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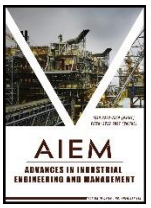

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REVIEW ARTICLE

PHYSICAL ERGONOMICS FACTOR ASSESSMENT OF WORKSTATION: A CASE STUDY IN ACF-J'S SANDAL MANUFACTURING IN CARCAR CITY, CEBU, PHILIPPINES

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ABSTRACT

A lack of ergonomic awareness and care in the physical environment setting has resulted in accidents, sickness, and pain, which may lead to poor job quality and employee performance. These include environmental influences as well as worker postures. This research focuses on the results of workplace assessments for lighting, noise, temperature, and worker postures. The workplace and workers' postures were evaluated and compared to ergonomics recommendations available in the literature.

The descriptive quantitative design was utilized by the researchers. In the absence of ergonomic standard design in the industry in line with the guiding principles of ergonomics, this technique would assess the specific problem, risk, and potential danger. The researchers would employ instruments to monitor the physical environment, such as a Lux Meter, Noise Level Meter, Thermometer, and RULA (Rapid Upper Limb Assessment), to examine the physical environment of the workstation. These techniques were used as the foundation for a proposal to analyze the influence of design and environmental circumstances on worker performance and well-being.

Through results and discussion, this research discovered that various physical environment variables failed to meet the standard need in terms of illumination, with the initial production area having only 267.4 lux, whereas the normal level required 300-1000 lx. Furthermore, the temperature in the industrial area surpasses the acceptable limit set by the United States. Occupational Health and Safety. Furthermore, utilizing the Osmond program on RULA, it was discovered that employees' postures are at action level 2, indicating that additional inquiry and modifications may be required. This study highlighted the implications, significant suggestions, and future research directions.

As a result, proper ergonomics and effective workstation design are critical to facilitating the process and providing a healthy interior environment that promotes workers' comfort, well-being, and job performance.

KEYWORDS

Anthropometric, Human factors/ergonomics, illuminance, lux meter, leq, monotonous, ulnar deviation

1. INTRODUCTION

The Manufacturing Industry is expanding rapidly these days, and having precise ergonomics and effective workstation design aids in the production of creation of products in an Industry (Cochran et al., 2016). A study of workers' interactions with their surroundings can help create a balance between workplace design and human physical needs (D.T. Gonçalves et al., 2017). Assuming that good rules for embedding ergonomic standards inside the workplace lead to workers doing the activity quickly and successfully. Workplace design also has a significant influence on worker productivity (S. M. Mercado, 2015). It is essential to establish a healthy interior environment that maximizes workers' comfort, well-being, and work performance E. Azar et al., 2019). It was stated that human factors/ergonomics (HFE) have a huge potential to help to the design of all sorts of systems. HFE is distinguished by three key characteristics: it employs a focus system, it is based on design, and it focuses on two closely connected outcomes: performance and well-being (J. Dul et al., 2012). The Safety and Productivity Enhancement through Ergonomics Development (SPEED) research was conducted in the Philippines in order to detect ergonomic hazards and give a realistic solution to the problems of ergonomic risks and musculoskeletal illnesses. According to the audit results, a total of 27 persons, the majority of whom were female (89%) replied to the symptom survey. Fifty-nine percent (59%) of those polled expressed uneasiness. The low back, hand/wrist, shoulder, and neck are the most commonly complained-about body areas. The audit results revealed that illuminances in some places exceeded recommended levels (Jisung Park et al., 2021).

ACF-J's Sandal Manufacturing Industry, located in Carcar City, Cebu, is known for its production of footwear and discovered that the workstation lacked some application of standard working environment and ergonomically workplace, which becomes a hindrance for workers, resulting in poor processes in manufacturing the product, as well as frustration and fatigue. The present Physical Environment, including

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Lighting, Temperature, Noise, and worker posture, must be evaluated in order to optimize the workstation.

To address the research gap, the researchers decided to conduct a study that will evaluate the workstation design of ACF-J's Sandal Manufacturing Industry in Carcar City, Cebu to identify the specific problem, risk, and potential work/ergonomic hazards in the absence of a standard working environment. The study's findings will provide the company with helpful insights, recommendations, and a plan for development based on Ergonomics Principles in order to enhance their workstation design.

