



## ANALYSIS OF ERGONOMICS (A Study Conducted in Puducherry State of Specific Industry)

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### **Abstract**

*In recent, industrial environment is extremely competitive, complex and dynamic. To sustain such environment the manufacturing system needs to be ergonomically designed so that it is responsive to changes. Ergonomics is the study of work. Ergonomics is the science of designing the work to fit the worker, rather than physically forcing the worker's body to fit the job in the organisation. The work smart ergonomics is that to maximize productivity by minimizing the potential for work related injuries in both existing and new workspaces. The aim of this research undertakes studies to provide answers to some of the basic issues related to the use of leather manufacturing machine tools. The studies were conducted to investigate human performance on leather machine tools under the impact of machine panel height, panel angle and working distance. The chief aim of these studies involves suggesting framework and analyzing the result to provide important ergonomic information to future leather manufacturing industries.*

**Keywords: Environment, Ergonomic, Machine, Work.**

### **1. INTRODUCTION**

Ergonomics can be defined simply as the study of work. More specifically, ergonomics is the science of designing the job to fit the worker, rather than physically forcing the worker's body to fit the job. Adapting tasks, work stations, tools, and equipment to fit the worker can help reduce physical stress on a worker's body and eliminate many potentially serious, disabling work related musculoskeletal disorders (MSDs). Healthier employees reduce company's costs for workers compensation and medical care. Turnover and absenteeism will decrease while productivity increases. At Work Smart Ergonomics, our goal is to maximize productivity by minimizing the potential for work related injuries in both existing and new workspaces. Bringing ergonomics into any working environment doesn't have to be expensive. A safe and sound workstation doesn't cost any more than one that's been poorly designed. The difference is in making informed, educated decisions along the way. The long-term benefits of creating the healthiest place to work will far outweigh initial costs overall. Although ergonomics officially came into being just 50 years ago, the principles have been understood for thousands of years. One just has to look at ancient hand tools to see how our ancestors intuitively understood the concept of physical fitness. Even in the early 1900s, scientific management pioneers in time and motion study—such as the Gilbreths—experimented with the design of tools to find the most effective ways to do things. The real impetus for the foundation of ergonomics, however, came during World War I. The rapid development of new technology exceeded the limits of human capabilities in some instances. For example, poor design of controls and instruments in aircraft cockpits meant that pilots often made fatal mistakes.

Today, there are three main areas of specialization within the field of ergonomics:

- Physical (the study of postures, movements, etc.);
- Cognitive (the study of workload, stress, decision making, etc.); and
- Organizational (the study of policies and processes).

The rapid growth of automation has led to the development of research on human-machine interaction environment. The research aims to understand the way of design of human-machine interfaces presenting ergonomic properties in S.K. Leather Industry which is located in Union Territory of Puducherry State. Moreover the researcher findout the level of satisfaction of employees by using various statistical tools.

### **2. HISTORICAL BACKGROUNDS ABOUT ERGONOMICS**

Early works of Van Wely (1970), Corlett and Bishop (1976), Bousenna et al. (1982), Bendix et al. (1985) and Westgaard et al. (1988) are important in the field of musculoskeletal discomfort, anthropometry and cognition. Other noteworthy contributions are the works of Kee and Karwowski (2004), Chung and Wang (2009), Messing et al. (2008), Genaidy et al. (2007), Karwowski et al. (2006) and Layer et al. (2009). Many researchers examined the effects of age and sex on human



performance. Some pioneer works in these fields are of Chung et al. (2010), Lindberg et al. (2006), Hawthorn (2000), Jimenez-Jimenez et al. (2011), Contreras et al. (2012), Trent and Davies (2012), Hazlett et al. (2010) and Huang and Wang (2010).

