Occupational Health And Safety Management In RMG Sector Of Bangladesh

Kallol Kumar Samaddar

Abstract: The ready-made garments (RMG) industry plays a vital role to augment the socio-economic development of Bangladesh. However, workers health and safety issue in this sector still less focused even though recent time increasing accident rate and loss of lives in some deadly incidents like accidents in Rana Plaza and Tazreen Fashion attack keen attention from home and abroad regarding fire hazards and building safety. In this circumstances, this study aims to depict overall scenario about occupational health and safety of workers in RMG factories and identify occupational health and safety factors which have an impact on workers performance as well as factories efficiency. Fire risk index (FRI) of various factories is occupied to get an overview of fire safety and relative importance of occupational health and safety factors are identified by relative important index (RII). Principal component analysis (PCA) is conducted to investigate the significance of occupational health and safety factors categorized in the variables. Then cause and effect diagram is developed to identify key causes behind musculoskeletal disorder and occupational accident. The relative important index (RII) shows that factories are relatively more concern about health hazard and emergency situation rather than working condition. Prolong working time is the most common in the factories which result in workers sufferings from lower back pain. Most of the workers are injured through needle piercing as negligence of using needle guard which is the root cause. The study also reveals that standard working condition augments factories performance in term of efficiency while accident rate impediment the factories from achieving target efficiency.

Index Terms: Factories Efficiency, Fire Risk Index (FRI), Musculoskeletal Disorder, Occupational Accident, Occupational Health and Safety Factors, Relative Important Index (RII)

1 Introduction

The readymade garments industry acts as a promoter of the prosperity of Bangladesh, has been making a crucial contribution rebuilding the country and its economy which is now the single largest export earner for Bangladesh. Textiles and clothing account for about 85% of total export earnings of Bangladesh. Out of which, 76% comes from the apparel sector [4]. From a humble beginning of 12 industries in 1978, the garment industry currently consists of 5,600 factories of various sizes and about 4.4 million people, mostly women, worked in this sector [1]. Around 20 million people are directly and indirectly depending on RMG sector for their immediate livelihood [6]. Despite many difficulties faced by the sector over the past few years, it has engraved an appropriate place in the world market and kept displaying outstanding performance. Despite the epic growth of the RMG industry and its luminous expectations, there are affluent challenges that need to be surpassed. One of the biggest challenge currently faced by the RMG industry is to ensure better occupational health and safety condition for the millions of garment workers. RMG industry is to ensure better occupational health and safety condition for the millions of garment workers. In Bangladesh, higher production and greater economic returns are considered as the prime goal rather than other major considerations in industries. The even petite significance is concentrated on the communal value in terms of influences on workers, workplaces, society, and environment. The impressions are adulterated by the incompatible worth of life decisions, pain, and suffering, opportunity costs and questions of equity [6].

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The estimates of direct economic costs and benefits are usually made keeping aside from the ethical liabilities to the society as a whole. Industrialists often consider the regulatory compliances and related administrative costs deterrent to productivity. As such occupational health and safety considerations remains ignored. As the issue of workplace safety has been ushered to the onwards due to the two egregious mishaps, the Tazreen fire and the Rana Plaza collapse of recent time, all stakeholders and investors are driven to act appropriately. Several institutions such as the Bangladesh Accord on fire and building safety, the Alliance for Bangladesh worker safety and national plan of action have been designed to ameliorate building and fire safety of Bangladesh's garment industry with a view to abstaining the saddening occurrences [1]. Maximum workers in these garment factories are almost illiterate and they have very limited knowledge of human rights, working conditions and labor standards [6]. Also, management of maximum factories is not concern about occupational health and safety condition inside their factory. However, ensuring better occupational health and safety conditions at all garment factories is an immense undertaking and will take a time to attain. However, with the support of global brands and international development partners, we believe the government of Bangladesh, Bangladesh Garment Manufacturers and Exporters Association (BGMEA) and Bangladesh Knitwear Manufacturers and Exporters Association (BKMEA) will be able to ascertain healthier occupational health and safety circumstances of the RMG industry and preserve the impetus of socio-economic advancement of the country.

2 BACKGROUND OF THE STUDY

The International Labour Organization (ILO) projected that every year about 2.3 million people dies from occupational mishaps and ailments whereas around 270 million suffer egregious non-fatal injuries and another 160 million become ill for shorter or longer periods from work-related causes in all over the world [2]. This epitomizes a colossal toll of anguish for workers and their families. Moreover, the ILO estimated that the total costs of such accidents and ill health amount to approximately 4 percent of the world's GDP (Gross Domestic

Product). Besides about 5 percent of the encumbrance of diseases and injury in firm market economies can be ascribed to work which resembles approximately to the ILO's figure [2]. Therefore avoiding occupational accidents and diseases should make economic sense for the community as well as being good business practice for industries as these significant losses have an adverse influence on economic accrual and puts a burden on society. If there are a deficiency of effective protection at work to assure health and safety various consequences such as absenteeism workplace accidents and occupational illnesses can lead to permanent occupational disability. The huge economic expenses of difficulties connected with health and safety at work that impede economic growth and affect the competitiveness of businesses. As a result, social security systems and public finances have to deal with a significant share of these costs.

3 METHODOLOGY

This research paper is based on survey methodology approach that has been applied to collect and analyze data by mix strategy. Five hundred (500) respondents are randomly selected from thirty-six (36) industries as the sample for the musculoskeletal disorder study while all the factories are considered for fire safety, occupational health and safety factors, accident and efficiency. The target group is interviewed via questionnaire and sometimes direct observation approach is applied. Various inspection reports and previous documents are also a great source of accumulating information about performance criteria of the particular environment. After the information is collected (retrieved from the factories and respondent successfully), some descriptive statistics such as mean standard deviation, fire risk index (FRI), relative important index (RII) and factor analysis, principal components analysis (PCA) and cause and effect diagram have been used for this analysis. For fire risk index is calculated by an equation that includes all nineteen (19) parameter weights and grades which are presented in appendix A. Reliability of questionnaires (in terms of internal consistency) is tested by the Cronbach's alpha (Cα) of each variable. Kaiser-Meyer-Olkin measure of sampling adequacy (KMO-MSA) and Bartlett's test of sphericity are applied to test the adequacy of the collected data for factor analysis. To explore all the potential or real causes (or inputs) that result in a single effect, causes are arranged according to their level of importance or detail, resulting in a depiction of relationships and hierarchy of events. Spearman correlation is applied to measure a non-parametric correlation between variables such as efficiency, occupational accident, occupational health and safety factors. In our study, for efficiency calculation six (6) months of individual factories' efficiency is considered and their average is calculated that is included in appendix C. Likewise, the data of musculoskeletal disorder (MSD) are represented in appendix B.

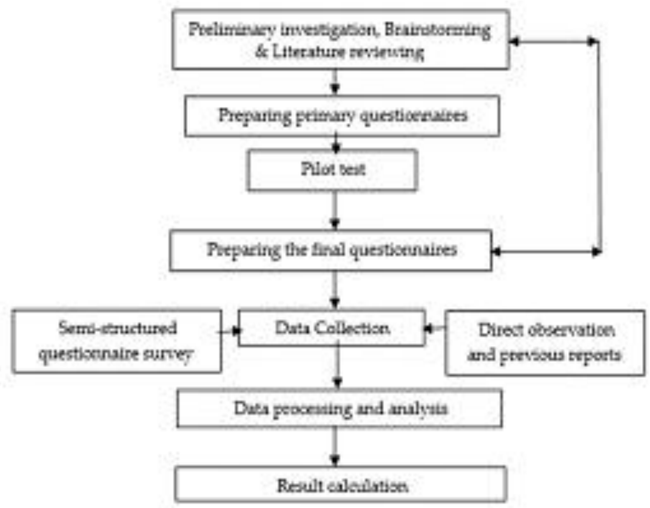

Fig. 1. *Flow chart of research study*

4 FINDINGS AND ANALYSIS

An overview of the results obtained in the study are presented and discussed in this chapter. In this research work, data have been collected from thirty-six (36) garment factories in Bangladesh. The demographic information in the context of location, membership, establishment period, employee number which has been depicted in table 1.