2. Review of Related Literature

This chapter contains the concepts, completed thesis, generalization or conclusion, methodology, and other information. Those provided in this chapter aid in familiarizing the reader with knowledge that is pertinent and comparable to the current research.

A review of related literature in any subject of study has become an unavoidable component of research activity. According to Best (1977), "familiarity with the literature in any problem area helps the student discover what is already known, what others have attempted to discover, what method of approach has been promising or disappointing, and what problems remain to be solved." The investigator has made a concerted effort to learn about and examine the research connected to the issue under inquiry that has been completed by other academics and scholars.

The study's goal is to determine the efficacy of using ergonomic concepts to create an efficient workspace. The following sections provide information about studies that are linked to the current investigation.

a. Studies on Physical the Environment of a Workplace

b. Studies on work postures in accordance with the Ergonomics Guiding Principles

A. Studies on the Physical Environment of a Workplace

According to their study on "Lighting Level and Productivity" stated that establishing appropriate lighting or illumination has long been viewed as one of the most significant industrial workplace design tasks that are connected with productivity and job efficiency (Juslén and Tenner, 2007). Numerous studies have found that excellent illumination improves job performance while also lowering injury rates.

The discovered in their study "Method for Evaluating the Effect of Design and Environmental Conditions" that adjustments in official lighting and noise regulations are necessary for identifying the potential effects on worker health (Mildrend Montoya-Reyes et al., 2020).

The concluded in his study on the "Impact of Work Environment on Performance of Employees in Manufacturing Sector" that an adequate lighting system, noise, furniture, and temperature can impact employees both physically and psychologically, and some health problems that may occur are headaches as a result of poor lighting system and undesirable noise, respiratory problems as a result of poor air quality, and fatigue as a result of inapproachable lighting (Christopher Mathews, 2016). Furthermore, administrative office managers should organize the workshop environment based on ergonomically sound workshop in which all environmental features can be acceptable for employees in order to sustain employee productivity.

That analyzes in their study "Work Environment and Employees' Performance" that participants who perceived their work environment as adequate and favorable scored comparatively higher on measures of job satisfaction, performance, and perceived organizational effectiveness (Srivastava, 2008).

This asserts in his paper "Workplace Environment and Its Impact on Organizational Performance in the Public Sector" that the workplace environment has an impact on employee morale, productivity, and engagement - both favorably and adversely (Chandrasekar, 2011). Employees who work in an unsafe and hazardous workplace are at risk of occupational sickness, which has a negative influence on their performance. As a result, productivity suffers as a result of the office environment. The quality of an employee's office environment has the greatest influence on their level of motivation and subsequent performance. How effectively they connect with the organization, particularly with their immediate environment, has a significant impact on their mistake rate, amount of creativity and cooperation with other employees, absenteeism, and, ultimately, how long they stay on the job. Creating a productive work environment for your staff is critical to increasing earnings for your organization, company, or small business. The interaction between work, the workplace, and the equipment of work, workplace becomes an intrinsic component of work itself. The management that dictates how, exactly, to maximize employee productivity center around two major areas of focus: personal motivation and the infrastructure of the work environment.

As a conducted research on the "Effect of workplace environment factors on employee performance." According to the findings, job aid and physical workplace environment have a significant relationship with employees' performance (Nina Munira Naharuddin and Mohammad Sadegi, 2013). Employees' performance level is dependent on the quality of the employees' workplace environment factors, which include job aid, supervisor support, and physical workplace environment.

Investigated "The Factors Affecting Employee Work Environment" and discovered that the work environment influences the quality and quantity of work generated by employees, while poor environmental conditions can cause inefficient worker productivity as well as lower job satisfaction (Anil et al., 2014). Because many employees spend the majority of their time creating activities in the company, the work environment is extremely crucial if the business want to retain higher productivity.

The study on "Work environments for employees creativity: Ergonomics" concluded that it is critical to provide a healthy indoor environment that maximizes worker comfort, well-being, and work performance, and that human factors/ergonomics (HFE) have great potential to contribute to the design of all types of systems (Jan Dul et al., 2020). HFE is distinguished by three key characteristics: (1) it employs a focus system, (2) it is design-based, and (3) it focuses on two closely connected outcomes: performance and well-being.

