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Safety in Workplace and Its Effect on Labor Productivity: A Case Study for Pharmaceutical Industry

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Abstract

Safety in workplace is a major issue for a manufacturing factory. Proper safety protocols can save lives, reduce accidents, reduce downtime and increase productivity. In this paper, the current condition of safety in a pharmaceutical factory was measured and analyzed. The relation between safety and individual labor productivity of the selected factory was studied. 2 sets of questionnaires were developed for workers and management personnel for measuring and analyzing current state of safety. Individual labor productivity was calculated using Kurosawa's approach. After measuring both the factors, it was analyzed to see how much the labor productivity was dependent on the safety features of the factory. Minitab-17 was used for the analysis. It was found that significant relation exists between safety and labor productivity. Suggestions for improving the safety status were provided based on the analysis which would help to improve the individual labor productivity as well if implemented.

Keywords: workplace safety, labor productivity, Kurosawa approach.

1. Introduction

The manufacturing industries of modern time are very complex in nature. The production quota that must be fulfilled are getting larger day by day. Industries are optimized in such way to achieve the maximum efficiency possible. Unfortunate accidents can occur anytime and can hamper production process. It can cost human lives and loss of capital. Designing foolproof safety and implementing it is essential. Implementation of safety can be done only when the organization is involved with it. Initiatives from top management is needed to install safety protocols and train employees. Employees have the responsibility to follow the proper safety protocols and not to show any negligence. Negligence from a single worker can cause catastrophic disaster. There are two interrelated aspects with safety. They are health or wellbeing of the employees and the environment [1]. Polluting the environment will affect employee's health which in turn may cause accidents.

Achieving high productivity is the goal of any manufacturing industry. Productivity indicates the amount of input given and how much output is achieved from that input [2]. The aim of this paper is to find out the relationship of safety in the workplace and how much safety affects the productivity level of the employees.

Productivity of an organization largely depends on two main factors. External factors which are not controllable and internal factors which can be controlled [3]. In this paper safety is considered as an internal factor to productivity.

One of the major objectives of this paper is to start an initiative for checking the safety level in different manufacturing factories in Bangladesh. In recent times accidents in manufacturing plants had cost huge loss of life. In 2013, the collapse of "Rana Plaza" had caused the loss of 1129 life [4]. Fire at "Tazreen Fashions Factory" killed 112 workers [5]. Boiler explosion at Tampaco Foils Ltd. killed 24 people [6]. More examples can be given of different accidents that occurred due to insufficient safety measures. Along with loss of life, the country is facing economic losses too.

The United States of America has suspended GSP for Bangladesh in 2013 due to serious shortcomings in labor rights and workplace safety [7]. To prevent frequent accidents and diminish the death tolls of workers the European Union also warned Bangladesh to suspend the GSP if safety standards are not increased [8]. Safety standards in the workplace can increase productivity, decrease accidents and break down, minimize risks among workers and benefit the organization and the country financially. The main objectives of this paper is to identify the effect of safety on labor productivity and identify factors that can improve the safety condition and the labor productivity as well.

2. Methodology

Productivity measurement can be performed in various ways. This paper deals with labor productivity of a pharmaceutical factory. In this paper, Dr. Kazukiyo Kurosawa's structural approached was used to measure the labor productivity [9]. Dr. Kurosawa had undertaken several assignments for the International Labor Organization and the Asian Productivity Organization. From his research [Kurosawa (1980)], individual labor productivity can be written as:

$$P_w = \frac{Output}{Input\ of\ Worker's\ Effort} \tag{1}$$

Where, P_w = A worker's productivity.

The structure of work hours on which productivity measurement is based on Kurosawa approach is shown below:

