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A Study on the Effect of Ergonomics on Computer Operating Office Workers in India

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Abstract

The effect of ergonomic factors have an influence on the productivity, health and wellbeing of office workers. Most of the office workers are working with computers. A study has been conducted for the benefit of millions of people working with computer. A subjective measurement was conducted through questionnaire survey from 70 office workers working with computers. These questionnaires were designed for the factors which are affecting the productivity and human health. The SPSS package was used to find the loading factor. Based on this analysis, all the factors are grouped under the four main ergonomic factors such as Physical, Environmental, Cognitive, Organizational ergonomics factor. Based on the Rotated component matrix these factors have been ranked as per the principal component analysis. The results revealed that the cognitive ergonomic factors and environmental ergonomic factors have more influence on productivity. Organization ergonomics and Physical ergonomics have less influence on office worker's productivity. Cognitive ergonomic factors and environmental ergonomic factors have imperative role to play in the effectiveness of office workers when compared with physical and organizational ergonomic factors. The effect of cognitive factor is more than the environmental factors. The mental workload, memory lag, task difficulties, room temperature, illumination affects the productivity, health and wellbeing of workers in India.

Keywords: Physical ergonomics; Organizational ergonomics; Environmental ergonomics; Cognitive ergonomics; Office workers

Introduction

An office is a room where professional duties and administrative work is carried out in the organization building. The details of the work depends on the type of business, but it will usually include using computers, communicating with others by telephone, e-mail or fax, keeping records and files etc., in soft and hard format. Features of an office such as people, building space, equipment, furniture and the environment, must fit together well for workers to feel healthy and comfortable and to be able to work efficiently and productively. At least 50% of the world's population currently works in some form of office. Mostly the developing countries like India and China are having more population. They are working with machines and majority of them are from computer sector. In the Information Technology (IT) and Information Technology Enabled Services (ITES), people are dependent on the computers. More IT and ITES sectors are increasing in India. The performance study of office workers productivity is necessary for productivity improvement. The studies on the effect of ergonomic factors are essential for improving the performance, health and productivity of office workers. The effect of such factors brings down the efficiency of them. The primary objectives of this study is to identify the factors that are affecting the human health, safety, productivity and performance of office workers by considering ergonomics. Any study on the effect of such factors on productivity can potentially benefit millions of people around the world. Hence an attempt has been made to carry out a study of these ergonomic factors.

Literature Review

People spend 80-90% of their time in office indoors. Indoor environment has important effects on human health and work efficiency. The factors affecting indoor environment mainly include temperature, relative humidity, indoor air quality, illumination, ventilation Graudenz et al. [1]. Indoor air environments must meet the requirement of thermal comfort and Indoor Air Quality (IAQ). Niu [2] stated that thermal comfort is affected by many factors, which mainly include air temperature, air humidity, air velocity, mean radiant temperature, human clothing, and activity levels. The wide use of air conditioning helps to improve thermal comfort, but health problems associated with poor IAQ appear more frequently. Houtman et al. [3] has explained that the indoor condition may also associate with physical illness and mental health (Cognitive) effect.

Bluyssen et al. [4] noted that the indoor building conditions are more related with health, comfort and wellbeing of workers. Kapit et al. [5] explained that the external stress factors such as incentive, supervision, job fear, promotion factor can influence the human nervous system, the immune system and the endocrine system and this in result can affect both physical and mental effect. Lee et al. [6] stated that indoor stress affects the health, comfort and productivity in an office environment. Nowadays the need for the control of thermal environment is widely recognized. It is agreed that the control of local thermal environment is needed for the comfort and satisfaction of workers [7,8] explained that the control of room temperature is one of the main issues in improving the working condition and productivity. Skyberg et al. [9] stated that the degree of perceived control may influence satisfaction of workers with the indoor environment.

Fanger [10] has investigated the discomforts caused by indoor air pollution, thermal load and noise on productivity. It was reported that the temperature between 23 and 29°C, each degree Celsius change would associate the same effect on human comfort with a change in perceived air quality of 2.4 dB, or a change in noise level of 3.9dB. Wong et al. [11] has identified the factors that are affects the performance of office people. The temperature, indoor air quality, noise and illumination factors have an important effects on overall performance, health and productivity. 40% performance has been reduced due to poor indoor environmental quality. Galasiu and Veitch [12] have stated that indoor environment factors affect the visual comfort of workers. This leads to visual health problem to human.

Roelofsen [13] stated that 10% of office worker's productivity may be increased by achieving the improved indoor environmental quality. The thermal discomfort caused by elevated air temperature has affected the performance of office workers. Indoor environmental quality has influence on the office worker's productivity [14]. Charles et al. [15] has stated that indoor air quality and thermal comfort are most important factors for the worker's performance, satisfaction and wellbeing. Poor office environmental conditions can affect the worker's health. Very low and very high indoor room temperature and humidity can dissatisfy the workers and also create health problems. Air conditioned office aims to provide a thermally accepted environment for office worker's comfort and health. Productivity loss can be minimized by achieving the improved thermal comfort [16].