For the indicated in their study "Determinants of job satisfaction affected by work environment" that it is vital for a company to hold workshops for workers on a regular basis in order to boost the productivity of any organization's personnel (Shiv Kant Tiwari, 2020). Various elements, such as employee working circumstances and internal and external locating factors, were discovered to need employees to leave their positions, proving that the work environment was extremely influential directly or indirectly on job satisfaction, as demonstrated by this study.The work environment has a big influence on employee happiness, yet boredom, stress, and busyness all lead to increased job discontent, whereas a superb work environment (health and safety, workplace entertainment, food and recreation) raises the degree of job satisfaction. There was no connection between workplace and job happiness of employees who worked under regular workplace circumstances, but there was a very significant impact between workplace and job satisfaction of employees who worked under tough workplace conditions.

B. Studies in work postures on accordance with the Ergonomics Guiding Principles.

As a stated in their study "An Owas-Based Analysis of Workers Engaged in Brick Making Factories" that workers' working posture should be corrected either soon or immediately because workers were likely to suffer from serious musculoskeletal disorders in the future in the brick factory there is a need for immediate corrective measures (Kumkum Pandey et al., 2012). Each body posture is stored and classified into four static injury risk classes.

In their article "Ergonomic Risk Assessment in an Aluminium Casting Industry," assess that ergonomics has been a critical problem that inhibits both the health and productivity of industrial employees (Kailash Subramanian et al., 2017). Due to the nature of the labor that they conduct at their workplaces, the industrial workers in this field have been experiencing joint and muscle problems in their lower back, arms, and necks.

The concentrated on an overview of ergonomics risk factors in the construction sector. The goal was to provide a fundamental overview and description of ergonomics (Jaffar et al., 2015). The study examined ergonomic risk variables in respect to humans and their job nature. The most major ergonomics risk factors, according to the research, are uncomfortable posture while performing occupational tasks, force and repetition of specific movement, including vibration. Other ergonomics risk factors include unpleasant static positions, muscle and tendon contact stress, and high temperature conditions. This study raised awareness of the potential hazards in the building sector.

It is present an overview of ergonomic risk control in the construction industry (Abdul-Tharim et al., 2011). The building and construction business is a dynamic and dangerous profession, making ergonomic

features to be applied on site both distinctive and hard. As a result, there are several regulating considerations to consider while adopting ergonomics and controlling ergonomics risk factors on the building site. Ergonomic controls are used to tailor the workplace to the individual worker. They aim to neutralize the body and minimize the other ergonomic risk factors. These controls must be able to accommodate a wide range of employees. There are several approaches and steps that can be taken to improve ergonomics implementation in the workplace and reduce risk factors. These control channels include communication, management control, ergonomic design factors, training and education, and written ergonomics programs.

Manual material transfer is a high-risk activity that can result in spine injuries, according to ergonomics. Manual material transport necessitates a significant amount of energy and strength. As a result, if all actions are performed poorly, they may trigger nerve and muscle irritation (Muslimah et al., 2006). Manual Material Handling (MMH) occupations including high physical demands, constant bending, squatting, and hip twisting may cause musculoskeletal system disruption (Deros et al. 2010). The major cause of this condition is the repetitive application of static stresses over a long period of time, which generates tensions or disturbances in the joints, tendons, and ligaments.

According to one of the most significant aspects of a workplace is the chair (Harel, 2008). The researcher also stated that every company or office should have ergonomic office chairs so that everyone may make the required modifications to be comfortable at their task.

According to occupational risk factors are the most significant contributors to these health issues and may be found in any industry. Musculo Skeletal Disorders (MSDs) can deteriorate employees' health, lowering their performance in accomplishing their responsibilities (Halim et al., 2005). Several studies have demonstrated that poor worker performance might have major economic and societal effects. This is evidenced by an increase in employer compensation claims, which may overload the health-care system. Inadequate production ergonomics is one of the leading causes of sick absence and workplace injuries in the business.

According to the Ovako Working Posture Analysis System (OWAS) approach estimates a worker's static load at workstation by assessing his posture (Kumkum Pandey et al., 2012). It is an analytical approach for improving ergonomic conditions at a workspace. It takes into account various back, shoulder, and leg postures. It also includes the weight that a worker lifts. Each body posture is stored and classified into four static injury risk classes.