Some other extensive articles and review which present the subject with various degrees of emphasis and diversification in broad segments of research topics, are provided by Chikhaoui and Pigot (2010), Maldonado-Macias et al. (2009), Kee and Lee (2012), Danuta (2010), Bendy and Karwowski (2006), Seidler et al. (2010), Godard and Fiori (2010), Reid et al. (2010) and Kim et al. (2009).

### 3. ROLE OF ERGONOMICS

Ergonomics is concerned with the 'fit' between people and their technological tools and environments. It takes account of the user's capabilities and limitations in seeking to ensure that tasks, equipment, information and the environment suit each other. To assess the 'fit' between a person and the used technology, ergonomists consider the job (activity) being done and the demands of the user; the equipment used (its size, shape and how appropriate it is for the task) and the information used (how it is presented, accessed and changed). Ergonomics in the workplace has to do largely with the safety of employees, both long and short-term. Ergonomics can help reduce costs by improving safety. This would decrease the money paid out in workers' compensation. For example, over five million workers sustain overextension injuries per year. Through ergonomics, workplaces can be designed so that workers do not have to overextend themselves and the manufacturing industry could save billions in workers' compensation. Companies once thought that there was a bottom-line tradeoff between safety and efficiency. Now they embrace ergonomics because they have learned that designing a safe work environment can also result in greater efficiency and productivity. Recently, U.S. laws requiring a safe work environment have stimulated great interest in Ergonomics- from ergonomic furniture to ergonomic training. But it is in the design of the workplace as a whole where the greatest impact can be seen for both safety and efficiency. The easier it is to do a job, the more likely it is to see gains in productivity due to greater efficiency. Analogously, the safer it is to do a job, the more likely it is to see gains in productivity due to reduced time-off for injury. Ergonomics can address both of these issues concurrently by maximizing the workspace and equipment needed to do a job, Imtiaz (2012).

Historically, Ergonomics was another name for Human Factors. Human Factors Engineering continues to be successfully applied in the fields of manufacturing, aerospace, aging, health care, IT, product design, transportation, training, nuclear and virtual environments, among others. Today, Ergonomics commonly refers to designing work environments for maximizing safety and efficiency. Anthropometrics plays a key role in this use of the word Ergonomics. Anthropometry refers to the measurement of the human individual for the purposes of understanding human physical variation. Today, anthropometry plays an important role in industrial design, ergonomics and architecture where statistical data about the distribution of body dimensions in the population are used to optimize products. Changes in lifestyles, nutrition and ethnic composition of populations lead to changes in the distribution of body dimensions and require regular updating of anthropometric data collections. Engineering Psychology often has a specialty dealing with workplace or occupational Ergonomics, Imtiaz (2012).

While 'health' and 'safety' has always been a dynamic and challenging field, individuals now are being asked to demonstrate cost savings with resources that are more limited than ever. How do companies meet the expectations of "doing more with less" in the health and safety field?.

### 4. ERGONOMICS IN INDUSTRIES

*"Health is a resource for everyday life, not the objective of living"*

**- Ottawa Charter for Health Promotion, WHO, 1986.**

Health is a positive concept emphasizing social and personal resources, as well as the physical condition of individuals and their diseases, and thus motivates people to focus attention on what is called social determinants of health (<http://en.wikipedia.org/wiki/ergonomics>). Employees have the right to the enjoyment of the highest attainable standard of physical and mental health. The enjoyment of this right is vital to their life and wellbeing and their ability to participate in all areas of public and private life (Antony, 2006 and <http://www.phdre.org/rights/health-html>) that is work related or domestic.

The four basic safety guidelines to be practiced while performing any activity are learning and applying proper skill, having appropriate and well maintained tools / equipment, knowing the safety rules specific to the activity and preparing adequately for the activity (Pruit et.al., 1994).



An 'occupational' health or safety hazard is anything in the 'workplace' that has the potential to cause harm to the human body, which vary greatly depending on the type of work involved. Equipment, processes, work procedures and the design of the workplace are all potentially hazardous (<http://www.worksafesash.net>). By "occupational environment" is meant the sum of external conditions and influences which prevail at the place of work and which have a bearing on the health of the working population.