Henri et al. [17] clearly explains that proper lighting was an important factor that has influence on the productivity. The effect of increased or decreased illumination affects the performance, psychological and biological effect of workers. Fisk and Rosenfeld [18] have investigated that the improvement in the thermal environment in office building in US. It states that, the improved thermal environmental, productivity also improved by 0.5-5%. Predicted performance has been reduced over a range on indoor room temperature [19].

Productivity of employees can be maximized by achieving improved indoor environmental quality and climate [20]. The performance of office workers has been reduced by 2% while the increase of room temperature in the range of 25-32°C and no effect on the performance in the temperature range of 21-25°C [21]. Improved indoor environmental quality can achieve the job satisfaction and retention of employee [22].

Various ergonomic factors such as indoor room temperature, illumination, visual comfort, work place design, physical fitness, physical workload, mental workload, motivation, knowledge updating, Bossism (supervision), task difficulties, sitting arrangement, incentive, commitment, relative humidity, Visual Display Terminal (VDT), indoor air quality, memory lag, job fear, job satisfaction, noise, job stress, training, promotion and depression are the related factors which can affect the performance, health, comfort and productivity of workers.

Data Collection and Analysis

A subjective measurement was conducted through questionnaire survey from 70 computer operating office workers. These questionnaires were designed for the factors which are affecting the productivity, performance and human health. The factors related questionnaire was prepared and circulated to the employees. This contains twenty five sub factor questionnaires based on the literature survey. This has 5-Point Likert scale ranging from 1 to 5. Indicated as Never (1), Rarely (2), Occasionally (3), Often (4) and Very often (5).

	Component			
	1	2	3	4
Mental Work Load	0.959	-0.013	0.019	-0.085
Memory lag	0.945	-0.178	0.056	0.033
Task Difficulties	0.858	0.095	-0.474	0.088
Depression	0.809	-0.332	0.002	0.447
Job stress	-0.799	-0.456	-0.034	-0.05
Job satisfaction	0.795	0.39	0.348	-0.134
Motivation	-0.787	-0.198	0.103	-0.084
Job Fear	0.733	-0.056	-0.572	-0.291
Room Temperature	0.147	0.959	0.177	-0.114
Illumination	0.006	0.925	0.249	0.248
Noise	-0.214	-0.9	-0.123	0.306
Indoor Air Quality	0.237	0.864	-0.293	-0.098
Relative Humidity	-0.105	-0.752	0.369	-0.307
Training	-0.246	0.086	0.951	0.047
Commitment	0.042	0.409	0.808	0.358
Promotion	0.101	-0.566	0.786	0.061
Bossism	0.521	-0.113	0.781	0.217
Incentive	-0.59	-0.109	0.713	-0.126
Knowledge updating	-0.043	0.504	0.653	0.496
Physical Fitness	0.172	0.079	-0.282	0.925
Physical work Load	-0.186	-0.08	-0.172	0.913
VDT	-0.056	-0.26	0.27	0.862
Sitting arrangement	0.068	0.309	0.329	0.814
Visual Comfort	-0.069	-0.319	0.483	0.782
Workplace Design	-0.105	0.174	0.366	0.738
Rotated Component Matrix[a]				
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization				

Table 1: Rotated component matrix.

Data analysis was performed using the statistical package for the social sciences (SPSS 17.0). In addition to the descriptive statistics of the test measures, to determine the factor structure of the checklists responded by the employees, the data were treated for principal components factor analysis using a varimax rotation. This allowed grouping of variables into subscales of multiple ergonomic factors mainly referred to four groups such as physical (6), environmental (5), cognitive (8) and organizational ergonomics (6). Using these results,