According to E. Metzger in June 2013, "By ensuring that workers have the freedom to move comfortably and naturally, companies can prevent many of the musculoskeletal injuries and fatigue that leads to lost time and productivity."

A. Sheprak May 2021 A work surface that is too high or too low might put pressure on the back, neck, and shoulders. Most everyday tasks should be performed at elbow height, whether sitting or standing. However, if you operate with heavy tools, you should change your position so that you are working at or below elbow height. Precision work, on the other hand, may need working at heights above the elbow.

According to the presence of unpleasant feelings as a result of an improper workstation layout may result in job injury and other detrimental effects on worker's health (Mali et al., 2015).

An incorrect arrangement can cause eye strain, neck stiffness, back discomfort, and arm pain. When compared to the current layout, improved excellent facility layout can reduce the overall danger level on the upper body and boost production by 194%. Inadequate chair level adjustment may contribute to a stagnation of blood flow to the leg. Incorrect sitting position might result in lower back pain. Identification used in traditional food production employing manual operating equipment might result in injury risk to the neck, shoulder, back, wrist, and leg. Repetitive work, in particular, can lead to tendon and shoulder issues. Workplace ergonomic evaluation ensures that the work system (equipment, tool, workstation, and policy) is correctly built to increase worker safety and health and maximize work business including productivity, efficiency, quality, and profitability.

3. Research Methodology

This is a quantitative research that focuses on quantifying data gathering and analysis using evaluation methods and actual workstation observation. The descriptive research design is being examined for the study. In the absence of ergonomic standard design in the industry in line with the guiding principles of ergonomics, this technique would assess the specific problem, risk, and potential danger. The researchers would employ gadgets to monitor the physical environment, and the RULA Employee Assessment worksheet would be used as a medium to analyze workers' posture as a foundation for developing additional suggestions.

3.1 Methods of Data Collection

This study relies heavily on primary and secondary data. The instruments to employ for assessing the physical environment of the workstation are the Lux Meter, Noise Level Meter, Thermometer, and RULA (Rapid Upper Limb Assessment). These techniques were used as the foundation for a proposal to analyze the influence of design and environmental circumstances on worker performance and well-being. The study relies heavily on both primary and secondary data.

Primary data : Gathered through an examination of the workstation.

Secondary data: Secondary data comprises mostly of data and information gathered through real observations of a worker's posture.

3.2 Flow of the Study

In the absence of ergonomic norms, the research study identifies the unique problem, risk, and potential danger. It was divided into three phases, as shown in Figure 1.

Input. The first part was the input, which determined the elements that impact worker performance directly in the workplace, notably lighting, temperature, and noise. In addition, the assessment of work position in line with ergonomics' guiding principles.

Process. The second phase will include requesting clearance from the manufacturing office, followed by an evaluation of the workstation. The collected data will be statistically handled, analyzed, and evaluated before reaching a conclusion and making recommendations.

Output. The research produced a suggested improvement plan for the Sandal Manufacturing Unit in Car-car City, Cebu.

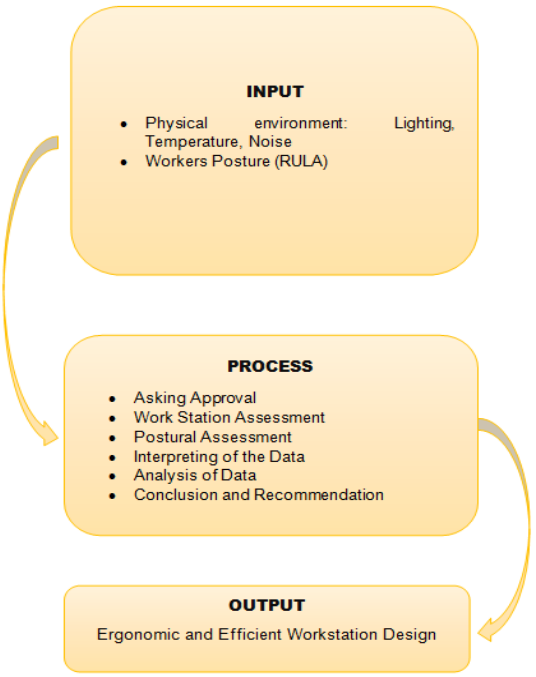

Figure 1: Flow Chart of the Study.