Ergonomics is the science that studies the relationship of humans to their working environment and seeks to improve working conditions and increase efficiency ([www.nonprofitihub.com](http://www.nonprofitihub.com)). It is also the study of designing objects to be better adopted to the shape of the human body and / or to correct the user's posture ([www.google.co.in](http://www.google.co.in)). It is the analysis and design of work equipment and environments to fit human physical and cognitive capabilities, Arnold et. al., 1995. Thus 'ergonomics' as a field of study can take up many connotations.

#### **4.1 PHYSICAL ERGONOMICS**

This is concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity. The relevant topics include working postures, materials handling, repetitive movements, work related musculoskeletal disorders, workplace layout, safety and health, Pheasant (1998). In practice, ergonomic studies must include the aspects of users (individuals), machine, workplace, and environment to analyse the problems, Dalela and Saurabh (1999).

#### **4.2 COGNITIVE ERGONOMICS**

It is concerned with mental processes (brain work), such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system. The relevant topics include mental workload, decision making, skilled performance, human computer interaction, human reliability, work stress and training, as these may relate to human system design.

#### **4.3 ORGANIZATIONAL ERGONOMICS**

It is concerned with the optimization of socio-technical systems, including their organizational structures, and processes and includes communication, work design, design of working times, teamwork, participatory design, community ergonomics, cooperative work and quality management (Pheasant, 1998).

#### **4.4 WORK PLACE ERGONOMICS**

The term workplace is comprehensive and includes any area where work is performed. The design specifications of the workplace in relationship with workers, physical characteristics and job requirements have a significant impact on their productivity, and physical and mental wellbeing. The worker also must ensure the use of right place and the right equipment for work organization of the work place is very important and saves more than 80 per cent of the human energy during work besides minimizing the mental fatigue felt as inherent, Oberoi and Gill (2003). Basically, there are three types of interaction in a working environment: man and physical agents, man and machine.

A number of factors in the physical work environment may lead to accidents. These factors could be unprotected place, congested work, unsafe piling and storage, overloading, poor maintenance, slippery surface, insufficient illumination and ventilation, contamination and pollution, unnecessary heat and dust, unguarded machines, unsafe equipment, and so on. Among the factors affecting the workers the following are most important to be considered in optimizing the relationship between workers and their job.

#### **5. GLOBAL SCENARIO OF LEATHER INDUSTRY**

The global trade in leather and leather products has been increasing over the years from mere US\$ 4 billion in 1972 to US\$ 70 billion in 1997. Although the exports of Indian leather and leather products have grown manifold during the past decades, our countries share in global trade is around 3% among world imports of leather products. Whereas India's share in world imports of leather footwear is 1%. Major exporting countries of leather footwear are China (14% share), Portugal (6% share), Brazil (5% share) and Indonesia (4% share). India's share in world imports of leather garments is 6%. Major exporting countries of leather garments are China (36% share), Germany (9% share), Italy (7% share), Turkey (5% share) and Pakistan (4% share). India's share in world imports of leather goods is 7%. Major exporting countries are China (22% share), Italy (22% share), France (7% share) and Greece (5% share), India's share in world imports of harness and saddlery is 8%. Major exporting countries of harness & saddlery are Germany (14% share), U.K. (14% share), China (12% share).



Overall, India is facing fierce competition in the international market from countries like China, Vietnam, Thailand, Indonesia, etc., which are emerging as major manufacturing countries. East European countries like Poland, Romania, Czech and Slovak Republics have re-emerged as major production centers particularly for the footwear sector. These countries pose major challenge to Indian exporters as they enjoy a geographical advantage.

## 6 .STATEMENT OF PROBLEM

Probably the most talked-about physical problem resulting from poor ergonomics is musculoskeletal disorders (MSDs). Improving the ergonomic activities will help the employees to become more loyal and committed to their work and organization leading to higher productivity. The research was conducted to find out the effectiveness of ergonomic activities which is adopted by the S.K. Leather Industry.

