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# Improvement of Ergonomic Factors That Affects Employees in a Textile Industry

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*Abstract –Ergonomics is an important aspect in an industry. The ergonomic factors play an important role in the effective running of a company, so these factors are to be considered seriously. In the ergonomic study various aspects in the industry are to be considered that relates with the employees; while working. The ergonomic problems will affect the workers in a negative way; this will leads to decrease in productivity, non-achievement of target value, etc. The main objective of this study is to find out the ergonomic problems that are dominant in a textile industry and to give suggestion to overcome these problems. In this study a survey is conducted to know the response of the employees about the working conditions provided by the company. A Questionnaire is designed to conduct the survey; a pilot study is also conducted for checking the reliability of the questionnaire. According to the results obtained from the survey; certain suggestions are given to overcome the problems.*

**Index Terms—** Ergonomics, Ergonomic Factors, Questionnaire Design, Reliability Checking.

## I. INTRODUCTION

“Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance”.

Human factors and Ergonomics is a multidisciplinary field incorporating contributions from psychology, engineering, industrial design, graphic design, statistics, operations research and anthropometry. In essence it is the study of designing equipment and devices that fit the human body and its cognitive abilities. The two terms "human factors" and "ergonomics" are essentially synonymous. Human factors and ergonomics are concerned with the 'fit' between the user, equipment and their environments. It takes account of the user's capabilities and limitations in seeking to ensure that tasks, functions, information and the environment suit each user.

Proper ergonomic design is necessary to prevent repetitive strain injuries and other musculoskeletal disorders, which can develop over time and can lead to long-term disability. Ergonomics improvements improve quality and operators productivity [7] - [9]. Usually, ergonomics evaluations are performed by ergonomists, while workplace layouts are designed by planning engineers, and the results are often unsatisfactory and do not improve productivity [5],[6]. So a study of ergonomic factors or facilities affecting workers in an industry is important. In an industry ergonomics plays a key role, if proper ergonomic facilities are not provided it will affect the performance of the company.

A case study is conducted regarding ergonomics in a leading textile industry. Production department (Weaving Unit) is selected for the case study. In this various ergonomic factors are considered that has an effect on the workers while working. Considering these ergonomic factors a survey is conducted regarding the satisfaction of the employees while working. A questionnaire is designed and reliability checking is done; after that a survey of 120 employees is conducted. According to this survey the response of the employees are obtained and ergonomic factor that has the highest responses are selected and suggestions are given to improve the factors.

## II. METHODOLOGY

In this study production department (weaving unit) is selected for the case study. The detailed study of the production department is conducted and various data's regarding the activities in production department are collected. From this data various ergonomic factors are selected and a questionnaire is designed. A pilot study of 20 employees is conducted with this questionnaire. From this data reliability checking of the questionnaire is conducted by using SPSS software and necessary modifications are done to questionnaire to improve reliability. After preparing final questionnaire main survey of 120 employees is conducted, and the responses of the employees are obtained. From this the ergonomic factors that have higher responses are selected and suggestions are given to improve the factors.

## III. ERGONOMIC FACTORS AFFECTING WORKERS IN PRODUCTION DEPARTMENT

The weaving unit is the important area in the production department. The production department consists of 382 power looms and 22 sulzer looms, 36 pirn winding machine, 1 sizing machine, 1 warping machine. The



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production department consists of 120 employees. The detailed study of the production department is conducted by considering various ergonomic factors like, the working environment, machines, working time, wages system and safety. A cause and effect diagram can be constructed as shown in figure 1 to analyse the factors that causes the ergonomic problems. The factors that contribute to ergonomic problem are discussed below.

#### A. Working Environment

The factors of Working Environment are shown below:

**1. Dust:** The working area of the production department is a dusty environment. Employees are both mentally and physically affected by this dusty environment. The continuous exposure to the dust will cause severe problems working in this environment for a long working periods or shifts. This will cause Bronchitis and sneezing this will affect the work.

**2. Sound:** There are 382 machines in the weaving unit and together there is a noisy environment in the production department. The continuous exposure to the sound will affects the workers in a negative manner in such a way that, it will cause headache, loss of attitude, presence of mind and hearing loss will occur.

**3. Temperature:** The temperature of the production department should be well controlled otherwise this will affect the working performance and attitude of the worker. If the controlling equipment's are not working properly this will cause improper temperature control in the production department. The roof of the production department is made of asbestos sheets this will absorb more heat this will cause to obtain more heat in the production department.

#### B. Working Time

The working time includes two factors such as shift and wage system.