3.3 Environment

The research will be carried out at Dapdap Liburon, Car-Car City Cebu. The town of San Fernando borders the municipality to the north, the towns of Aloguinsan and Barili to the west, the Cebu Strait to the east, and the town of Sibonga to the south. Carcar is located around 40 kilometers (25 miles) south of Cebu City. It covers an area of 116.78 square kilometers (45.09 square miles). The sampling area was obtained from the Sandals facility in Car-Car City, Cebu.

Research Participants - The respondents of this research are the overall

workers of the factory since their population is small because the factory undergoes downsizing. Table 1 shows the population size and the number of workers in a different category.

Table 1: Population size.	
Population size (total no. of workers) = 17	
CATEGORY (Work Assignment)	**(No. of Workers)**
Development/Design Sketching	1
Materials Preparation	2
Cutting and Stitching	5
Assembling the Product	9

3.4 Instrument

The ergonomic parameters to be examined for the Physical Environment for main data include lighting levels, sound levels, temperature environment, and postural analysis utilizing the RULA Assessment tool. Table 2 shows the measuring device as well as the measurement procedure for each component. The actual observation of employees' posture will be examined using (Rapid Upper Limb Assessment) RULA for secondary data.

4. Research Procedure

4.1 Data Gathering Procedure

The researchers will send an authorization letter to the office of the sandal manufacturing industry in Carcar City to administer a data collection through actual observation. This letter is for the purpose of formality as we inform them that we will be having our data collection. After the permission is granted, the researchers will go to the office of the sandal manufacturing industry in Carcar City located at Dapdap, Car-Car City Cebu to conduct an assessment on their workstation. The respondents of this study will be studied by actual observation of their work postures.

The findings of the physical workplace assessment and the RULA evaluation were examined and interpreted to identify the present ergonomics of the workstation in the Sandal Manufacturing Industry in Carcar City. A matrix of points is carried out on the architecture of the sandal production to identify the locations where the readings of illumination, noise, and temperature factor will be done in the evaluation of the physical environmental conditions. The following phase is to determine whether the factors meet official criteria before concluding with adjustments to the production cell that allow for greater job performance. The outcome will serve as the foundation for developing the recommended improvement strategy.

4.2 Statistical Treatment of Data

The following statistical formula will be used in the research study to quantitatively analyze the findings of the inquiry. The following are the tools used to analyze the collected data:

Arithmetic Mean. It is the total of the numbers in the collection divided by the number of numbers in the collection. The collection consists of the subjects' responses to a survey.

The formula for getting arithmetic mean

$$\bar{x} = \frac{\sum x}{n}$$

Where:

X= Individual value

n= Total number of values

$\bar{x}$= Arithmetic mean

∑= Summation

Logarithmic Average:

$$L = \log \sum_{i=0}^{n} 10 \frac{V_i}{10}$$

Where:

L= logarithmic

∑= Summation

Osmond Ergonomics Software: An evaluation technique for determining the likelihood of upper limb diseases.

Rula Score: To recognize occupational risk factors related with upper-limb musculoskeletal diseases (MSDs), which include joint, nerve, muscle, ligament, and tendon injuries or discomfort.

Table 2: RULA Score.		
SCORES	**ACTION LEVEL**	**REMARKS**
1-2	1	Acceptable posture
3-4	2	Further investigation, and changes may be needed
5-6	3	Further investigation, changes soon
7	4	investigate and implement changes

5. Presentation, Analysis, and Interpretation of Data

This chapter contains the data collected, the results of the statistical analysis, and the findings' interpretation. As previously stated in the prior chapter, data is interpreted descriptively. The data analysis and interpretation process is divided into two stages. The first section is based on the findings of the physical environment evaluation of the workstation. The second section is based on the facts and information gathered from real observations of employees' posture. These are provided in tables in the order in which they were discovered in the specific research topic of Physical Ergonomics factor evaluation of workstation: A case study in ACF-J's Sandal Manufacturing.

Phase 1: Physical Environment Assessment

The physical factors of workplace's environment were assessed using the Lux meter to measure the level of illuminance, sound level meter for the noise, and Digital Thermometer for the level of temperature of the workstation.

Tables 3, 4 and 5 shows the result on the assessment of the physical environment of the workstation and its remarks if it complies with the recommended level requirement in terms of Lighting, Noise, and Temperature. The whole data for each factor are shown in the appendix.