## 7 .NEED FOR THE STUDY

Because of this study a lot of benefits can be accrued. This study focuses its attention on ergonomics. Through ergonomics only the company can provide the comfortable work environment to the individuals. This would be helpful for better productivity and performance and reduces occupational injuries and illness labour. Therefore this study is the need of the hour.

## 8. SCOPE OF THE STUDY

This study is done in S.K Leathers Industry, Puducherry. The variables included in this study are Working Environment, Work Stress, Health & Safety, Working Capacity and Job Satisfaction. The result thus obtained can be used in this company. This variable plays a major role in the impact of ergonomics.

## 9. OBJECTIVES OF THE STUDY

The objectives of the study are as follows:

1. To find out the nature of ergonomics in study industry.
2. To bring out the determining factors of ergonomics in study Industry.
3. To find out the impact of ergonomics in the workplace of the industry.
4. To find out the satisfaction level of the employees with the current system of ergonomics in industry.
5. To offer some viable suggestions for ergonomic practices.

## 10. RESEARCH METHODOLOGY

Research Methodology to the various sequences, steps to be adopted by a researcher to study a problem with certain objective in view. This research paper is purely related of descriptive research. The main goal of this type of research is to describe the data and characteristics about what is being studied. The idea behind this type of research is to study frequencies, averages, and other statistical calculations. Although this research is highly accurate, it does not gather the causes behind a situation. Descriptive research is mainly done when a researcher wants to gain a better understanding of a topic. It is quantitative and uses surveys and panels and also the use of probability sampling.

During interviews, it is important to note the interaction between researchers and participants in a particular context or setting (Terre Blanch, Durrheim & Painter, 2006). With the importance of the setting in mind, the researcher personally contact each employee of the organisation. The researcher was careful to ensure that the interview place was comfortable, temperate and quiet, and located at a sufficient distance from other employees to ensure privacy. Because the validity and success of the research depended on the participants being at ease with the research process (Hesse-Biber & Leavy, 2004), the researcher introduced himself in a warm and friendly manner, detailed the context of the interview and emphasised its purpose.

Here the researcher makes it consists 178 employees as a sample size to analyze the effectiveness of ergonomics S.K. Leather Industry. The selected respondents represented a balanced mix of various demographic factors (age, gender, marital status, educational levels, and employment status and income groups). Simple Random sampling was used for the purpose of the survey, and a research sample was taken to measure the effectiveness of ergonomics in the study Industry.

The questionnaire for the research was divided into two parts: the first part deals with the demographic data of the respondents and the second part of the questionnaire with 42 statements was used. These statements are measured through the five point Likert's five-point scale were the respondents had to fill one choice ranging from strongly disagree to strongly



agree. The questionnaire is prepared for the respondents have been pre-tested by the researchers' in person. Comments on the question were noted and after careful analysis necessary modification has been made in the questionnaire. Pre-testing was conducted on 10 respondents. The researchers identified three respondents each departments randomly at S.K. Leather Industry in the study region. In the course of the time, the researcher had experienced some difficulties in getting answers to some of the questions raised and suitable changes have been incorporated before finalizing the well-structured questionnaire.

## 11. ANALYSES AND INTERPRETATION

### 11.1 CLUSTER ANALYSIS

#### 11.1.1 Segmentation of Ergonomics

Based on the five factors the ergonomics can be segmented. K-means cluster is used to categorize ergonomics in three clusters.