Table 1: *Demography according to various attributes*

Attribute		Number of factories	Percent age
Location	Dhaka	12	33.33%
	Narayanganj	4	11.11%
	Savar	6	16.67%
	Gazipur	14	38.89%
Membership	BGMEA	22	61.11%
	BKMEA	9	25%
	None	5	13.89%
Employee number	Below 2000	3	8.33%
	2001-3500	11	30.56%
	3501-5000	14	38.89%
	5001-6500	6	16.67%
	Above 6500	2	5.56%
Establishment period	After year 2000	17	47.22%
	Before the year 2000	19	52.78%

The above table 1 recounts that maximum factories are selected from Dhaka and Gazipur. Most factories are a member of BGMEA while BKMEA in second whereas five factories do not have any membership. According to employee number factories are divided five major sections and among them, maximum factories are placed 2001-5000 in number.

4.1 Fire Risk Index

Risk indexing is a way of evaluating multiple attributes into a single value and various risk indexes differ primarily in the number and types of parameters (attributes) considered and the arithmetic functions used to summarize these parameters. For current research work a linear additive model of the following form has been used in order to determine Fire Risk Index [7]:

$$FRI = \sum (W_i * X_i)/\sum W_i$$

Where, X_i is a dimensionless score or grade points for parameter i, Wi is the importance of parameter i. Wi has been found by calculating the average of weight given by expert for each parameter. X_i has been given to parameter by comparing with the ideal case through direct investigation. For the first factory,

$$FRI= (366.2/81.6) = 4.49$$

Average FRI (Fire Risk Index) shows the scenario of Bangladeshi readymade knitting garment factories in case of fire safety by providing a value in the scale of 5.

Table 2: *FRI (Fire Risk Index) for 36 Garment Factories.*

Factory Number	Fire Risk Index	Factory Number	Fire Risk Index
1	4.49	19	4.64
2	3.98	20	3.64
3	3.06	21	4.37
4	4.59	22	3.33
5	4.04	23	3.69
6	3.47	24	4.54
7	4.07	25	3.71
8	4.48	26	2.84
9	3.08	27	2.01
10	3.60	28	3.05
11	4.22	29	4.32
12	3.49	30	3.43
13	4.17	31	2.89
14	3.43	32	4.06
15	4.26	33	4.56
16	3.81	34	4.78
17	3.38	35	3.80
18	4.34	36	4.18

Average Fire Risk Index,

$$(\sum FRI)/n = (137.8/36) = 3.83;$$

Where n= number of garment factories.

A graphical representation through histogram for Fire Risk Index versus a number of garment factory has been shown below.

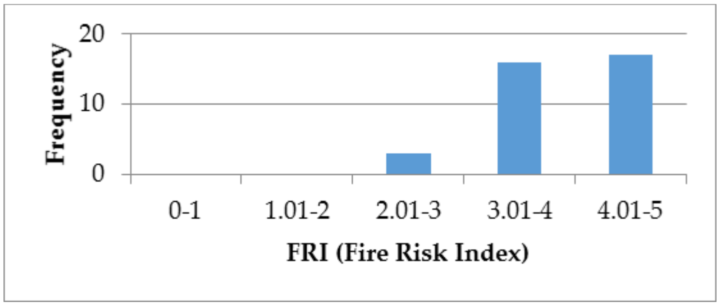

Figure 2: *Fire Risk Index vs Frequency*

From figure 2, it has been found that FRI ranged from 2.01 to 3.00 for 3 factories among 36 factories. This range of FRI indicates the poor condition of fire safety in those factories. Other 16 factories' FRI is ranged from 3.01 to 4.0 that indicates the average condition of fire safety in those factories. Rest 17 factories among 36 factories are ranged from 4.01 to 5.00 which indicate a good condition of fire safety in those factories. Location based average FRI is calculated using the formula as shown below, Average FRI in each location = (Sum of the FRI situated in that location)/ (No. of factories in that location).

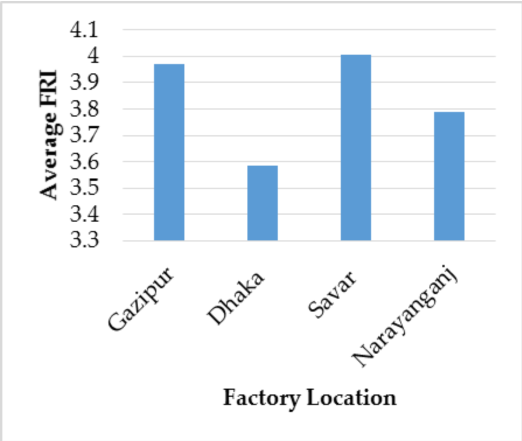

Figure 3: *Comparison of average FRI among different location of factories*

From the above figure 3, it has been found that Factories of Savar area have more precautions about fire safety than other areas (Gazipur, Dhaka, Narayanganj area). Factories of Gazipur and its surroundings have more concern about fire safety after Savar area. Factories of Narayanganj and its surroundings have more concern about fire safety after Gazipur area. Factories of the capital city have the lowest average fire risk index which concludes that factories from the capital city have the lowest concern about fire safety. Those factories either are members of BGMEA, BKMEA or member of none these two organizations. Average FRI (Fire Risk

Index) has been calculated using the formula as shown below, Average FRI for members of each organization = (Sum of the FRI member of that organization)/ (No. of factories in that organization).

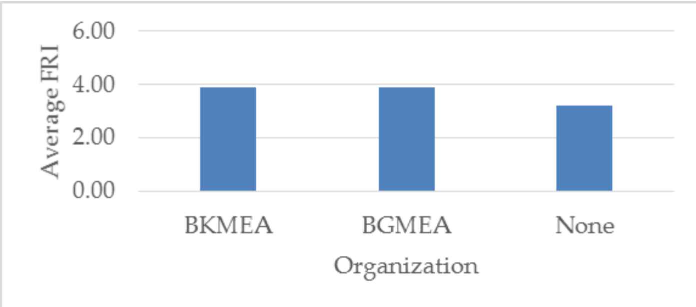

Figure 4: *Comparing average FRI among different organizations*

From the bar chart, figure 4, it is noticeable that factories under the membership of BKMEA have more concern about fire safety than others (BGMEA and others who are not members of both BGMEA and BKMEA). BKMEA and BGMEA both pressurizes their organization's members to follow safety code. Nonmembers of both organizations have no strict rule to follow about fire safety, therefore, has the lowest average FRI.

4.2 Factor Analysis

Ranking of occupational health & safety measurement factors represents the importance of particular factors that influence the level of occupational health & safety in RMG. A total of 28 factors is ranked in descending order of RII (Relative Important Index) based on the answers to particular questions. RII is calculated by following equation [5]:

$$RII = \sum W/(A*N)$$

For first aid box, *RII = 158/(5*36)*= 0.878

Where, $\sum W$, Summation of the weight given to first aid box by the respondents = 158. *A*, Highest weight = 5.00. And *N*, Total number of respondents =36.

Table 3: *Comparison of ranking of the overall factors*

Factors	RII(Relative Important Index)	Ranking
First Aid Box	0.878	1
Light	0.811	2
Width of stairs	0.761	3
Air circulation	0.756	4
Sanitation system	0.745	5
Pure drinking water	0.739	6
Working space	0.733	7
Vibration level	0.706	8
Safety sign	0.667	9
Paddle guard	0.661	10
Eye guard	0.633	11
Reports on safety incidents	0.622	12
Apron	0.611	13
Safety related inspection	0.6	14
Face Musk	0.589	15
Regular health inspection	0.576	16
Safe operating procedure	0.575	17
Heat insulator	0.572	18
Health & safety training	0.57	19
Hand gloves	0.561	20
Needle guard	0.556	21
Earmuff	0.55	22
Working time	0.544	23
Review and update safe work	0.533	24
Noise level	0.494	25
Temperature level	0.478	26
Cleanness of workplace	0.394	27
Dust control system	0.389	28

Table 3 reveals that the factors affecting occupational health and safety in RMG with an overall ranking. In this study table shows that the level of overall occupational health and safety has been mostly emphasized on the factor "first aid box" and less emphasized factor "dust control system", that indicates the level of occupational health and safety among RMG in Bangladesh is working condition oriented. On the other hand, another factors such as "dust control system" and "cleanliness of workplace" have been less emphasized which also indicates that health hazards are still neglected and health condition worsen day by day in RMG. Prior to principal component analysis, the strength of each factor is examined by communality to decide the accuracy of factor analysis.

