The Effect of Workplace Design and Cognitive Ergonomics on Work Productivity

Telma Anis Safitri [1*], Haryadi [2], Adi Indrayanto [3]

[1]Universitas Jenderal Soedirman, telma.safitri@gmail.com, Indonesia
[2]Universitas NahdlatulUlama Al Ghazali, haryadi_feb@yahoo.com, Indonesia
[3]Universitas Jenderal Soedirman, adi.indrayanto@unsoed.ac.id, Indonesia

ABSTRACT

This study is based on layout theory which emphasizes the importance of layout at workstations in increasing company productivity. Several previous studies have proven that workplace design has a positive effect on worker productivity. However, research on workers regarding cognitive ergonomics is still very little. Therefore, the purpose of this study was to determine the effect of workplace design and cognitive ergonomics on work productivity. The design of this study used a survey with a research period of the cross-sectional method. The samples used by eyelash workers in Purbalingga were 100 people. Hypothesis testing is done by using regression analysis with the help of SPSS software version 22.0. The results show that Workplace Design and Cognitive Ergonomics have a positive effect on Work Productivity.

Keywords: Workplace Design, Cognitive Ergonomics, Work Productivity

1. Introduction

The world era of globalization in all industries and operations has become very competitive. The main key to be achieved by the organization in a competitive environment is the productivity of the workers. According to Heizer and Render (2015) productivity is a comparison of the output (goods or services) to the inputs used by the organization (resources, such as labor and capital). or improvement to the ratio of results or input is done by an operations manager where increased productivity means increased efficiency.

An organization and company cannot be separated from the role of human resources in carrying out their operations. According to Hameed and Amjad (2009), most workers will carry out their operational activities in the office (indoor) for a long time. Good work results and increased work productivity can certainly be assumed from a good and comfortable work environment. Many studies have proven that workplace design has a positive effect on work productivity. Some of them are research conducted by Leblebici (2012) on employees of Foreign Private Banks in Turkey. The results of his research stated that there was a relationship between office space and employee productivity. Likewise with the research conducted by Amina Hameed & Shehla Amjad (2009) on banking organizations in Pakistan as many as 13 banks. The results obtained in this study that office design is a very vital aspect in increasing employee productivity. A comfortable office design can motivate employees and can improve their performance. Ilozor,

[1]Corresponding author. E-mail: telma.safitri@gmail.com

B.D., Peter E.D. Love, and Graham Treloar (2002) also in their research on a sample of 12 office settings, the results of the physical properties of the office space can be used to influence the level of work productivity.

In addition to workplace design factors can improve employee performance. A study conducted by Vimalanathan and Ramesh Babu (2017) proves that cognitive ergonomics factors have a greater influence than environmental ergonomics. Cognitive ergonomics according to Hollnagel, E. (1997) focuses on the reciprocal influence between work and thought. The International Ergonomics Association (IEA) also states that Cognitive Ergonomics is a branch of ergonomics that deals with human mental processes, including; perception, memory, and reaction, as a result of human interaction with the use of system elements. When workers experience cognitive stress such as distractions, interruptions, and excessive tasks, it will have an impact on the employee's welfare which is reduced at work (Kalakoski, 2020). Therefore, this study aims to examine the effect of workplace design factors and cognitive ergonomics on work productivity.

2. Literature Review

2.1 Workplace Design and Productivity

According to Horgen, T., Joroff, ML, Porter, WL, & Schon, DA (1999), Workplace design is the process of creating a workplace that requires understanding the problem, developing a new work environment, and then monitoring the interaction between the work environment and its users from the start. time to time. Based on Heizer and Render (2015) in their book entitled "Operations management: sustainability and supply chain management" explains that the decision to carry out a strategy on spatial planning is one of the main decisions by an operations manager that determines the long-term efficiency of the operating process. Spatial planning has strategic implications because it can create competitive priorities in terms of processes, capacity, flexibility and so does the quality of employees' work life. Workplace design by combining ergonomics and workflow that performs job checks to optimize the layout.