Measurements of Illuminance Levels Based on Workstation Lighting Assessment Results

Table 3: Illuminance Measurements.		
ILLUMINANCE LEVEL (Standard Illuminance: 300-1000 lx)		
Area	**Ave. Lux**	**Remarks**
1	823.4	Acceptable
2	267.4	Not Acceptable
3	420.4	Acceptable

The table shows the illuminance level analysis result, where the current illuminance level of the second area is not acceptable, it only has 267.4 lux, and the standard level requires is 300-1000 lx. On the other hand, the first and third area complies with the required illuminance level for a workshop with 823.4lux on the first area and 420.4lux on the third area.

Noise Level Measurements in accordance with Workstation Noise Assessment Results

Table 4: Noise Measurement.		
NOISE LEVEL (Allowable Noise: 85 dB)		
Area	**Ave. Noise**	**Remarks**
1	63.63324	Acceptable
2	66.09604	Acceptable
3	66.34646	Acceptable

The table shows the noise level analysis result on the three-production area with different work categories. After the researchers measured the level of noise in the workstation, they compare the result to the ergonomic

standard if it complies to the allowable noise level of 85 decibels for an 8 hr work exposure. It was determined that the three areas are acceptable to the standard allowable noise requirement where the first area has an average noise measurement of 63.63324 dB, 66.09604 dB for the second area, and 66.34646 dB for the third area.

Temperature measurements correlate with the findings of the Workstation's current thermostat assessment

Table 5: Temperature Measurement.

TEMPERATURE LEVEL (20°C – 25.6°C)		
Area	**Ave. Temperature**	**Remarks**
1	30.0254	Exceed
2	30.46875	Exceed
3	30.36161	Exceed

The table displays the thermostat level analysis result based on average temperature measurements taken at various places in the workstation's three production areas. The average temperature in the first region is 30.0254°C, the average temperature in the second area is 30.46875°C, and the average temperature in the third area is 30.36161°C. The normal thermostat suggested by the United States Occupational Safety and Health Administration is between 20 and 25.6 degrees Celsius. The study's findings indicate that the present level of temperature in the work station's three production zones exceeds the requirement.

Phase 2: Worker's Posture

Assessment scores using RULA (Rapid Upper Limb Assessment) in terms of ARM and WRIST; and NECK, TRUNK and LEG

The RULA (Rapid Upper Limb Assessment) and REBA (Rapid complete Body Assessment) analytic tools were used to analyze the complete job assignment category. This ergonomics tool employs a systematic approach to assessing whole-body postural MSD (Musculoskeletal Disorders) and the risk associated with them.

Tables 6 and 7 indicate the level of risk linked with work-related musculoskeletal condition in ACF-J's footwear manufacturing plant workers. The average score and assessment of the amount of danger gained by the employees posture were provided sensibly. Appendix contains the complete data for each worker in each employment category.

Table 6: Daily Average Scores of Workers Posture.

WOKRKER's POSTURE	DAY1	DAY2	DAY3	DAY4	DAY5	DAY6	DAY7	WEEKLY AVERAGE SCORE
ARM and WRIST	4.4118	4.41176	4.18182	4.23529	4.32353	4.32353	4.26471	4.307486631
NECK, TRUNK, LEG	4.1765	4.11765	3.88235	3.76471	3.17647	3.94118	3.76471	3.831932773

Table 7: Rapid Upper Limb Assessment (RULA) Result.

POSTURE	AVE.SCORE	ACTION LEVEL	REMARKS
ARMS and WRIST	4.31	2	Further investigation, and changes may be needed
NECK, TRUNK and LEG	3.76	2	Further investigation, and changes may be needed

Tables 6 and 7 illustrate the amount of risk linked with work-related musculoskeletal disease among factory workers in ACF-J's footwear production. The average score and interpretation of the amount of danger gained by the employees posture were sensibly provided. Appendix contains the complete data for each worker in each job category.

6. Summary, Conclusion and Recommendation

This chapter contains a summary and a conclusion that leads to the creation of suggestions.

6.1 Summary

The primary goal of the study was to evaluate the physical ergonomics element of the workstation in the Sandal Manufacturing Industry in Carcar City Cebu for the calendar year 2022 as the foundation for enhancing ergonomic and efficient workstation design.