Table 4: *Communalities of each factor*

Factors	Initial	Extraction
Width of stairs	1.000	.810
First Aid Box	1.000	.877
Noise level	1.000	.715
Vibration level	1.000	.807
Light	1.000	.771
Temperature level	1.000	.693
Air circulation	1.000	.737
Cleanness of workplace	1.000	.827
Sanitation system	1.000	.642
Pure drinking water	1.000	.752
Dust control system	1.000	.768
Working space	1.000	.686
Working time	1.000	.750
Needle guard	1.000	.796
Eye guard	1.000	.789
Paddle guard	1.000	.803
Heat insulator	1.000	.732
Earmuff	1.000	.872
Face mask	1.000	.870
Hand gloves	1.000	.768
Apron	1.000	.779
Regular health inspection	1.000	.855
Health and safety training	1.000	.881
Safe operating procedure	1.000	.870
Safety related inspection	1.000	.868
Safety sign	1.000	.871
Reports on safety incidents	1.000	.832
Review and update safe work	1.000	.816

The communities of all factors are shown in table 4. It reveals that each factor has communality greater than 0.5, which suggests their accuracy valid for factor analysis. Principal component analysis with Varimax orthogonal rotation is used to reduce 28 factors into highly predictive variables of occupational health and safety in RMG.

Table 5: *Reduction of the factors into six (6) critical variables*

Variable no	Variable level	Eigen value	Percentage of variance	Factors	Factor loadings
1.	Safety Equipment	10.798	39.992	Ear muff	.930
				Face Musk	.893
				Apron	.866
				Eye guard	.862
				Needle Guard	.844
				Hand gloves	.833
				Paddle guard	.793
				Heat insulator	.723
2.	Management	4.447	16.470	Health and safety training	.927
				Safety sign	.902
				Safe operating procedure	.890
				Review and update safe work	.870
				Safety related inspection	.869
				Reports on safety incidents	.849
				Regular health inspection	.840
3.	Working Condition	3.629	13.442	Light	.790
				Working time	.785
				Air circulation	.711
				Dust control system	.704
				Cleanness of workplace	.682
				Noise level	.641
				Working space	.576
4.	Health Hazard	1.455	5.388	Vibration level	.864
				Temperature level	.708
				Sanitation system	.663
				Pure drinking water	.552
5.	Emergency Situation	1.108	4.071	First Aid Box	.924
6.	Infrastructure	1.075	3.841	Width of stairs	.826

Table 5 narrates that total of 6 variables is developed, named as safety equipment, working condition, management, health hazard, emergency situation and infrastructure factor with Eigen values greater than 1.00. The total percentage of variance of this study is 83.204 which means the six (6) variables can explain 83.204 percentage (%) of the total variation of the data set. KMO MSA and Bartlett's test of sphericity are measured to test the adequacy of the collected data from respondents used in factor analysis.

Table 6: *KMO MSA and Bartlett's test result*

Kaiser-Meyer-Olkin of Sampling of Sampling Adequacy		0.820
Bartlett's Test of Sphericity (Approx. Chi-Square)		5230.313
	df (degree of freedom)	86
	Sig.	0.000

In this study, the result of Bartlett's test of sphericity is approx. Chi-square = 5230.313, df = 86 and significant level, p = 0.000 and KMO MSA value is 0.820 which is suggested to be acceptable for factor analysis. A statistic Cronbach's alpha (Cα) for investigating the internal consistency of questionnaire is examined for each variable (shown in Table 7).

Table 7: *Cronbach's alpha (Cα) reliability test results for each variable*

Variables	Cronbach's alpha (Cα)
Safety Equipment	.955
Management	.958
Working Condition	.900
Health Hazard	.866

The validity and reliability of questionnaires (in terms of internal consistency) is tested by the Cronbach's alpha (Cα) of each variable. Table 7 presents that, the variables "safety equipment"," management", "working condition", and" health hazard " respectively has Cronbach's alpha (Cα) value of 0.955, 0.958, 0.900 and 0.866. Each of the Cronbach's alpha (Cα) values of these four variables is considerably high which indicates high validity and reliability in term of internal consistency.

4.3 Musculoskeletal Disorder Analysis

The chapter commences with an analysis of the demographical data gathered from the study sample (n=500). The data analyzed are presented in the form of pie charts. This followed by a description of the most leading sample characteristics by means of frequencies and percentages.

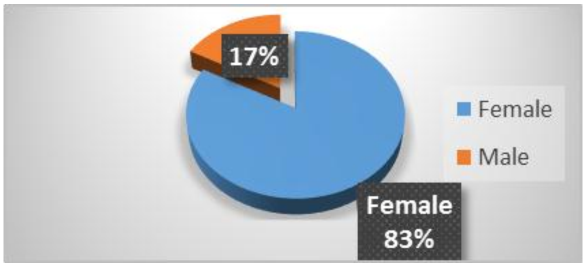

Figure 5: *Frequency of workers vs. gender classification*

Figure 5 delineates the gender distribution of the sample. The sample respondents of a larger number of female respondents to that of male respondents. Female respondents comprised of 83% (n=415) compared to 17% (n=85) male respondents.

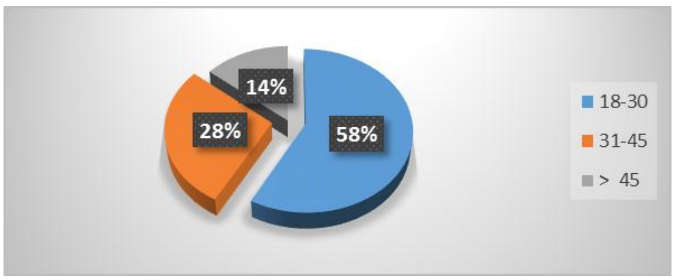

Figure 6: *Frequency of workers vs. age.*

The graphical presentation of the age distribution of the sample is depicted in figure 6. The majority of the respondents (n=290 or 58%) fall in the age category 18-30 years. This is followed by 140 (28%) of the respondents in the age category 31-45 years old. The minority of the respondents fall in the age category 46 years and older, constitutes 14% (n=70) of the sample. From the ensuing results, it can, therefore, be concluded that the majority of the workforce participating in the study is very young, ranging from the ages 18-30 years old.

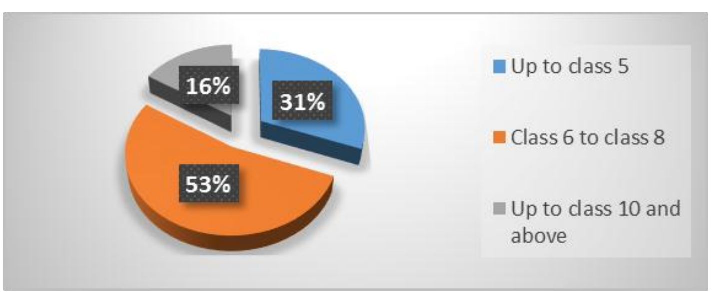

Figure 7: *Frequency of workers vs. education level*

Figure 7 illustrates the education level of the sample. The graph indicates that the majority of the respondents, 53.2% (n=266) has an educational level of class 6 to class8 and 30.8 (n=154) possess an educational level of class up to 5. Eighty (80) respondents (16%) has an education level up to class 10 and above.

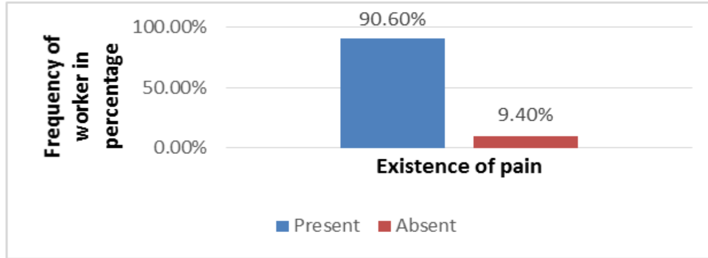

Figure 8: *Frequency of workers vs. existence of pain*

Figure 8 displays the existence of pain of the sample. The different kinds of pain exist in 90.6% (n=453) of workers whereas 9.4% (47) of the sample has no pain.