Dorgan et al (2005) argue that because of the number of time employees spend at their workplace, it is important to ensure that the indoor environment is of appropriate quality. They propose that there is a relationship between environmental quality on health and worker productivity. Most research studies show an average 10% loss in productivity due to poor room quality. The better the design of the workplace, the higher the level of work productivity produced by employees. The importance of the workplace environment for workers will put the best under a conducive working environment because the human brain and body are closely related and the efficiency of workers depends on their physical and mental fitness. Consideration should be given to the placement of furniture and equipment about sources of light, heat, and ventilation as well as to the comfort, cleanliness, and first-aid work practices of each user (Baba, 2021). Likewise, lighting in the workplace is so important that work cannot be done effectively without it. Where lighting is poor, it causes eye strain for workers and consequently, they produce low-quality work (Baba, 2021). Therefore, this study expects hypothesis 1 as follows:

H_1: Workplace Design has a positive effect on work productivity

2.2 Cognitive Ergonomics and Productivity

The completion of work tasks in today's work environment is highly dependent on cognitive function, or mental processes involved in information processing such as attention, working memory, decision making, and continuous workplace learning (Sørensen et al, 2014). The cognitive demands of work tasks produce a cognitive load, which easily exceeds the natural limits of human cognitive capacity, but strain can also be exacerbated by working conditions. Cognitive stress related to work is a significant risk factor for poor work performance, as it directly impacts the human ability to handle cognitively demanding work activities (Kalakoski, 2020). The cognitive ergonomics approach can improve work efficiency, reduce human error, and help understand how humans process information during interactions (Murata, 2000). In other words, the higher the level of human cognitive ergonomics, the higher the level of productivity produced.

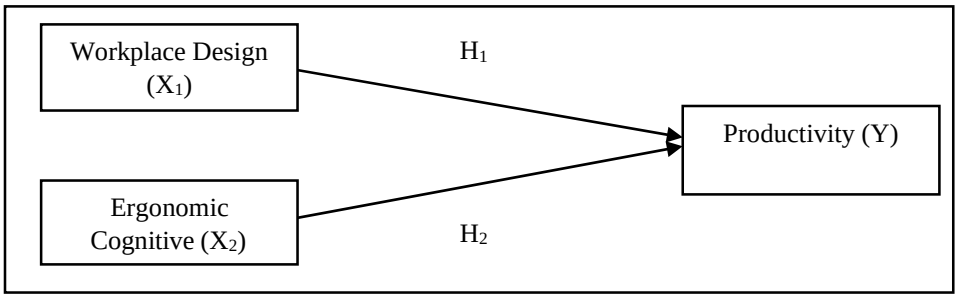
As explained in the article from Kalakoski (2020) that workplace cognitive ergonomics interventions focus on ergonomic practices (or human factors) that try to ensure proper interactions between work, product, and environment, as well as human requirements, capabilities, and limitations. The goal of cognitive ergonomics is to make human-system interactions in the workplace consistent with human cognitive capacities and limits by focusing on human cognitive functions and the variables that affect them.

Previous research has shown that cognitive ergonomics can affect employee productivity. As is the case in the research conducted by Vimalanathan and Thangavelu (2017) by conducting subjective measurements through questionnaires from 70 office workers who work with computers. The results obtained Mental workload, memory slowness, task difficulty, depression, job stress, job satisfaction, motivation and work fear contribute to affect work productivity. Based on this reference, hypothesis 2 in this study is as follows:

H_2: Cognitive Ergonomics has a positive effect on work productivity

Thus, the conceptual model that will be tested in this study is presented in Figure 1. As based on the discussion above, this study investigates and verifies the results of previous studies regarding work productivity as an antecedent of workplace design and cognitive ergonomics.

Figure 1. Research Conceptual Model



3. Research Methodology

3.1 Samples and Procedures

The sample that will be used in this study uses eyelash workers in the production operator section of the industry by calculating the number of samples as many as 100 respondents which have been obtained from the technique developed by Cochran (1997). The sampling technique in this study used a non-probability sampling technique, namely purposive sampling with the criteria to be used in this sampling were workers who had at least 1 year of experience in their work. Respondents who meet the requirements and are interested in participating in this study are asked to fill out a short questionnaire that has been provided.

3.2 Measurement

3.2.1 Work productivity

Productivity is an index that measures output (goods and services) against inputs (labor, materials, energy, and other resources) used for the production process (Feige, A., Wallbaum, H., Janser, M., & Windlinger, L., (2013); Stevenson, WJ (2018)). Respondents assessed their productivity level using 4 items from the work productivity questionnaire taken from the research of Senen and Solihat (2008), namely the amount of production, production quality, accuracy, and seriousness. Respondents completed the questionnaire using a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

3.2.2 Workplace Design

Workplace design is concerned with the shape, dimensions, and layout (placement and orientation) of the various material elements that surround one or more working people (Marmaras, 2012). Respondents assessed their workplace design using indicators from key aspects of Indoor environmental quality (IEQ) taken from the research of Kang, S., Ou, D., & Mak, C. M. (2017) conducted in an open office space. The key aspects of the IEQ include Office Layout, Air Temperature, Air Quality, Lighting, and Noise. Respondents completed the questionnaire using a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