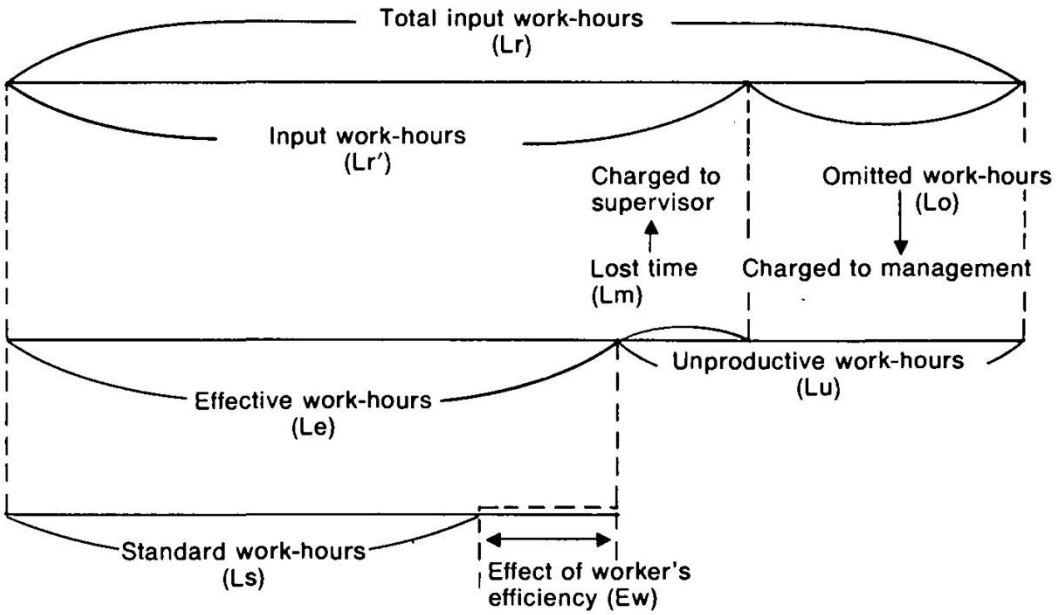

Fig. 1. Structure of work hours in Kurosawa approach [9].

Total input work hour consists of regular work time and overtime per day. Omitted work-hours are such type breaks that are ensured by the management. Such kind of break normally consists of lunch break. The lost time that may occur in a factory may include the time required to get instructions from the supervisor, prayer break, miscellaneous breaks i.e. drinking water, tea breaks, gossiping etc. The appointed supervisor is responsible for these lost times. The overall productivity of a worker can be measured using the below equation [Kurosawa (1980)]:

$$\tau_R = \frac{Q}{L_r} \tag{2}$$

Where, τ_R is the overall employee productivity, Q is the total output and L_r is the total input work hour.

For measuring the safety of the workplace and compare it to the individual productivity, 217 workers were interviewed based on a self-administrated questionnaire. The questionnaire contained two sets of questions. The first set contained basic information of the workers i.e. gender, age, education, experience, working hour etc. Names and ids of the workers were kept hidden to ensure honest and spontaneous responses from them. The second set contained questions about the safety conditions of the workplace from the perspective of each individual employee. The questions in the second set were about adequate safety equipment, proper safety protocols, safety signs, training of personnel, conducting safety drills, proper insulation, proper ventilation, adequate first aid and ambulance service etc. The responses were marked using a point scale of 1-5. Where 5 indicates strongly agree, highly adequate or similar type of response and 1 indicates strongly disagree, highly inadequate or similar type of response. The overall summation from all the questions were calculated to assign the individual a score on the safety condition. The safety scores were than compared with the individual productivity score using fitted line plot and regression analysis.

3. Data Analysis and Results

The basic information of the workers is summarized in the following table:

Table 1. Summary of workers basic information

No. of workers interviewed	217
Male Workers	60 (27.65%)
Female Workers	157(72.35%)
Age	Minimum 18 years, Maximum 42 years 1. 18-24 (41.47%) 2. 25-30 (29.49%) 3. 31-36 (22.58%) 4. 37-42 (6.46%)
Education	1. 8^{th} grade (10.6%) 2. SSC (65.9%) 3. HSC (23.5%)
Work Experience	Minimum 0 years, Maximum 20 years 1. 0-5 (45.62%) 2. 6-10 (23.04%) 3. 11-15 (26.27%) 4. 16-20 (5.07%)

Employee productivity was calculated using equation (2). Regular time and overtime was added to get the total input work hour L_r. Omitted work hours (lunch break) L_o was one hour and constant for all employees. Lost time L_m consisted of time for instruction from the supervisor, tea and coffee break, drinking water, gossiping, using the toilet etc. These lost times for each employee was noted down based on employee's own assumptions. Lost time L_m used in the calculation is estimated value as accurate values are not kept in record. The lost time of each employees consist over the span of regular time and the overtime. Regular output and overtime output of each employees were taken. Reports from floor in-charge, supervisor and estimation from employees were used to get an estimated average value for each employee. The output for each employee was calculated using the following equation:

$$Q = (O_t * O_O) + (R_O * 7) - (L_m * (\frac{R_O + O_O}{2})) \quad (3)$$

Where, Q is the output, O_t is overtime, O_O is overtime output, R_O is regular output and L_m is lost time.

The output values from equation (3) and the total input work hours (L_r) were used in equation (2) to calculate the overall productivity of the workers. The summary of the overall productivity is given in the below table:

Table 2. Summary of productivity of workers.

Minimum Value	20.625
Maximum Value	46.75
Mean	32.546
Standard deviation	7.717

The safety scores were calculated based on the response from the questionnaire. The possible range of scores were:

Fig. 2. Safety score range and safety condition.