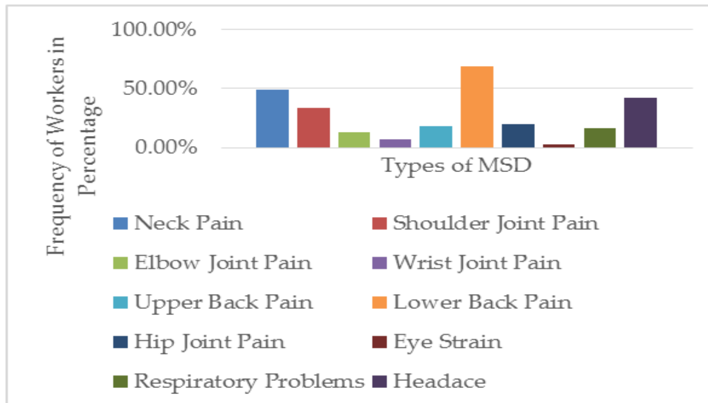

Figure 9: *Frequency of workers vs. types of MSD*

Figure 9 depictures the graphic presentation of types of MSD distribution of the sample. The majority of the respondents (n=310, 68.43%) suffer from lower back pain while the second major is neck pain (n=221, 48.78%). In addition, pain in shoulder joint (n=153, 33.77%) and headache (n=190, 41.94%) are also found constantly among the sample. There are observed almost similarity between upper back pain (n=83, 18.32%) and pain in hip joint (n=88, 19.42%) as well as pain in elbow joint (n=60, 13.24%) and respiratory problems (n=74, 16.33%). On the other hand, eye strain (n=13, 2.87%) is the minor MSD which is about half of pain in wrist joint (n=30, 6.62%).

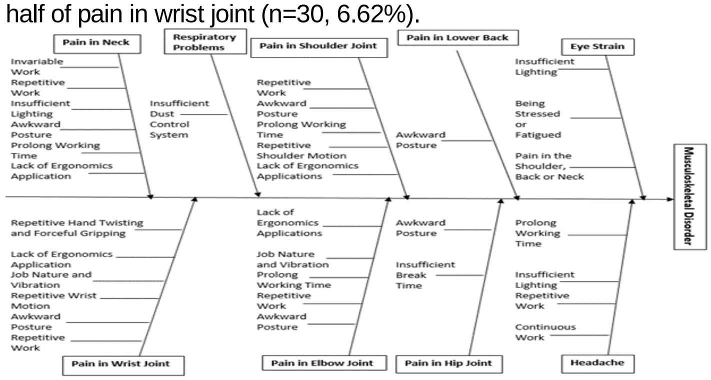

FIGURE 10: *CAUSE AND EFFECT DIAGRAM OF MUSCULOSKELETAL DISORDER*

This fishbone diagram 10 is marked to fathom the origin of musculoskeletal disorder at the workplace in the garment industry of Bangladesh. We used the eight (8) generic headings to prompt ideas. Layers of branches show through thinking about the causes of the problem. Pain in the neck, shoulder, elbow joint, wrist joint, hip joint and in lower back have some commonly determined causes as repetitive and invariable work, prolong working time, awkward posture due to lacking in ergonomic application and break time. Another important factor inefficient lighting and continuous work are responsible for eye strain and neck pain. At the end, dust is a plausible cause of respiratory-related injuries. Spearman Correlation between Occupational Health and Safety Factors and musculoskeletal disorder to represent the relationship among workers in particular factories.

Table 8: *Spearman correlation between MSD and occupational health and safety factors.*

Occupational Health and Safety Factors (OHSF)	Musculoskeletal Disorder (MSD)	Correlations between OHSF with the Presence of MSD
Standard working time	Pain in elbow joint	-0.357**
	Pain in neck	-0.672**
	Pain in shoulder joint	-0.439**
	Pain in hip joint	-0.755**
	Headache	-0.335**
Appropriate lighting at the workplace	Pain in lower back	-0.56**
	Pain in neck	-0.778**
	Headache	-0.675**
	Eye strain	-0.827**
Allowable vibration level	Pain in elbow joint	-0.710**
	Pain in shoulder joint	-0.672**
Effective dust control system	Respiratory problems	-0.571**

***. Correlation is significant at the 0.01 level (2-tailed).*

The above table 8 represents the relationship between the occupational health and safety factors with regards to the presence of musculoskeletal disorder (MSD) among workers in particular factories. From the table, we can summarize that standard working time, appropriate lighting at the workplace, allowable vibration level, and effective dust control system have great influence over different MSD problem. According to Bangladesh National Garments Worker's federation, the maximum working hour per day is 10 hours including 2 hour overtime [2]. In our study, we have found that the factories that fail to follow standard working time, workers are sufferings from pain in the hip joint. Similarly, pain in elbow joint, headache and pain in the shoulder are weakly correlated while a pain in the neck has moderately correlated at the significance level of 0.01 level (2-tailed). According to occupational health and safety manual, the requirement of lighting in a garment factory is 500-1000 lux [3], varies due to working category. In our research, eye strain is a very common problem among workers because of lighting problem and illumination in garments which indicates a strong negative correlation with appropriate lighting at the workplace. In the same way, lighting system has a moderate negative correlation with pain in lower back and headache while strong negative with pain in the neck that means a situation of neck pain is worst or presence highly in those factories in which sufficient lighting system cannot be managed. In our analysis, we have found that the factories are exposed to high vibration machines, the existence of elbow and shoulder pain also increase among workers which suggest pain in elbow joint is negatively strong correlated and pain in shoulder negatively moderate correlated with vibration level at same significance level. Moreover, dust control system shows moderate negative correlation with respiratory problems of workers which represent workers suffer most in those factories in which system fails to control dust as for 8 hours working period dust should not exceed the limit of 2.5 mg/m3 for cotton dust and 10 mg/m3 for [3] . Therefore we can draw an outline from above relationships that when the factories fail to provide standard occupational environment and equipment the rate of MSD increases with considerably.

4.3 Occupational Accident Analysis

The chapter begins with an analysis of the number of accidental data documented from thirty-six (36) garments factories the study sample (n= 3948). The analyzed data are presented in the form of column charts. This followed by a description of the most leading sample characteristics by means of frequencies and percentages.

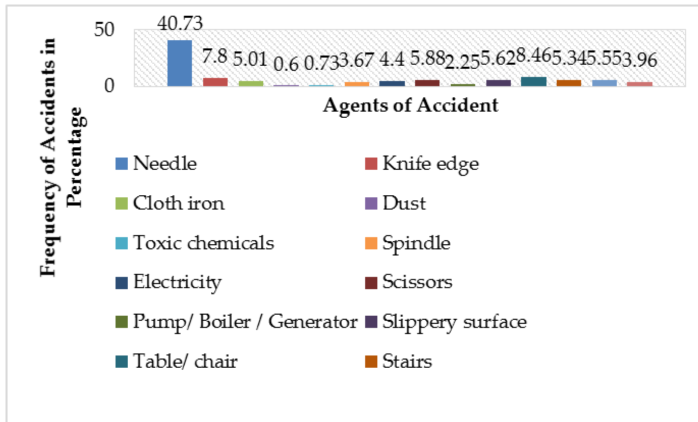

Figure 11 *Frequency of accidents vs. agents of accident*

The figure 11 exhibits a graphical presentation of the agents that are accountable for accidents have occurred during the specific time period of one year in thirty-six (36) garments factories. The majority of the accidents occur due to the agent about 1608 workers (40.73%) by a needle while second best occurrence, almost one-fifth ($1/5^{th}$) in comparison with a needle, is chair or table in agronomical point of view. There are almost similar frequency has been observed for scissors (n=232, 5.88%), slippery surface (n=222, 5.62%), trolley (n=219, 5.55%), stairs (n=211, 5.34%) and cloth iron (n=198, 5.01%). The spindle (n=145, 3.67%) and others (n=155, 3.96%) categories also show almost similarity as well as electricity (n= 174, 4.40%) is about double compared to the agent pump or boiler or generator (n= 89, 2.25%) in relation with the accidents. In addition, knife edge plays a vital role in the causation of accidents about 308 workers (7.80%) and the least responsible agents are toxic chemicals (n= 29, 0.73%) and dust (n=24, 0.60) where dust is the lowest of all.