3.2.3 Work Cognitive Ergonomics

Cognitive ergonomics analyzes human work in studying the cognitive aspects of interactions between people, work systems, and the tools found in them, intending to design them so that their interactions are effective (Vickens, 2000). Respondents assessed cognitive ergonomics using 8 items from the cognitive ergonomics questionnaire taken from the research of Vimalanathan and Thangavelu (2017), namely mental workload, memory delay, task difficulty, depression, job stress, job satisfaction, motivation, and work fear. Respondents completed the questionnaire using a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

4. Results

In testing the questionnaire and the indicators that already exist, are they consistently used to measure variables, then validity and reliability tests are used. While the associative analysis tool

in this study was to determine the effect of workplace design variables (X1) and cognitive ergonomics (X2) on work productivity (Y) using multiple regression analysis.

4.1 Validity and Reliability Test

Tests on the validity and reliability were carried out first on 30 respondents who met the research criteria. Validity is often defined as the degree to which an instrument measures what it purports to measure. Validity requires that an instrument is reliable (Kimberlin, et al 2008). The test results on the variable indicators show a value greater than the R table (0.361) except for one indicator in the workplace design variable, the correlation coefficient value is smaller than the R table value. So this indicator is not included in further research.

The reliability test in this study is to determine whether the results of the answers to the questionnaire by the respondents are stable in measuring a symptom or event. A reliable instrument is an instrument that is used several times to measure the same object, will produce the same data. The test results obtained that all variables in this study had a Cronbach Alpha value greater than 0.60, so this research instrument can be said to be reliable (reliable) to be used as a measuring instrument.

4.2 Classic Assumption Test

The purpose of classical assumption testing is to find out whether the results of the regression estimation carried out can be used as a basis for testing hypotheses and drawing conclusions.

4.2.1 Normality Test

Normality testing aims to test whether, in the regression model, the dependent variable with the independent variable has a normal distribution or not. The results obtained from testing using the Kolmogorov-Smirnov Z produce sig values. (2-tailed) of 0.618 > 0.05, which means the standardized residual value is declared to be normally distributed.

4.2.2 Multicollinearity Test

Multicollinearity testing aims to test whether in the regression model there is a correlation between independent variables, where to detect the presence or absence of multicollinearity in the study is to use the Variance Inflation Factor (VIF). The results obtained in the test obtained the VIF value in Workplace Design and Cognitive Ergonomics of 1,040 < 10, which means that there is no multicollinearity with other independent variables.

4.2.3 Autocorrelation Test

Autocorrelation test aims to test whether in a linear regression model there is a correlation between confounding errors in period t. In this study, the presence of autocorrelation was tested with Durbin Watson. The test results show the Durbin Watson count value is 2.099 with the du value in the table of 1.715 and 4-du of 2.285, which means that the regression model does not contain autocorrelation problems.

4.2.3 Heteroscedasticity Test

Heteroscedasticity testing in the regression model was conducted to determine whether in the regression model there was an inequality of variance and from another observation. The test results

show the value of sig. of workplace design variables of 0.335 and Cognitive Ergonomics of 0.305, both of which are greater than 0.05, which means that the regression model in this study does not occur heteroscedasticity.

4.3 Multiple Regression Analysis

Multiple regression analysis was conducted to test the hypothesis about the partial and simultaneous effect of the independent variable on the dependent variable. The results of regression analysis with SPSS 16.0 software obtained the following equation:

$$Y = - 0{,}103 + 0{,}218\ X_1 + 0{,}146\ X_2 + e \quad (1)$$

The constant value generated by the above equation is -0.103. The number indicates that if the Workplace Design (X1) and Cognitive Ergonomics (X2) are constant (unchanged), then the resulting work productivity is -0.103. While the workplace design (X1) has a coefficient value of 0.218, meaning that for every increase in the workplace design variable by 1 unit, work productivity increases by 0.218. The coefficient on the Cognitive Ergonomics variable (X2) has a coefficient value of 0.146, meaning that for every increase in the cognitive ergonomics variable by 1 unit, work productivity will increase by 0.146.