The summary of the safety score of the individuals are given in the below table:

Table 3. Summary of Safety Score

Minimum Value	31
Maximum Value	51
Mean	40.055
Standard Deviation	4.377

From the summary, it can be concluded that based on the range of safety determined by this paper, the current safety status of the factory is Moderate Safety.

The fitted line plot of productivity and safety for the 217 workers interviewed is shown in the below figure 3:

Fig. 3. Fitted line plot of safety and productivity.

Confidence level of 95% was used in the above graph. The P value calculated was less than 0.05, which suggests that safety and productivity are related with one another. Pearson correlation coefficient found was 0.832. It indicates that as safety increases, the productivity score also increases significantly.

4. Discussion

Analyzing the data for relation between safety and productivity shows that if the factory can increase the safety facilities for the employees it will increase the productivity also. It is highly possible that productivity depends on other factors as well. However, this study shows significant relation between safety and productivity of the selected factory. The overall safety score based on the study conducted in this paper was "Moderate Safety". It is possible to improve the safety of the factory further. The possible ways to increase safety based on the employees' responses from the questionnaire are given below:

a. Worker who were employed within the last 3 years did not received any training on safety. Training program can be arranged for them.
b. Comparatively young workers do not have access to sufficient safety equipment. As there is not enough safety equipment for all, senior workers get the priority to use them. Adequate personal protective equipment should be brought by the management.
c. Safety drills are not conducted currently. Management should consider conducting safety drills (especially fire safety drill).
d. 31% of the workers handle machines that might cause big accidents. The problems with those machines are:
    i. Vibration
    ii. No protective apron
    iii. Wear

    Replacing these machines or by providing preventive maintenance and by arranging protective aprons for these machines may reduce the risk of accidents.

e. 65% of employees think that accidents might cause due to the carelessness of their fellow colleagues. Accidents can be prevented if the workers are more careful. Because one careless act may cause the life of other people. Management can motivate all the employees to think carefully before anyone does anything. If everybody is careful, many unwanted accidents can be prevented.

Based on the response from the workers and an interview with some management personnel, increasing safety can increase productivity by:

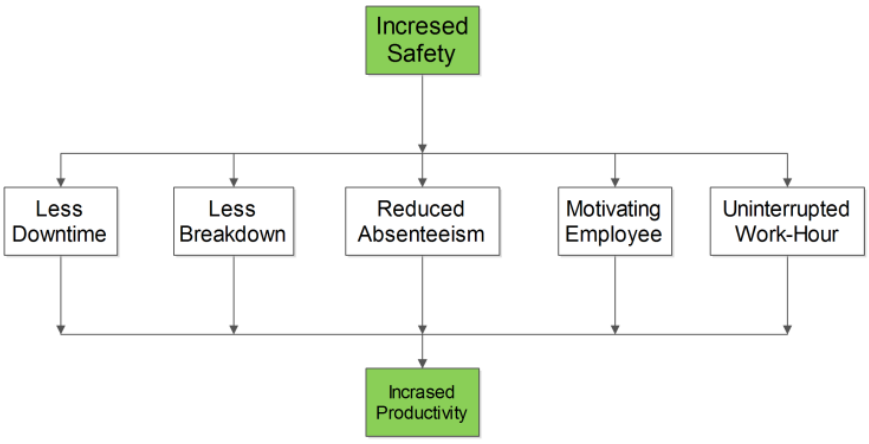

Fig. 4. How increasing safety can increase productivity

Safety in the workplace influences the labor productivity. Accidents may occur due to low safety facilities in the factory. The occurrences of accidents mainly happen due to machine failure and inadequate safety equipment. These accidents that injures the employees increase the unproductive work hours which in turn reduces the labor productivity.

Moreover, accidents and injuries cause absenteeism which creates problem in the production floor by creating problems like unbalanced line, bottlenecks etc. So, it is necessary to take actions to reduce unproductive work hours by ensuring a safe workplace where the occurrences of accidents are down to minimum.

5. Conclusion

The main objective of increasing safety facilities is to reduce the loss of human life. Ensuring safety is a big challenge for management. Unwanted accidents may occur anytime. However, careful planning and strictly implementing safety protocols may reduce the rate of accidents. The employees should feel safe working in their respective workstations. Productivity relies on many factors and safety is one of them. The factory that was studied here had a very high linear relationship of safety and productivity. Increasing safety features may incur some cost. However, it will save human life, capital and will increase the productivity. Ultimately increased safety features will save more than the cost it will incur. Based on the response from the employees, suggestions were discussed in the discussion section that may increase safety and in turn increase employee productivity. This study can be continued further by implementing the suggestions discussed and monitoring the progress. The lost time calculation in this study was based on employees' assumption which is a limitation of this paper. Calculation of accurate lost time was not possible due to shortage of time and manpower.

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