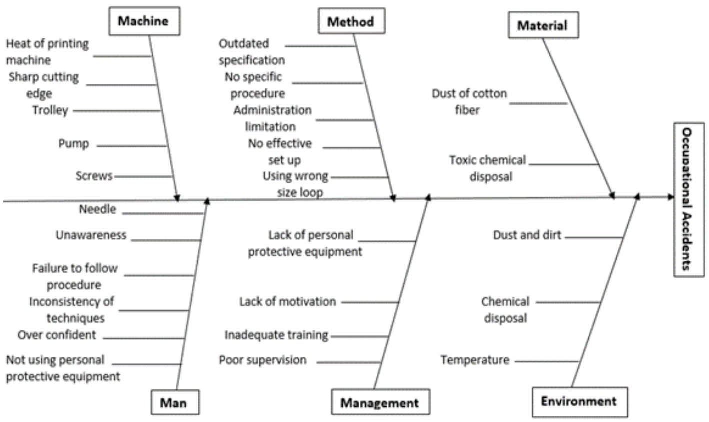

Figure 12: *Cause and effect diagram for an accident in the garment industry.*

This fishbone diagram 12 was drawn to understand the source of periodic accidents occurs in garments of Bangladesh. We use the six generic headings to prompt ideas. Layers of branches depict thorough thinking about the causes of the problem. Under the heading “Machines,” the idea shows six (6) kinds of equipment such as a needle, pump, trolley, screws, sharp cutting edge and heat of printing machine that are greatly responsible for occupational accidents at workplace. In addition, there are only three causes are identified like dust and dirt, chemical disposal and temperature level in “Environment”. However, the inconsistency of techniques, unawareness, over confident, failure to follow the standard procedure as well as lacking in using PPE is listed under the category of “Man”. In “Method” category of cause, absence of specific procedure, limitation in specifications and administration, ineffective work set up and wrong loop size are considered for corresponding analysis. Moreover, “Management” is the most important section as the effects of management are always not as visible like others which include poor supervision, lacking in motivation, inadequate training and lacking in supplying PPE. At last, there are only two possible causes documented for “Material” heading. Spearman correlation between occupational health & safety measurement factors and accident rate to illustrate the relationship between the occupational health and safety factors with regards to the occurrence of the accident for certain period of the time interval in particular factories.

Table 9: *Spearman correlation between Accident rate and Occupational health and safety factors.*

Occupational Health and Safety Factors (OHSF)	**Correlations between OHSF with accident rate**
Standard working space	-0.527**
Allowable vibration level	-0.425**
Safe level of noise	-0.402*
Cleanliness of workplace	-0.306
Effective air circulation system	-0.232
Acceptable thermal environment	-0.544**
Standard sanitation system	-0.283
Availability of pure drinking water	-0.425
Effective dust controls system	-0.425**
Appropriate lighting at the workplace	-0.780**
Standard working time	-0.587**
Eye guard	-0.741**
Paddle guard	-0.706**
Needle guard	-0.849**
Heat insulator	-0.684**
Earmuff	-0.450**
Face mask	-0.579**
Hand gloves	-0.626**
Apron	-0.243**
Regular health inspection	-0.359*
Health and safety training	-0.107
Safe operating procedure	-0.220
Safety related inspection	-0.332*
Safety sign	-0.292
Reports on safety incidents	-0.304
Review and update of safe work	-0.225

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

The above table illustrates the relationship between the occupational health and safety factors with regards to the occurrence of the accident for certain period of the time interval in particular factories. According to ILO, standard workspace for the worker should be $10m^3$ but most of the factories fail to render which results various accidents due to work in confined place [2]. In our study, also reveals a negative moderate correlation between standard workspace and accident rate which justify the situation. Besides thermal environment has a great impact on the occurrence of the accident as according to OSH manual should be maintained between $25\text{-}30^0$ Celsius and deviation of temperature accelerate accident rate which also indicates negative moderate correlation with each other [3]. In factories, appropriate lighting system reduces accident as a violation of standard (750-1000 lux) [3] and the presence of illumination increases accidents which also represent a negative strong correlation. There is a strong negative correlation between personal protective equipment like eye guard, paddle guard, and needle guard with accident rate that reveals the absence of these factors or proper application increases accident occurrence. However, negative moderate correlations are also observed among allowable vibration level, effective dust control system, standard working time, heat insulator, face mask and hand gloves with accident rate whereas apron is weakly negative correlative at the significance level of 0.01 level (2-tailed). Therefore availability and usages of apron have very little influence on accident occurrence. In addition, safe level of noise has a negative correlation which is moderate while regular health inspection and safety related inspection are negative weakly correlated with accident rate at the significance level of 0.05 level (2-tailed). Moreover, the rest of the factors such as air circulation, cleanliness of workplace, sanitation system, pure drinking water, ear muff, health & safety training, safe operating procedure, safety sign, reports on safety incidents and review and update safe work show no relation with accident rate. All these results clearly indicate that the scarcity of those factors influences accident occurrence.

4.4 Efficiency analysis with respect to occupational health & safety measurement factors and occupational accident

The Spearman correlation coefficient is used in this study to test the strength of association between occupational health and safety measurement factors and efficiency. The results from spearman correlation are given below.

Table 10: *Spearman correlation between efficiency and occupational health and safety factors*

Occupational Health and Safety Factors (OHSF)	Correlations between OHSF with efficiency
Standard width of stairs	-0.266
First aid box	-0.029
Standard working space	0.712**
Allowable vibration level	0.478**
Safe level of noise	0.436**
Cleanliness of workplace	0.632**
Effective air circulation system	0.435*
Acceptable thermal environment	0.508*
Standard sanitation system	0.616
Availability of pure drinking water	0.567
Effective dust controls system	0.492**
Appropriate lighting at the workplace	0.511**
Standard working time	0.430**
Eye guard	0.224
Paddle guard	0.266
Needle guard	0.499**
Heat insulator	0.376*
Earmuff	0.400*
Face mask	0.484**
Hand gloves	0.426**
Apron	0.387
Regular health inspection	0.211
Health and safety training	0.142
Safe operating procedure	0.192
Safety related inspection	0.287
Safety sign	0.231
Reports on safety incidents	0.248
Review and update of safe work	0.225

The above table 10 compares the relationship among the occupational health and safety factors with regards to efficiency of particular factories. From the table, we can figure out that standard working space is strongly correlated with efficiency at the significance level of 0.01 (2-tailed) that indicates if standard working space (10 m^3 per worker) can be maintained [3], efficiency is also enhanced. In addition, standard working time which is maximum 10 hours including 2 hours overtime per day and appropriate lighting at the workplace (150-1000 lux) [3] improve factories efficiency, indicated as moderate positive correlation. However, some factors like as allowable vibration level, cleanliness of workplace, dust control system, light , working time, needle guard, face mask and hand gloves have shown a moderate correlation which indicates that standardization of those factors is the responsible efficiency of factories. Therefore these factors need to be properly maintained to increase efficiency. It is interesting to observe that there are also found a moderate correlation with efficiency for the factors air circulation, temperature level, ear muff and heat insulator at the significance level of 0.05 (2-tailed) whether the rest of the factors have shown no influence on efficiency in certain significance level. The Spearman correlation coefficient is used in this study to test the strength of association between no of accident and efficiency. The results from spearman correlation are given below.

Table 11: *Spearman correlation between the no of Accident and Efficiency*

	Accident rate	Factory efficiency
Accident rate	1	
Factory efficiency	-0.515**	1

The above table 11 represents spearman moderate negative correlation with efficiency and no. of an accident in a certain period of time span where it is so obvious that increase of accident has a bad impact on efficiency and downwards the trend.