**1. Shift:** The working time includes two shifts, i.e. from 8am to 8 pm and 8pm to 8am. The employees in the production department have to work for 12 hours. Working for continuous 12 hours will cause poor concentration, laziness, etc. If the facilities are not given correctly and the working time is too long mental stress will be more for the worker and this adversely affect the work and this result in poor quality products.

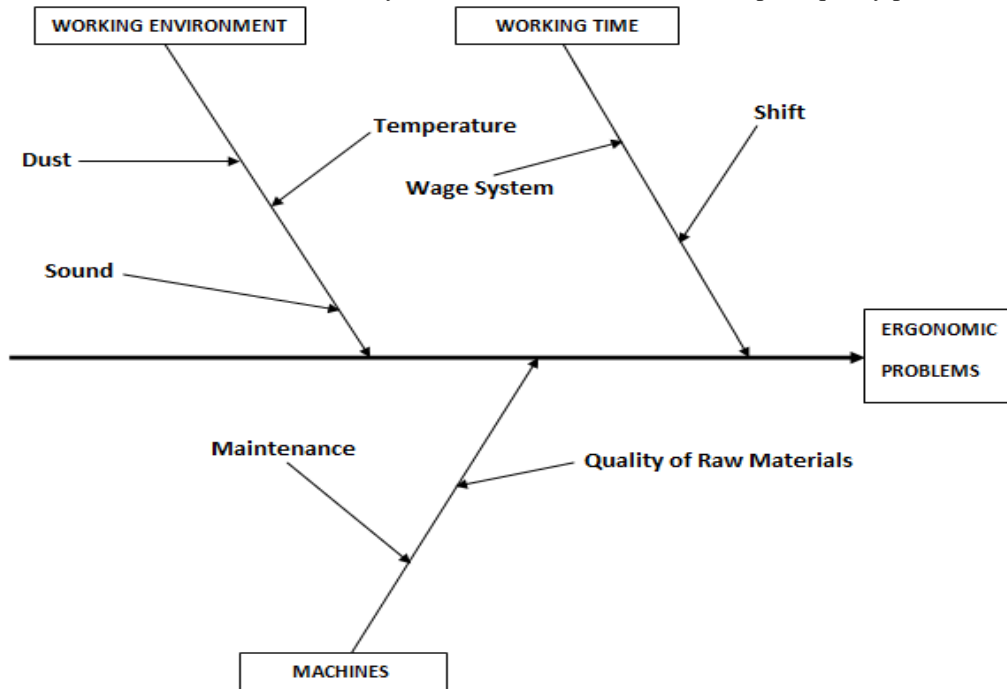


Fig1: Cause and Effect Diagram for Ergonomic Problems

**2. Wage System:** The wage system adopted is the Piece Rate System. The wage system ensures guaranteed minimum wage and they get rated for the products they have produced more than the target rate. The workers are motivated to work for a long shift of 12 hours due to the wage system adopted. The 12 hour shift will cause serious problems to the worker because they have stand and work this will cause back pain, ligament problems to legs causes' leg pain. This will badly effect on the work of the employees and cause lack of focus on the work and the illness dominates.



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**C. Machines**

The production department consists of 382 power looms and 22 sulzer looms, 36 pirn winding machine, 1 Sizing Machine, 1 Warping Machine. They have adopted the preventive maintenance. The Sizing machine is driven by a motor in which the power is transmitted through a chain drive. During the power transmission the portion were the warping beam enters into the saw box of the sizing machine the chain drive lags its tension so that the cotton yarn itself is loading the yarn from the warping beam. These results in the weakening of the cotton yarn and causes delay while working.

**D. Industrial Safety**

Industrial safety is an important aspect while running a company. The company should provide sufficient safety measures and to make the employees aware about the importance of the safety precautions to be taken while working. The awareness of using the safety measures is not properly done by the company.

**IV. QUESTIONNAIRE DESIGN AND SURVEY**

Considering the ergonomic factors a questionnaire is designed to find out the response of the employees regarding the ergonomic factors while working in the production department.

**A. Design of Questionnaire**

In order to identify the responses of the employees, a questionnaire is designed in which the ergonomic factors are included in each of the questions. The questionnaire consists of 22 questions and the level of satisfaction is rated at a 1-5 scale. Each question consists of five options to be rated, i.e. strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree. A pilot study is conducted to check the reliability of the questionnaire.

**B. Pilot Study**

A pilot study is conducted, after designing the questionnaire. Pilot study is the survey conducted before the main survey, in order to check the reliability of the questionnaire. By conducting the pilot study we can find out the initial response about the questionnaire and the modifications needed on the questions can be made. In the pilot study a basic response of 20 employees where considered. From the response of the 20 employees the reliability checking of the questionnaire is done by using SPSS software.

**C. Reliability Checking of Questionnaire**

The responses of the 20 employees are entered in to the SPSS Software. Then the reliability checking of the questionnaire is done.