**Table 11.1.1 Segmentation of Ergonomics**

Factors	Cluster		
	1	2	3
Working Environment	3.86 (II)	3.50 (III)	4.92 (I)
Work Stress	4.25 (II)	3.69 (III)	4.31 (I)
Health & Safety	4.03 (II)	3.88 (III)	4.12 (I)
Working capacity	3.88 (II)	3.17 (III)	3.92 (I)
Job Satisfaction	3.96 (I)	3.17 (III)	3.92 (II)
No. of cases in each cluster	130	24	24
<b>Total Percentage</b>	<b>74</b>	<b>13</b>	<b>13</b>

Table 11.1.1 contains the mean value scores of five factors related to ergonomics and the ranks are specified in the bracket. Table shows that around 74 percent of customers belong to cluster 1 category (Neutral degree of ergonomics), 24 percent are in cluster 2 category (Low degree of ergonomics) and 24 percent belong to cluster 3 category (High degree of ergonomics). This reveals that majority of respondents participated in cluster 1 category (Neutral degree of ergonomics). The mean value of these three clusters are 4.238 the first ranking to cluster 3 and 3.996 second ranking to cluster 1 and 3.482 the third ranking to cluster 2

#### 11.1.2 Cluster Anova

**Table 11.1.2 Cluster Anova**

Factors	ANOVA					F	Sig.
	Cluster		Error				
	Mean Square	df	Mean Square	df			
Environment	14.150	2	.027	175	529.741	.000	
Work Stress	3.406	2	.058	175	58.516	.000	
Health & Safety	.392	2	.039	175	9.965	.000	
Working capacity	5.406	2	.132	175	40.890	.000	
Job Satisfaction	6.427	2	.115	175	56.075	.000	

The ANOVA table indicates that there exists significant difference among all the three clusters. The significant value for all the five factors is 0.000. This means that all the five factors have significant contribution into three segments based on the influence of ergonomics.

## 11.2 CORRESPONDENCE ANALYSIS

### 11.2.1 Correspondence Analysis of Age-wise

The correspondence analysis is carried out to identify which age category of respondent's associates with which cluster degree of ergonomics. The chi-square and significant values are 1.356 and 0.000.





**Figure 11.2.1 Association between Age and the Factors  
Row and Column Points**

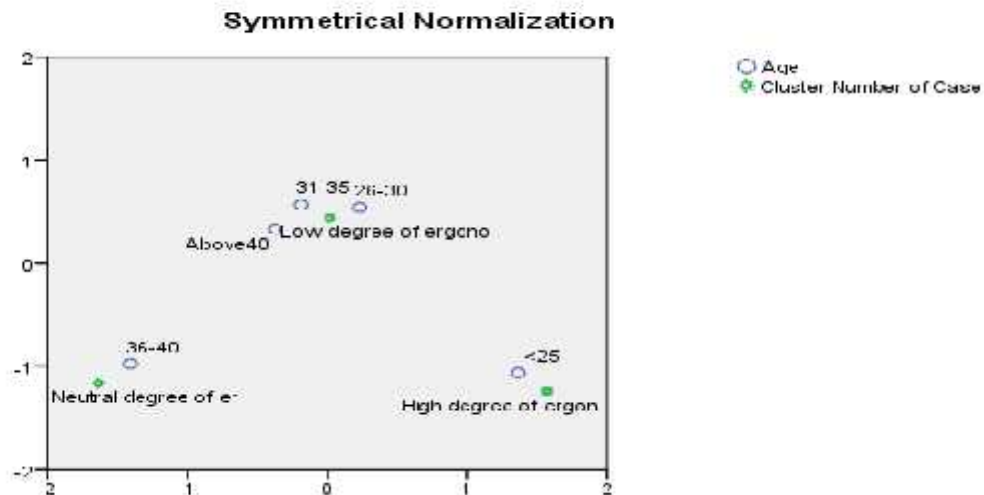
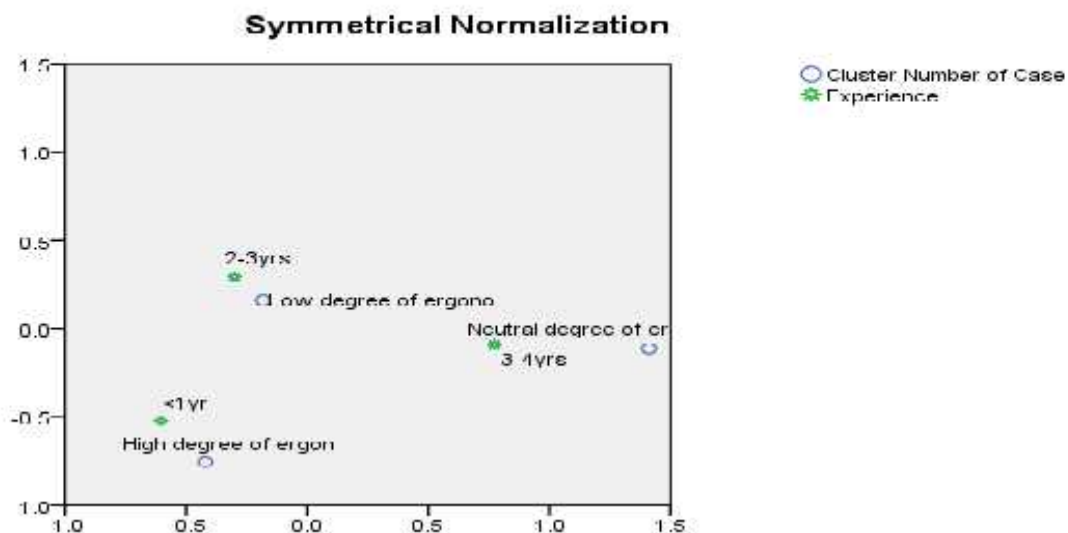