5 CONCLUSION

The empirical study has extracted an overall scenario of the 36 selected garments factories in the context of occupational health and safety condition. For fire safety, the allocation of FRI of the 36 factories research discloses that the performance of these garment factories is less than appeasement in general. Mean fire risk index (FRI) was only 3.83 (on a scale of 5) and 53% of the factories had a score less than 4. The existence of combustible items (cloth, cotton) inside is the worst parameters among the nineteen investigated parameters and require immediate attention from the regulators. In health hazard condition, the factor named cleanliness is worst compared to other factors while the dust of fiber and pieces of cloth are everywhere in the factories. In addition, most of the factories have no proper dust control system which has an injurious impact on workers' health especially respiratory problem and leads to overall inefficiency. Moreover, the factories do not have proper temperature control system. In some floor of the most factories, the noise level is more than 75 dB. It is also found that workers work for more than nine hours in a day or forty-eight hours in a week. In terms of health care facility factories have the scope of improvement as they provide the very limited amount of this concern. The study also indicates the presence and proper application of safety equipment as a result 54% accident in the garments occurring due to the absence of using of safety equipment. In these factories, workers are not introduced with personal protective equipment (PPE) with necessary education while management has some misconceptions about the application of safety equipment. In our study, we have found that management of most of the factories does not review and update safe work procedure in time. Health inspection and examination program, as well as proper safety training in a particular environment, are hardly conducted on those factories. Upper management and decision makers have come forward for seeking scope of improvement to maintain standard regulated by different organizations. There is some strong evidence that represents the BKMEA member factories performed better than the non-members. This indicates BKMEA should further enterprising to advance its association base and maintain its good practice. However, it might also be noted that even the BKMEA members still have large scope towards improvement to make. Cause and effect diagram is used to focus on key causes of MSD problems of workers which are very common in the workplace as garment work is more repetitive and constant work in an awkward posture for a longer period. Most common cases are back pain, neck pain, headache and pain in shoulder joint that are responsible for working time, insufficient lighting and absence of ergonomic application while designing workstation. About 40.73% injury has occurred. The main reasons behind accidents are improper and a shortage of using personal protective equipment's (needle guard, hand and finger gloves, eye protective equipment's, masks etc.) workers unawareness, wrong procedure, lack of training, improper knowledge about these injuries, poor supervision, overconfidence, dusty environment and poor maintenance etc. Spearman correlation is used in our study where we have found a close relation between efficiency with working space, cleanliness, and light of workplaces so those factors have great influence on efficiency. Accident rate has a negative correlation with efficiency as if accident increases, efficiency will decrease. Garment manufacturers are continuing to build garments factories without proper infrastructure and facilities cannot be justified. Meanwhile, it is the largest industry in Bangladesh, more people can be engaged in this affiliate which may minimize the unemployment level as well as the impoverishment level. Appropriate materialization of general and international criteria should be made obligatory; otherwise, death snare for workers will continue to be built. The recent steps taken by the government, BKMEA and BGMEA showed some progress in taking safety measures in factories. The government and the proprietors of garments factories should be more alarmed about industrial safety-related instructions and guidelines which will lessen their expenditures as well as the severe losses due to accidents ultimately recover overall efficiency. Inspection, reporting, and compliance with existing national and international laws and standards must be imposed precisely to minimize further occurrences due to the scarcity of occupational health and safety requirements.

6 Appendices

6.1 Appendix A

For current research work a linear additive model of the following form has been used in order to determine Fire Risk Index:

$$FRI = \sum (W_i * X_i) / \sum W_i$$

Where, Xi is a dimensionless score or grade points for parameter i, Wi is the importance of parameter i. Wi has been found by calculating the average of weight given by expert for each parameter. Xi has been given to parameter by comparing with the ideal case through direct investigation. Fire safety parameter: Parameter considered in this research work is given below [7].

- F1=Locked / unlocked condition of exit door
- F2=Existence of chemical material inside
- F3=Practice of fire drill
- F4=Exposed electrical or gas line inside the factory
- F5=Presence of combustible item (cotton, cloth) inside
- F6=Presence of alternative power system
- F7=Availability of gas mask for emergency
- F8=Number of fire extinguisher in the factory
- F9=Number of fire trained employees
- F10=Width of stairs
- F=11Number of fire masks
- F12=Number of fire buckets
- F13=Amount of water contained the tanks
- F14=Number of first aid box available
- F15=Number of smoke detectors
- F16=Number of heat detectors
- F17=Number of emergency lights
- F18=Number of fire hoses
- F19=Number of fire alarms

Table 11: *Importance of Parameter (Wi) Calculation*

Parameter \ Expert	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Expert 9	Expert 10	Average
Locked / unlocked condition of exit door	4	5	5	5	5	4	5	5	5	5	4.8
Existence of chemical material inside	3	3	5	3	3	5	4	3	5	5	3.9
Practice of fire drill	3	3	4	4	4	5	4	4	5	4	4
Exposed electrical or gas line inside the factory	4	4	4	4	3	5	4	4	5	5	4.2
Presence of combustible item (cotton, cloth) inside	5	4	5	3	4	5	4	4	5	4	4.3
Presence of alternative power system	4	4	4	2	2	3	4	3	3	5	3.4
Availability of gas mask for emergency	5	5	4	4	5	4	5	5	5	5	4.7

Number of fire extinguisher in the factory	5	5	4	5	5	4	5	5	5	5	4.8
Number of fire trained employees	3	3	5	5	4	4	5	5	4	5	4.3
Width of stairs	4	4	3	4	4	3	4	4	5	4	3.9
Number of fire masks	4	3	4	4	5	3	3	4	4	5	3.9
Number of fire buckets	5	4	4	4	4	3	5	5	4	4	4.2
Amount of water contained the tanks	5	4	4	3	4	5	5	5	5	4	4.4
Number of first aid box available	5	5	4	4	4	3	4	4	4	5	4.2
Number of smoke detectors	5	5	4	5	5	4	5	5	5	5	4.8
Number of heat detectors	4	5	5	3	3	4	4	4	5	5	4.2
Number of emergency lights	5	4	4	3	3	3	5	5	4	5	4.1
Number of fire hoses	5	5	4	5	4	4	5	5	5	5	4.7
Number of fire alarms	5	5	4	5	5	4	5	5	5	5	4.8

Table 11: *Fire Risk Index (FRI) calculation*

		Factory no. 01		**Factory no. 02**		**Factory no. 03**		**Factory no. 04**		**Factory no. 05**	
Factor name	Wi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi
F1	4.8	5	24	4	19.2	2	9.6	5	24	4	19.2
F2	3.9	4	15.6	3	11.7	3	11.7	4	15.6	4	15.6
F3	4	5	20	4	16	3	12	5	20	5	20
F4	4.2	5	21	3	12.6	3	12.6	5	21	4	16.8
F5	4.3	3	12.9	2	8.6	2	8.6	3	12.9	2	8.6
F6	3.4	4	13.6	3	10.2	3	10.2	5	17	5	17
F7	4.7	3	14.1	3	14.1	3	14.1	4	18.8	3	14.1
F8	4.8	5	24	5	24	4	19.2	5	24	5	24
F9	4.3	4	17.2	4	17.2	3	12.9	5	21.5	4	17.2
F10	3.9	5	19.5	4	15.6	3	11.7	5	19.5	5	19.5
F11	3.9	4	15.6	4	15.6	3	11.7	4	15.6	4	15.6
F12	4.2	4	16.8	4	16.8	3	12.6	4	16.8	4	16.8
F13	4.4	5	22	3	13.2	2	8.8	5	22	3	13.2
F14	4.2	5	21	5	21	4	16.8	5	21	5	21

F15	4.8	5	24	5	24	4	19.2	5	24	4	19.2
F16	4.2	5	21	5	21	3	12.6	4	16.8	3	12.6
F17	4.1	4	16.4	4	16.4	3	12.3	4	16.4	4	16.4
F18	4.7	5	23.5	5	23.5	4	18.8	5	23.5	5	23.5
F19	4.8	5	24	5	24	3	14.4	5	24	4	19.2
SUM	81.6	85	366.2	75	324.7	58	249.8	87	374.4	77	329.5
FRI=			4.487745		3.979167		3.061275		4.588235		4.03799