**Table I: Reliability Statistics of pilot study at initial phase**

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.299	0.213	22

The result of reliability checking is shown in the Table I above; a constant known as Cronbach's Alpha is found to be 0.299. The value of the constant is very low than the acceptable range. The acceptable value of Cronbach's Alpha should be greater than 0.7; in this case the value obtained is 0.299 which is very low. The detailed output of reliability checking for questionnaire used in pilot study is shown in Table II.

Scale Mean if Item Deleted is; excluding the individual item listed, all other scale items are summed for all individuals and the mean of the summated items is given. Scale Variance if Item Deleted is; excluding the individual item listed, all other scale items are summed for all individuals and the variance of the summated items is given. Corrected Item-Total Correlation is the correlation of the item designated with the summated score for all other items. The column Cronbach's Alpha if Item Deleted is the most important column in the table. This represents the scale's Cronbach's alpha reliability coefficient for internal consistency if the individual item is removed from the scale.

Again the reliability checking is done to find whether the value of Cronbach's Alpha is in the acceptance range or not. For this various trials of reliability checking is done; by deleting the questions and finally the solution is obtained and the Cronbach's Alpha is found to be 0.770; which is in the acceptable range (0.770 > 0.6). From the questionnaire 9 questions are removed, out of 22; and the reliability checking satisfies for remaining 13 questions. In this way the reliability checking is done and this questionnaire can be used for the survey. The result of final reliability checking is shown below (Table III and Table IV):



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Table I : Item-Total Statistics Pilot Study At Initial Phase

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1	78.2000	17.432	0.274	0.238
2	78.7000	21.063	-0.374	0.365
3	78.5000	16.895	0.749	0.191
4	78.0000	18.737	0.030	0.302
5	78.7000	20.221	-0.183	0.380
6	78.6000	14.568	0.435	0.134
7	78.4000	17.726	0.158	0.264
8	77.8000	18.905	0.094	0.288
9	79.0000	15.789	0.496	0.162
10	78.7000	21.905	-0.546	0.392
11	79.7000	17.905	0.067	0.294
12	79.2000	15.537	0.344	0.182
13	79.3000	16.642	0.357	0.207
14	77.8000	19.116	0.047	0.296
15	78.4000	19.200	-0.045	0.325
16	78.2000	18.274	0.214	0.264
17	78.2000	18.905	0.027	0.302
18	78.3000	18.116	0.124	0.276
19	78.5000	23.000	-0.491	0.448
20	78.4000	19.200	0.017	0.302
21	79.0000	21.684	-0.413	0.393
22	78.7000	14.958	0.376	0.160

Table II : Reliability Statistics Pilot Study At Final Phase

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.770	0.790	13



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Table III :Item-Total Statistics Pilot Study At Final Phase

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1	45.0000	24.842	0.529	0.743
2	45.3000	25.905	0.736	0.743
3	45.4000	23.200	0.430	0.754
4	45.2000	25.853	0.296	0.766
5	45.8000	25.221	0.408	0.754
6	46.0000	21.684	0.633	0.724
7	46.1000	25.989	0.312	0.764
8	44.6000	26.779	0.397	0.758
9	45.0000	26.947	0.226	0.770
10	45.1000	27.674	0.101	0.783
11	45.2000	27.537	0.225	0.769
12	45.0000	25.474	0.604	0.743
13	45.5000	21.947	0.551	0.737

**D. Survey**

The final questionnaire prepared after reliability checking is used for the survey. A survey of 120 employees is conducted by using the questionnaire, the scores for each question are calculated and then it is shown in the TableIV.

Table IV: Scores Obtained From the Survey of 120 Employees

Parameters	Response Of The Employees (%)
Company	73
Dust	71
Temperature	82
Sound	61
Work Time	67
Wage	74
Stress	74
Communication	81
Machines	90
Overall Satisfaction	76

Table V : Results of Ergonomic Factors

QUESTION NO:	RESPONSE (%)
1	73
2	71
3	87
4	76
5	61
6	67
7	61.5
8	86
9	75
10	73
11	81.5
12	90



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E. Findings from the Survey

13	75.5
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The results from the survey are shown in the Table VI regarding the ergonomic factors affecting employee satisfaction. A bar chart is plotted, considering the results obtained from the survey as shown in fig 2. From bar chart it is clear that ergonomic factors that are discussed, are having significant contribution to employee satisfaction. So necessary steps should be taken to improve these factors and there by improve efficiency and quality.