Figure 11.2.1 illustrates that the respondents with age <math><25</math> are coming under high degree of ergonomics. The respondents with age between 36-40 are placed under. And the respondents with age between 26-30, 31-35, & above 40 are coming under low degree of ergonomics. This gives the impression that the respondents with age between 26-30, 31-35, & above 40 insisting the importance of ergonomics.

### 11.2.2 Correspondence Analysis of Experience-wise

The correspondence analysis is carried out to identify which experience category of respondent's associates with which cluster degree of ergonomics. The chi-square and significant values are 43.848 and 0.000.

**Figure 11.2.2 Association between Experience and the factors  
Row and Column Points**



The Correspondence analysis reveals that there exists a significant association between the experience and the factors of ergonomics. The chi-square value and significant values for the association are 43.848 and 0.000. From the correspondence



analysis, it is clearly illustrates that the respondents with experience <1 years are coming under high degree of ergonomics. The respondents with experience 3-4 year are placed under neutral degree of ergonomics. And the respondents with experience 2-3 are placed under low degree of ergonomics. This gives the impression that the respondents with experience between 2-3years are insisting the importance of ergonomics.

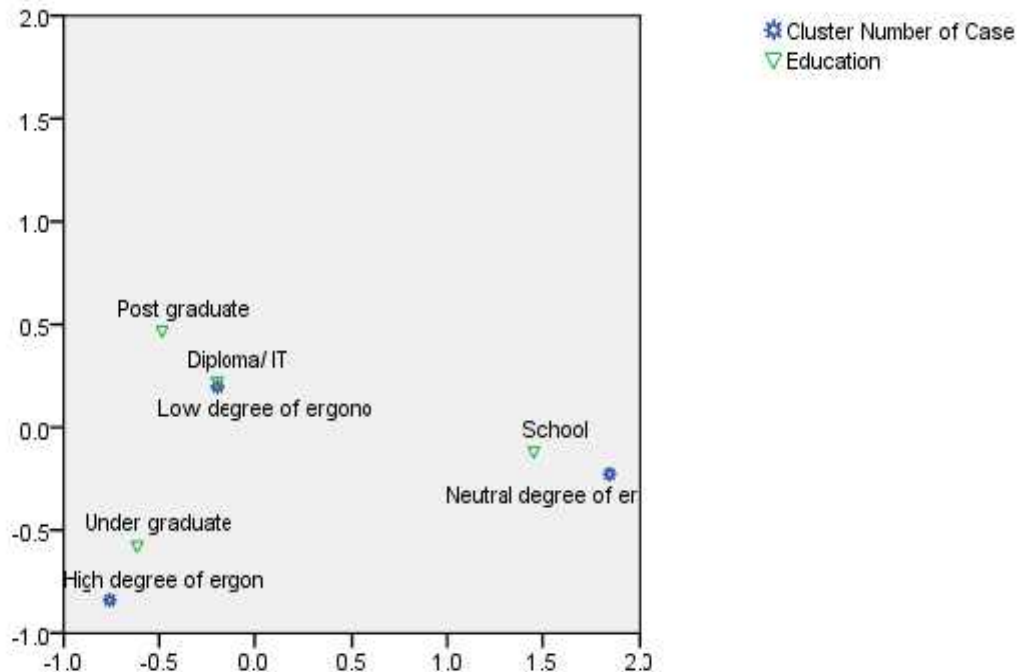
### 11.2.3 Correspondence Analysis of Education-wise

The correspondence analysis is carried out to identify which experience category of respondent's associates with which cluster degree of ergonomics. The chi-square and significant values are 50.409 and 0.000.

Figure 11.2.3 Association between Education and the Factors

#### Row and Column Points

#### Symmetrical Normalization



From the correspondence analysis, it is clearly illustrates that the respondents with under graduate are coming under high degree of ergonomics. The respondents with school are placed under neutral degree of ergonomics. And the respondents diploma/ IT and post graduate are placed under low degree of ergonomics. This gives the impression that the respondents with diploma/IT and post graduates are insisting the importance of ergonomics.

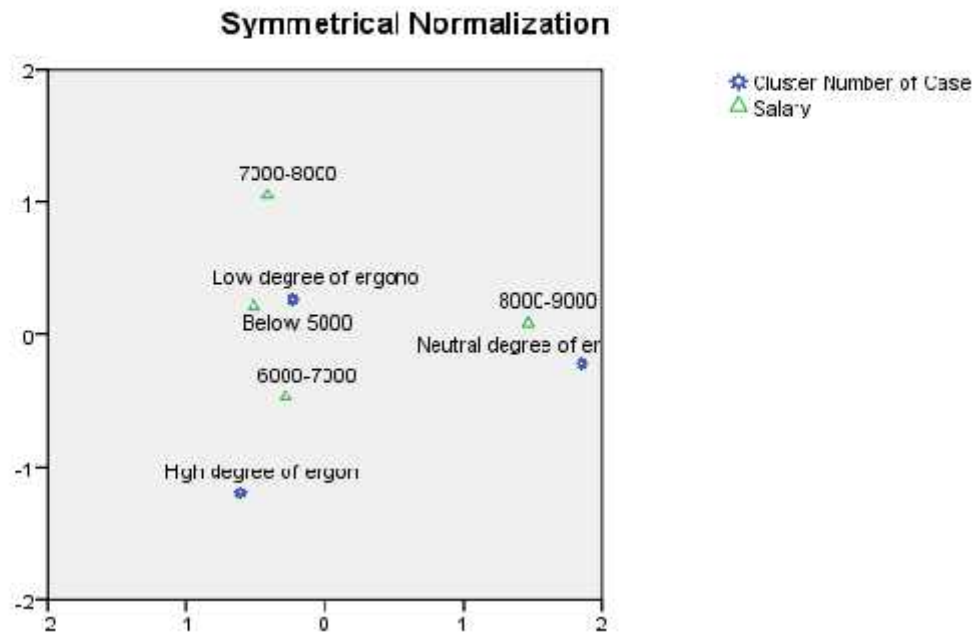
### 11.2.4 Correspondence Analysis of Salary-wise

The correspondence analysis is carried out to identify which salary range of respondent's associates with which cluster degree of ergonomics. The chi-square and significant values are 65.799 and 0.000.