	Factory no. 06		**Factory no. 07**		**Factory no. 08**		**Factory no. 09**		**Factory no. 10**		**Factory no. 11**	
Factor name	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi
F1	3	14.4	4	19.2	5	24	3	14.4	4	19.2	4	19.2
F2	4	15.6	4	15.6	4	15.6	2	7.8	3	11.7	3	11.7
F3	3	12	4	16	5	20	2	8	4	16	4	16
F4	4	16.8	4	16.8	4	16.8	3	12.6	3	12.6	4	16.8
F5	2	8.6	3	12.9	3	12.9	2	8.6	2	8.6	3	12.9
F6	4	13.6	4	13.6	5	17	3	10.2	4	13.6	4	13.6
F7	3	14.1	4	18.8	4	18.8	2	9.4	2	9.4	4	18.8
F8	4	19.2	5	24	5	24	5	24	4	19.2	5	24
F9	3	12.9	4	17.2	5	21.5	2	8.6	3	12.9	3	12.9
F10	4	15.6	4	15.6	4	15.6	3	11.7	3	11.7	5	19.5
F11	4	15.6	4	15.6	5	19.5	2	7.8	3	11.7	4	15.6
F12	3	12.6	3	12.6	5	21	4	16.8	2	8.4	5	21
F13	3	13.2	3	13.2	3	13.2	3	13.2	4	17.6	4	17.6
F14	4	16.8	5	21	5	21	5	21	5	21	5	21
F15	4	19.2	4	19.2	5	24	4	19.2	5	24	5	24
F16	3	12.6	4	16.8	4	16.8	2	8.4	3	12.6	4	16.8
F17	3	12.3	4	16.4	4	16.4	4	16.4	5	20.5	5	20.5
F18	4	18.8	5	23.5	5	23.5	3	14.1	4	18.8	4	18.8
F19	4	19.2	5	24	5	24	4	19.2	5	24	5	24
SUM	66	283.1	77	332	85	365.6	58	251.4	68	293.5	80	344.7
FRI=		3.469363		4.068627		4.480392		3.080882		3.596814		4.224265

	Factory no. 12		Factory no. 13		Factory no. 14		Factory no. 15		Factory no. 16		Factory no. 17	
Factor name	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi
F1	4	19.2	5	24	4	19.2	5	24	4	19.2	4	19.2
F2	3	11.7	3	11.7	3	11.7	3	11.7	3	11.7	3	11.7
F3	3	12	5	20	3	12	5	20	5	20	2	8
F4	4	16.8	4	16.8	4	16.8	4	16.8	4	16.8	4	16.8
F5	3	12.9	3	12.9	2	8.6	2	8.6	1	4.3	1	4.3
F6	3	10.2	5	17	5	17	5	17	5	17	3	10.2
F7	3	14.1	3	14.1	3	14.1	4	18.8	3	14.1	3	14.1
F8	4	19.2	4	19.2	3	14.4	5	24	4	19.2	4	19.2
F9	3	12.9	4	17.2	3	12.9	3	12.9	3	12.9	3	12.9
F10	4	15.6	4	15.6	3	11.7	4	15.6	4	15.6	3	11.7
F11	3	11.7	3	11.7	2	7.8	5	19.5	5	19.5	3	11.7
F12	4	16.8	4	16.8	3	12.6	5	21	5	21	5	21
F13	3	13.2	5	22	4	17.6	5	22	5	22	5	22
F14	4	16.8	5	21	4	16.8	5	21	4	16.8	3	12.6
F15	4	19.2	5	24	4	19.2	4	19.2	3	14.4	3	14.4
F16	3	12.6	3	12.6	3	12.6	3	12.6	3	12.6	3	12.6
F17	4	16.4	5	20.5	4	16.4	5	20.5	5	20.5	5	20.5
F18	3	14.1	4	18.8	3	14.1	4	18.8	3	14.1	3	14.1
F19	4	19.2	5	24	5	24	5	24	4	19.2	4	19.2
SUM	66	284.6	79	339.9	65	279.5	81	348	73	310.9	64	276.2
FRI=		3.487745		4.165441		3.425245		4.264706		3.810049		3.384804

	Factory no. 18		Factory no. 19		Factory no. 20		Factory no. 21		Factory no. 22		Factory no. 23	
Factor name	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi
F1	5	24	5	24	4	19.2	4	19.2	3	14.4	3	14.4
F2	3	11.7	3	11.7	3	11.7	3	11.7	3	11.7	4	15.6
F3	5	20	5	20	3	12	5	20	3	12	3	12
F4	4	16.8	4	16.8	3	12.6	4	16.8	4	16.8	4	16.8
F5	2	8.6	3	12.9	3	12.9	3	12.9	2	8.6	3	12.9
F6	4	13.6	5	17	5	17	5	17	3	10.2	3	10.2

F7	5	23.5	5	23.5	4	18.8	4	18.8	2	9.4	2	9.4
F8	5	24	5	24	5	24	5	24	4	19.2	4	19.2
F9	3	12.9	4	17.2	3	12.9	5	21.5	3	12.9	3	12.9
F10	5	19.5	5	19.5	3	11.7	4	15.6	4	15.6	4	15.6
F11	3	11.7	5	19.5	3	11.7	5	19.5	3	11.7	4	15.6
F12	5	21	5	21	4	16.8	4	16.8	3	12.6	4	16.8
F13	5	22	5	22	3	13.2	5	22	5	22	5	22
F14	4	16.8	5	21	4	16.8	5	21	3	12.6	3	12.6
F15	5	24	5	24	4	19.2	5	24	4	19.2	4	19.2
F16	5	21	5	21	4	16.8	4	16.8	2	8.4	3	12.6
F17	5	20.5	5	20.5	4	16.4	5	20.5	4	16.4	5	20.5
F18	4	18.8	4	18.8	3	14.1	3	14.1	3	14.1	4	18.8
F19	5	24	5	24	4	19.2	5	24	5	24	5	24
SUM	82	354.4	88	378.4	69	297	83	356.2	63	271.8	70	301.1
FRI=		4.343137		4.637255		3.639706		4.365196		3.330882		3.689951

	Factory no. 24		**Factory no. 25**		**Factory no. 26**		**Factory no. 27**		**Factory no. 28**		**Factory no. 29**	
Factor name	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi
F1	5	24	5	24	3	14.4	3	14.4	3	14.4	4	19.2
F2	5	19.5	4	15.6	4	15.6	2	7.8	4	15.6	4	15.6
F3	5	20	5	20	4	16	1	4	4	16	5	20
F4	5	21	3	12.6	3	12.6	2	8.4	3	12.6	4	16.8
F5	3	12.9	2	8.6	2	8.6	2	8.6	3	12.9	5	21.5
F6	4	13.6	3	10.2	3	10.2	3	10.2	3	10.2	4	13.6
F7	3	14.1	2	9.4	2	9.4	2	9.4	3	14.1	3	14.1
F8	5	24	5	24	3	14.4	2	9.6	3	14.4	5	24
F9	5	21.5	4	17.2	2	8.6	1	4.3	2	8.6	3	12.9
F10	5	19.5	4	15.6	4	15.6	2	7.8	3	11.7	3	11.7
F11	4	15.6	3	11.7	2	7.8	2	7.8	2	7.8	5	19.5
F12	4	16.8	4	16.8	2	8.4	2	8.4	2	8.4	5	21
F13	5	22	3	13.2	2	8.8	2	8.8	4	17.6	4	17.6
F14	5	21	4	16.8	4	16.8	2	8.4	3	12.6	5	21

F15	5	24	5	24	3	14.4	2	9.6	2	9.6	5	24
F16	3	12.6	2	8.4	2	8.4	2	8.4	3	12.6	5	21
F17	5	20.5	4	16.4	2	8.2	1	4.1	4	16.4	4	16.4
F18	5	23.5	4	18.8	4	18.8	3	14.1	4	18.8	5	23.5
F19	5	24	4	19.2	3	14.4	2	9.6	3	14.4	4	19.2
SUM	86	370.1	70	302.5	54	231.4	38	163.7	58	248.7	82	352.6
FRI=		4.535539		3.707108		2.835784		2.006127		3.047794		4.321078