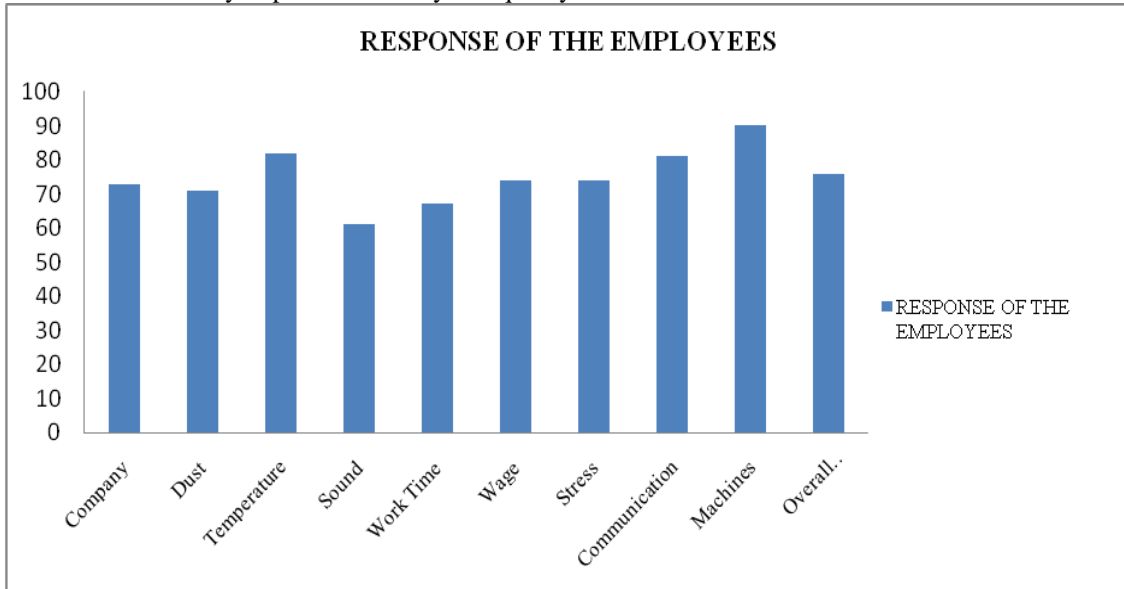


Fig 2: Bar chart for Ergonomic Factors

### V. SUGGESTIONS FOR IMPROVING ERGONOMIC FACTORS

From the survey conducted among employees in production department it is understood that the ergonomic factors have high relevance with the employee satisfaction. The following steps can be taken to improve these factors.

#### A. Working Environment

The working environment deals with the factors such as dust, sound and temperature. From the survey, factors contribute 71% (dust), 81% (temperature) and 61% (sound). It should be properly maintained by providing disposable type safety masks. Provide an environment which is less noisy by using new soundless machines and provide correct safety measures from the noise. The asbestos roof causes high temperature rise in the production department along with the heat emission from the machines causes continuous yarn breakage in hot days. This will create stress in the workers this will affect the work, so use proper temperature controlling devices.

#### B. Working Time

The working time includes two factors i.e. the wage system and the shift. From the response of the employees it is found that wage system contributes 74% and Shift contributes 67%. The 12 hour shift will allow earning more salary; it is the motivational part due to the wage system adopted. The long hour shift will cause back pain and other health issues, so the reduction of the shift from 12 hour to 10 hours will be more effective.

#### C. Machines

The working condition of machines also has a great effect on the performance of the worker. From the survey conducted it is found that the ergonomic factor machine contributes 90% response. The sizing machine has a serious problem of lack of tension in regular intervals of time this will cause the weakening of the cotton yarn. So the machine should be replaced. High quality raw materials should be used for the production process. The preventive maintenance should be done properly.

#### D. Yarn Breakage and Industrial Safety

Yarn Breakage cannot be avoided but it can be controlled to a certain limit, by using reliable machines and providing sufficient temperature controlling devices. The sprinkler is not in working condition, so replace or repair the sprinkler this will reduce the yarn breakage to an extent. The company should strictly follow the rules regarding safety that is the compulsory use of the safety measures.





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## VI. CONCLUSION

The ergonomic study in the production department is conducted by a survey and also by the data collection. Almost all of the employees are partially satisfied, some are highly satisfied; but in order to attain full satisfaction, improvement of these ergonomic factors will help. A satisfied employee will work hard for the company and the company can achieve the required target. So the company should take care about the ergonomic factors otherwise it will cause bad results from the employees that will result in low productivity and non-achievement of the target. Modern machines and equipment's are to be employed in the industry to achieve higher goals and to sustain in the competing world. Employee satisfaction and involvement is a major part of company's success, and to achieve high profit. A satisfied employee will work hard for the company so the net result is profit for the company. So the ergonomic factors are to be considered strictly to achieve maximum profit.

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