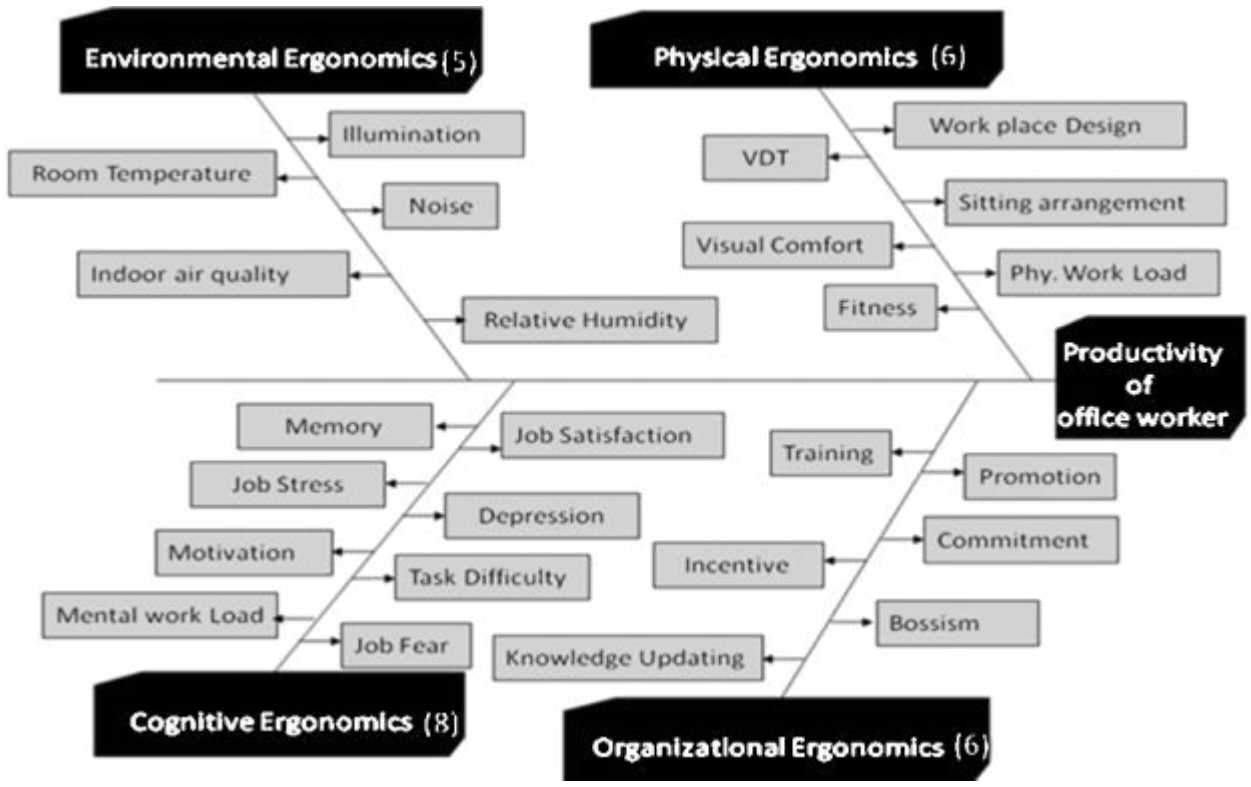

Figure 1: Cause and effect diagram for factors affecting productivity of office workers.

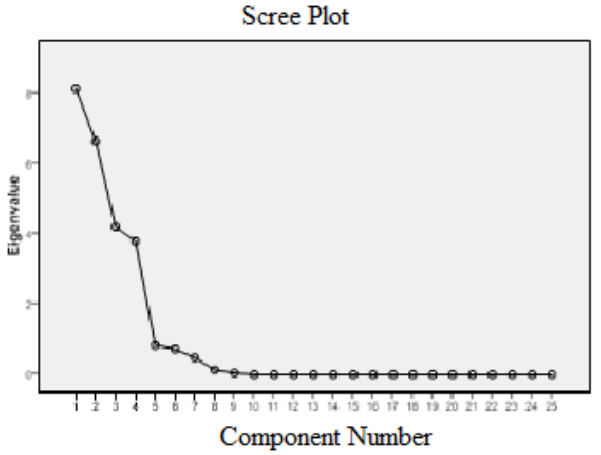

Figure 2: Eigen value of components (Scree plot).

cause effect diagram may be drawn as per Figure 1. Rotated Component Matrix shown in Table 1.

Results

The value of component more than 0.5 will be taken into account for consideration as the vital factor irrespective of sign. From the Table 1, component 1 start from mental workload to job fear, it has eight sub factors (cognitive). Component 2 starts from room temperature to relative humidity, it has five factors (Environmental). Similarly component 3 (Organizational) and component 4 (Physical) have six factors in each. Cognitive ergonomic factors have eight factors (mental workload, memory lag, task difficulties, depression, job stress, job satisfaction, motivation, job fear). The environmental ergonomic factors have five factors (Room temperature, illumination, noise, indoor air quality, relative humidity). The Organizational ergonomic factors have six factors (Training, commitment, promotion, Bossism, incentive, knowledge updating). The physical ergonomics have six factors (Physical Fitness, physical work load, VDT, sitting posture, visual comfort, workplace design).

Conclusion

From the rotated component matrix (Table 1), twenty five factors can be grouped in to four components such as Cognitive, Environmental, Organizational, and Physical Ergonomics. Figure 2 shows the scree plot of these 25 factors. When the Eigen value was more then 1, that component will be treated as main component. Here first four components have more than 1 Eigen value. From the Table 1, we conclude that the cognitive ergonomic factor have more impact on the productivity of office workers. Mainly the mental workload of people may affect the productivity and performance. Comparing the other cognitive factors, the job fear has less impact to play on the office workers productivity. Similarly in the environmental ergonomics, the indoor room temperature has an imperative role to play on the office workers productivity. Illumination also has an effect on office work. Comparing the other environmental factors relative humidity has less

impact on productivity. Providing training to the employee shall improve the performance and productivity. Lag of commitment is also one of the main factors that affect the performance of worker. Furthermore it is concluded that the physical ergonomic factors such as physical workload, VDT, workplace design, sitting posture also affects the performance, human health and wellbeing. Nowadays all the office workers are working with ergonomically designed workstation so physical ergonomics has less effect in than other factor.

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