	Factory no. 30		**Factory no. 31**		**Factory no. 32**		**Factory no. 33**		**Factory no. 34**		**Factory no. 35**		**Factory no. 36**	
Factor name	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi	Xi	Wi*Xi
F1	3	14.4	3	14.4	4	19.2	4	19.2	4	19.2	2	9.6	5	24
F2	4	15.6	3	11.7	4	15.6	5	19.5	5	19.5	2	7.8	2	7.8
F3	4	16	3	12	3	12	4	16	4	16	3	12	5	20
F4	3	12.6	2	8.4	3	12.6	5	21	4	16.8	5	21	5	21
F5	3	12.9	4	17.2	4	17.2	4	17.2	4	17.2	3	12.9	4	17.2
F6	3	10.2	4	13.6	4	13.6	5	17	5	17	5	17	5	17
F7	3	14.1	3	14.1	5	23.5	5	23.5	5	23.5	4	18.8	5	23.5
F8	4	19.2	4	19.2	4	19.2	4	19.2	5	24	4	19.2	4	19.2
F9	3	12.9	2	8.6	4	17.2	5	21.5	5	21.5	5	21.5	5	21.5
F10	3	11.7	2	7.8	3	11.7	5	19.5	5	19.5	3	11.7	3	11.7
F11	3	11.7	3	11.7	5	19.5	5	19.5	5	19.5	4	15.6	4	15.6
F12	4	16.8	3	12.6	4	16.8	4	16.8	5	21	2	8.4	2	8.4
F13	4	17.6	3	13.2	5	22	5	22	5	22	4	17.6	4	17.6
F14	4	16.8	4	16.8	5	21	5	21	5	21	5	21	5	21
F15	3	14.4	3	14.4	4	19.2	4	19.2	5	24	5	24	5	24
F16	2	8.4	2	8.4	3	12.6	4	16.8	5	21	3	12.6	3	12.6
F17	4	16.4	2	8.2	5	20.5	5	20.5	5	20.5	4	16.4	4	16.4
F18	5	23.5	2	9.4	3	14.1	4	18.8	4	18.8	4	18.8	4	18.8
F19	3	14.4	3	14.4	5	24	5	24	5	24	5	24	5	24
SUM	65	279.6	55	236.1	77	331.5	87	372.2	90	386	72	309.9	79	341.3

FRI=		3.4264 71		2.8933 82		4.062 5		4.5612 75		4.7303 92		3.7977 94		4.1825 98

6.2 Appendix B

TABLE 12: *Presences of MSD among workers in percentage*

Factories	Elbow	Wrist	Respiratory	Low back	Eye	Headache	Neck	Shoulder	Hip
1	10%	0%	20%	20%	0%	10%	30%	10%	0%
2	10%	10%	30%	10%	0%	20%	40%	20%	10%
3	0%	10%	20%	40%	0%	10%	20%	10%	0%
4	0%	0%	0%	10%	0%	10%	10%	10%	0%
5	20%	20%	10%	60%	0%	40%	30%	30%	20%
6	20%	20%	10%	30%	0%	10%	20%	40%	20%
7	20%	20%	20%	30%	0%	20%	30%	40%	20%
8	10%	0%	20%	10%	0%	10%	30%	10%	0%
9	10%	0%	10%	20%	0%	10%	40%	20%	10%
10	0%	0%	0%	10%	0%	10%	10%	20%	10%
11	40%	0%	40%	10%	0%	30%	50%	40%	20%
12	50%	10%	60%	80%	10%	40%	60%	40%	10%
13	20%	0%	50%	40%	0%	30%	40%	20%	30%
14	20%	0%	50%	40%	0%	20%	20%	20%	20%
15	10%	0%	50%	20%	0%	20%	20%	30%	10%
16	20%	10%	60%	60%	10%	60%	20%	20%	20%
17	20%	0%	40%	80%	10%	40%	10%	20%	20%
18	60%	20%	50%	60%	10%	40%	60%	60%	40%
19	60%	40%	60%	80%	10%	40%	70%	60%	40%
20	10%	0%	10%	10%	0%	30%	20%	50%	10%
21	10%	0%	10%	10%	10%	60%	50%	60%	20%
22	0%	0%	0%	20%	0%	40%	20%	40%	20%
23	0%	0%	10%	20%	0%	30%	20%	30%	10%
24	20%	10%	40%	10%	0%	20%	20%	20%	0%
25	20%	10%	30%	30%	0%	40%	40%	40%	0%
26	0%	0%	20%	40%	10%	40%	60%	60%	50%
27	20%	10%	30%	20%	10%	20%	50%	50%	30%
28	20%	0%	30%	10%	0%	20%	30%	20%	10%
29	60%	40%	40%	20%	10%	40%	70%	20%	0%
30	0%	0%	0%	10%	0%	10%	50%	10%	40%
31	10%	0%	10%	20%	0%	30%	60%	30%	30%
32	10%	0%	0%	40%	0%	20%	40%	40%	20%
33	20%	0%	20%	50%	0%	20%	60%	50%	20%
34	20%	0%	20%	80%	0%	40%	80%	60%	0%
35	10%	0%	10%	50%	0%	20%	30%	40%	0%
36	10%	0%	10%	20%	0%	10%	20%	50%	10%

6.3 Appendix C

Table 11: *Overall average efficiency of selected factories*

Si. no	January	February	March	May	June	July	Average
1.	32.86%	34.79%	34.65%	33.60%	31.72%	35.81%	34%
2.	45.78%	47.34%	44.78%	44.85%	46.30%	42.73%	45%
3.	51.65%	58.68%	57.16%	55.52%	53.24%	56.10%	55%
4.	61.86%	62.55%	62.28%	60.98%	62.05%	61.29%	62%
5.	38.46%	37.23%	42.89%	36.26%	40.23%	42.89%	40%
6.	47.13%	48.28%	44.73%	46.39%	45.85%	42.52%	46%
7.	42.28%	41.88%	43.98%	40.15%	44.24%	42.92%	43%
8.	60.78%	58.25%	59.98%	61.28%	57.77%	56.69%	59%
9.	38.28%	39.23%	38.88%	36.26%	37.17%	38.41%	38%
10.	49.72%	53.22%	51.69%	50.96%	52.07%	48.61%	51%
11.	47.19%	48.64%	48.15%	46.17%	47.76%	47.88%	48%
12.	41.82%	38.91%	40.62%	39.12%	38.26%	38.73%	40%
13.	43.27%	44.14%	43.76%	47.29%	47.18%	44.51%	45%
14.	56.44%	58.14%	58.36%	55.27%	56.15%	56.96%	57%
15.	62.35%	62.18%	62.08%	61.70%	62.64%	61.08%	62%
16.	44.74%	43.12%	43.58%	46.18%	46.03%	47.20%	45%
17.	51.67%	48.87%	49.23%	51.63%	51.12%	49.86%	50%
18.	42.48%	43.21%	43.40%	40.15%	41.24%	39.60%	42%
19.	36.42%	34.81%	33.75%	35.83%	34.79%	35.43%	35%
20.	48.26%	45.26%	47.85%	44.72%	45.21%	44.66%	46%
21.	36.11%	38.05%	36.26%	36.53%	38.37%	35.92%	37%
22.	41.41%	41.17%	42.14%	39.70%	40.51%	42.26%	41%
23.	62.77%	60.69%	60.84%	61.28%	61.13%	61.77%	61%
24.	43.29%	41.42%	42.35%	45.19%	44.84%	43.46%	43%
25.	48.85%	50.51%	49.19%	48.76%	48.09%	49.22%	49%
26.	35.01%	35.25%	32.72%	34.62%	34.37%	33.56%	34%
27.	42.49%	40.13%	42.47%	41.33%	41.96%	41.57%	42%
28.	43.61%	43.28%	42.59%	46.84%	44.28%	44.80%	44%
29.	43.16%	43.83%	41.72%	41.30%	41.42%	42.75%	42%
30.	59.93%	60.28%	60.59%	58.61%	58.89%	59.53%	60%
31.	40.28%	39.31%	41.89%	42.51%	41.07%	41.27%	41%
32.	50.46%	49.78%	51.22%	50.44%	49.11%	49.51%	50%
33.	44.85%	46.41%	45.67%	45.34%	44.71%	45.38%	45%
34.	38.97%	38.27%	37.16%	39.74%	39.05%	37.56%	38%
35.	55.28%	55.69%	55.17%	56.35%	55.71%	57.24%	56%
36.	58.95%	59.86%	57.26%	59.91%	59.14%	57.43%	59%

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