From the correspondence analysis, it is clearly illustrates that the respondents who earning the salary in the range of 8000-9000 are placed under neutral degree of ergonomics. And the respondents who earning below 5000 and in the range of 6000-7000 are placed under low degree of ergonomics. This gives the impression that the respondents who earning below 5000 and in the range of 6000-7000, they are insisting the importance of ergonomics.



Figure 11.2.4: Association between Salary and the Factors  
Row and Column Points



## 12. FINDINGS OF THE STUDY

Most of the respondents are actively participating towards their work i.e., in agreeing state. And majority of the respondents are agreeable to say that employee ergonomics programme is functioning effectively. Majority of the respondents are male. And most of the respondents are belonging to the age group of 26 to 35 years. And majority of the respondents have completed their Diploma/IT. Majority of the respondents are earning in the range of 6000-7000. The respondents are happy with the existing activities of ergonomics practices in the company. From the ranking for Working Environment Variable, the respondents agree that they conducive working environment and it is very dominant than other four variables and its presence is more important in the company. From the ranking for Work Stress Variable, the respondents have strongly agreed to state that they feeling uncomfortable while repeating the same motion.

From the ranking for Health & Safety Variable, the respondents have strongly agreed to state that their organization providing health and safety to the workers. From the ranking for Job Satisfaction Variable, the respondents are agreed that they are satisfied with the compensation package given by the management. From chi-square method it was found that there is an association between the demographic variables like age, gender, education, experience and salary and the factors. From cluster analysis it was found there is significance amongst the three clusters mentioned in the analysis. By using frequency analysis, it is found that the scale 3.5-5 has the highest percentage in the variable work stress on ergonomics. By using cluster analysis, the cluster 3(High degree of ergonomics) the mean value has the highest ranking. By using ANOVA, it is found that all the five factors have significant relationship on Ergonomics.

## 13. SUGGESTIONS & RECOMMENDATION

The employee must be provided with flexible work scheduling to improve their involvement, strengthening morale, and minimizing turnover, and absenteeism. The workplace stress would affect all the workers because of the workload, physical and mental condition of their body. To prevent the workplace stress each and every worker should adopt the personnel equipment and tools provided by the organization. Organization can benefit from developing and retaining the workforce they have and individuals can benefit from an organization that encourages and develops them to meet their aspirations. Importance of recognizing ergonomics is not enough to just attract individuals with high potential. Developing, managing





and retaining those individuals as part of a planned strategy is equally important, by adopting systems to measure the return on this investment. So an appropriate training program must be given to employee to improve their productive capacity.

#### 14. CONCLUSIONS

In today's competitive business world, Ergonomics has become a very important aspect of workplace design, and rightly so. Efficient design makes it easy for people to function better and be more productive. Long term damage to the musculoskeletal system and work related injuries can be minimized or avoided. From the foregoing project study, the arguments that support a good ergonomics management system cannot be ignored. An organization like S.K. Leather Industry which wishes to have a competitive edge in today's marketplace, with its emphasis on quality and excellence, must embrace ergonomics management, recognizing its value as a cost reduction, quality improvement, performance improvement and productivity enhancing process. Improved ergonomics management is both a realistic goal and an achievable objective of the company. The study concludes that this study explores the ergonomics activities at S.K. Leather Industry. It infers that to achieve the gains, people throughout the organization must be committed to making ergonomic improvements. At the employee level, workers need to understand their responsibility in using equipment correctly, in stretching and taking breaks throughout the day and in reporting any problems they experience. At the management level, it's essential to commit the resources for making improvements and to communicate the importance of ergonomics to everyone in the organization. Under this context, if the management of S.K. Leather Industry focusses its alteration on the proper management of ergonomics, then assuredly the company would reap huge benefits.

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