It was specifically required to answer the following questions: what is the current ergonomics of the Sandal Manufacturing Industry in Car-car City Cebu in terms of Physical Environment including Lighting, Noise, and Temperature; what is the current posture of workers on Arms, Wrist, Neck, Trunk, and Leg; and what is the level of compliance based on ergonomic standards?

This is a quantitative study that focuses on quantifying data collecting and analysis using an evaluation procedure and actual workstation observation. Thus, the dimensions of the ACF-J's workstation are measured using the tape measure; for primary data, the ergonomic factors to be measured for the Physical Environment are lighting levels using the lux meter, sound levels using the sound level meter, and the thermal environment using the thermometer. The actual observation of employees' posture will be examined for secondary data using Rapid Upper Limb Assessment (RULA).

6.2 Conclusion

As shown by the results in Chapter 3, the existing illuminance of the second area is not suitable; it only has 267.4 lux, whereas the standard level required is 300-1000 lx. The first and third areas, on the other hand, meet the needed illuminance level for a workshop, with 823.4lux on the first area and 420.4lux on the third.

For the noise measurement, after the interpretation of data, the researchers compared the current noise level of the workstation vs. the standard requirement, where the allowable exposure time in 8 hours must only have 85 decibels, and the workstation has 63.6 to 66.3 decibels, it means that the existing ergonomic in the workstation complies the ergonomics standard in terms of the level of noise. Moreover, the standard thermostat recommended by the U.S Occupational Safety and Health is between 20 to 25.6 degrees Celsius, however, the current level of temperature of the three production areas of the workstation has 30°C which means that it exceeds the standard level of the temperature.

The workers posture analysis based on the result of the study, using the Osmond software, it was determined that arms and wrist is on an action level 2 which has an average RULA score of 4.31 wherein further investigation and changes might be needed, same as well as the result for the final average RULA score ot the neck, trunk and leg where it has 3.76 average score that indicates also an action level 2 of risk level where further investigation and changes might be needed.

6.3 Recommendation

After a series of data treatment, the researchers found out that the noise of the workstation is acceptable based on standards, but one of the three areas exceeds to the level of compliance in terms of lighting, and also the three areas exceed to the level of compliance in terms of temperature. On the other hand, the researchers also found out that some of workers postures are not acceptable and needs a further investigation. Therefore, the researcher makes the following recommendations for lighting, temperature and workers postures.

6.3.1 Physical Environment

To get around the insufficient illuminance in lighting, the manufacturing organization should replace bulbs on a regular schedule, clean light fixtures on a regular basis, and add more light fixtures in appropriate spots. In terms of temperature control, the researcher recommends that the management upgrade their roofing because it was discovered by the researchers that the roof of the workshop is not at its standard height and does not have a ceiling, which is a major factor that causes the temperature of the workshop to exceed the standard requirement. Furthermore, following the upgrading, management should install wall or ceiling fans.

6.3.2 Workers Posture

To compensate the postures of the workers while doing their tasks, the management should allocate budget for the upgrades of some features of the workstation and provide an ergonomically designed adjustable seat for the comfort height of the worker's needs. The adjustable seat height provides the workers maximum adjustability in regards to their popliteal height and scope for comfort. The management should set up an ergonomic workstation with accordance to the guiding principles of ergonomics to provide a more comfortable workstation and eliminate the risks of worker's postures.

Explanations

Anthropometric - A person's size, shape, and functional capacities are all measured physically.

Ergonomics - A scientific field focused with the knowledge of interactions between humans and other system elements, as well as the profession of applying theory, concepts, data, and methodologies to design in order to enhance human well-being and overall system performance.

Human Factors/Ergonomics - Ergonomics (or human factors) is a biological investigation of the interactions between humans and other components of a system.

Illuminance -The amount of light emitted per unit area at any point on a surface exposed to incident light. The lux meter is used to measure it. Also known as lighting.

Lux Meter - Light meters, often known as lux meters, are tools used to monitor light levels or light pollution.

Leq - the average sound level recorded over the period sampled.

Monotonous- The same or always the same and not altering.

Ulnar Deviation- A medical condition that causes the joints in the wrist and hand to shift so that the fingers bend toward the ulna bone on the outside of the forearm.

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