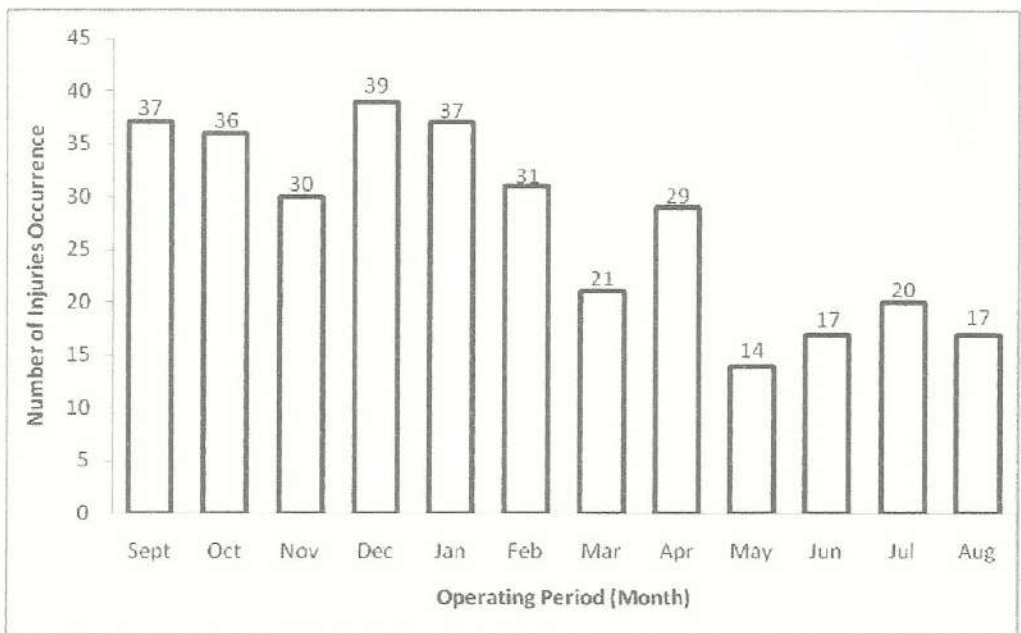


Figure 2: Variation of Number of Injuries with Months of the Year

Anatomical Site of Injury: The commonest anatomical sites of injury were the hands and the wrists with 169 (52%) instances, while the feet and the ankles, legs and other sites accounted for 81 (25%), 62 (19%) and 16 (5%) of these injuries respectively.

Type of Injury: The commonest type of injury were cuts and lacerations 194 (59%), sprains and strains 64 (20%) and others 70 (21%).

Magnitude and Risk Factors of Injuries

Causes of Injury: Injuries were caused as a result of object/substance such as bottle: metal chips etc: technical and human factors. The objects/substances that caused the injury were bottle 161 (49%), machine 85 (26%), bottle tops (or metal chips) 53 (16%) and others such as ergonomics, process design etc accounted for 29 (9%) of the injuries.

The commonest technical factor accountable for the incidence of injury was the environment 183 (54%) of the injuries; and while gloves, anti-slip boots and overalls are provided to the workers in certain departments for certain job tasks, injuries were noted in 105 (32%) occurrences despite using the protective wear(s). Machinery was accountable for 45 (14%) of injuries as pieces of bottles and metal chips were sometimes projectile from machines bottle burst and various other processes.

Among human factors, not using protective wear(s) seems to be the commonest cause of injury as observed in 124 (38%) occurrences; over indulgence or self-confidence on the job due to carelessness with the mechanical process resulted in 55 (17%) of the injuries and others such as inexperience etc resulted in 39 (12%) of the injuries.

Risk Factors: The observed data from the accident investigation procedure for risk factor analysis (Table 2) by statistic percentage analysis, depicted that age less than 30 years, work experience less than three years and intensive hand dominance are significantly associated with high risk of injury. A whole set of factors such as educational status, work shift, total plant experience, use of protective wears, health status vis-à-vis musculoskeletal history in the area of the shoulders, the elbows, and more particularly of the neck and the wrists/hands and personal habits and extra professional activities (smoking, sport, etc) were also studied as risk factors, but were found to be stochastically negligible.

Table 2: Risk Factors Analyses of Injured Workers ($n_1=192$, $n_2=136$)

	Risk Factor	Workers' actually No. of Injuries	» one Injury
Age	Below 30	130(67.7%)	102(75.0%)
	30 and Above	62(32.3%)	34(25.0%)
Departmental Experience	Below 3yrs	133(69.2%)	93(68.3%)
	3yrs and above	59(30.8%)	43(31.7%)

n_1 - Workers' actually no. of injuries, n_2 - Workers' who suffered more than one injury.

Discussion

The plant studied had a high incidence of injury of 1119.5/1000 workers/year and the risk of workers' being injured is high considering that 66% of the workers had an injury and 67% of

those injured had more than one injury. All shifts had a higher number of injuries in the second half of the shift except for the night shift (Table 1). However, injury per worker is highest during the morning shift (40%) and lowest during the general shift (6%) which compares favourably with other research work reported by Bazroy *et al.* (2003) and Bigos *et al.* (1986). The time series analyses of injuries hit the climax of injuries in the latter half of the week; Thursday to Saturday (Figure 1) and, during the first and the last quarters of the year; January and April and September and December (Figure 2). Enquiries from the management revealed that there was a higher schedule pressure and workload during the period under review.

The observed data depicts that injuries were caused as a result of contact with bottles (49%), machines (26%), bottle tops (or metal chips) (16%) and others such as ergonomics, process design etc (9%); and 52% of these injuries are to the hand and wrist.

The stochastic percentage analysis of accident investigation observed data led to the emergence of the following significant risk factors:

- a. Age below 30 year. Bazroy *et al.* (2003), Bigos *et al.* (1986) and Agarwal (1990) reported similar findings of higher rates of injuries to workers' of this age group.
- b. Departmental experience less than three years. The incidence of injuries is higher and/or exacerbated when a worker is new on a task/job and pick up as experience accumulates, as also reported by Bazroy *et al.* (2003), Chew (1985) and Xiang *et al.* (2000). Thus, management should pay attention to properly trained and supervised new workers.
- c. Intensive hand dominance. In this study, the manual work had more injuries as a result of the workload, schedule pressure and the type of work deployment.

Conclusion

The most effective solution for eliminating workstation accidents in a manufacturing plant were investigated and analyzed. Methods used support developing a suitable way to study, design and optimize plan for investigating accidents and identifying risk factors; and selecting and implementing safety programs to ultimately benefit both the worker and the employer. Though reactive steps are the typical beginning point, proactive approaches should be instituted to prevent these kinds of problems from developing. This ongoing process emphasized an institution's efforts to review hazards before an injury or illness occurs.

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