The coefficient of determination (R2) measures how far the model's ability to explain variations in the dependent variable (Ghozali 2005). The value of the coefficient of determination is between 0 (zero) and 1 (one). A small value of R2 means that the ability of the independent variables in explaining the variation of the dependent variable is very limited. A value close to 1 means that the independent variables provide almost all the information needed to predict the variation of the dependent variable (Ghozali 2005). The test results show that the coefficient of determination (R square) is 0.599, which means that 59.9% of the Work Productivity variable can be explained by the Workplace Design and Cognitive Ergonomics variables, while the remaining 40.1% is explained by other reasons. variables that have not been studied.

4.3.1 Simultaneous Test (F Test)

Simultaneous Test (F test) is used to find out how much the independent variables (X1and X2) jointly affect the dependent variable (Y). The results of the ANOVA test or f test obtained a Fcount of 72.497, this value is greater than Ftable, namely 3.09 or Fcount 72.497 > Ftable 3.09 with a probability of 0.000. The probability value is much less than 0.05, so the regression model can be used to predict work productivity or it can be concluded that the two independent variables of Workplace Design and Cognitive Ergonomics simultaneously affect Work Productivity.

4.3.2 Partial Test (T-Test)

To find out that Workplace Design and Cognitive Ergonomics have a partial effect on Work Productivity, a t-test was carried out. This test is carried out by comparing tcount with ttable at the real level = 0.05. The results of the t-test indicate that the Workplace Design variable (X1) has a tcount of 9.961 and a t-table value of 5% distribution of 1.66 so it can be concluded that tcount>ttable means that the Workplace Design variable has a positive and significant effect on Work Productivity. With the results of this analysis, it can be concluded that research hypothesis 1 can be accepted. Likewise with the Cognitive Ergonomics variable (X2) which shows the t-count value of 4.667 and the value of the 5% t-table of 1.66, the t-count value > t-table. which means

that the cognitive ergonomics variable has a positive and significant effect on work productivity. Thus it can be concluded that Research Hypothesis 2 is acceptable.

5. Discussion

The findings obtained in this study are that workplace design has a positive effect on work productivity. This research is in line with research conducted by Haynes (2005); Zakerian, et al (2016); and Leblebici (2012). Workplace design is considered important to support the respondent's work activities in the organization. The creation of a high-performance workplace design can be done with an emphasis on the comfort system of the work environment. A comfortable office design can motivate employees and improve their performance substantially. Good office design has a positive influence on employee productivity (Sehgal 2012; Amjad (2009).

Further findings indicate that cognitive ergonomics has a positive effect on work productivity. This research is in line with research conducted by Vimalanathan and Thangavelu (2017). The importance of cognitive function to maintain a work environment that is suitable for work conditions. As the function of Cognitive Ergonomics aims to design conditions with the work environment in improving cognitive function and human performance in the workplace, and as a consequence can increase productivity, safety, and health in the workplace. work. With cognitive ergonomics in organizations, the main goals are mostly focused on improving work functions and reducing human errors. Improving product safety and quality is also a major concern as mechanized workplaces can result in increased decision-making and operator monitoring requirements, which can increase the likelihood of human error and accidents.

Therefore, this study contributes to an understanding of the importance of workplace design and cognitive ergonomics on increasing employee productivity. Cognitive function is critical to safe and effective operations in organizations and the workplace. However, despite their importance, cognitive problems have not been systematically highlighted in workplace ergonomics programs (MacLeod, 2006). In this sense, cognitive ergonomics is an emerging branch of ergonomics and is part of the larger field of human factors and the discipline of ergonomics. However, cognitive ergonomics is still an untapped area for improving the design of machine controls, instruction sets, and so on. Therefore, cognitive ergonomics is expected to make a significant contribution to improving work performance, lean operation, productivity, and ultimately creating a safer and healthier working environment in the industry.

6. Conclusion

This study examines the effect of Workplace Design and Cognitive Ergonomics on Work Productivity, intending to know the effect either partially or simultaneously. Based on the results of the analysis using SPSS 22, it can be concluded that:

- Workplace Design has a positive and significant influence on Work Productivity, so it can be concluded that doing workplace design can increase employee concentration which results can increase work productivity.
- Cognitive Ergonomics has a positive and significant influence on Work Productivity. Cognitive Ergonomics has become critical to safe and effective operations in organizations and workplaces. With this, it can increase employee productivity.

- Workplace Design and Cognitive Ergonomics have a positive and significant influence on Work Productivity simultaneously, so it can be concluded that the better the Workplace Design and Cognitive Ergonomics, the Work Productivity will also increase, on the contrary, if employees are not happy or satisfied with the workplace design or the existing cognitive ergonomics in the organization, the potential for employee productivity will also be low.

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