UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Application of Ergonomics Principles for Workplace Arrangement of Bicycles Workshop

This report submitted in accordance with requirement of the University Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (Process and Technology)(Hons.)

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Department of Manufacturing Engineering Technology) (Hons.). The member of the supervisory is as follow:

……

Mohd. Razali Bin Md. Yunos

ABSTRAK

Tesis ini adalah mengenai pelaksanaan dan analisis ke atas susun atur bengke basikal. Beberapa susun atur bengkel basikal telah disiasat dan data tela diperolehi telah direkodkan. Data yang diperolehi kemudian dimasukkan ke dalam perisian yang dipanggil ARENA. ARENA membantu untuk menentukan kecekapan dan produktiviti pekerja. Susun atur yang disiasat ialah susun atur lurus, bentuk O dan susun atur berbentuk U. Ketiga-tiga susun atur ini menghasilkan keluaran yang berbeza dan kadar produktiviti yang berbeza. Reka bentuk susun atur yang terbak ditentukan berdasarkan kitaran masa, biangan keluran dan kadar produktiviti yang dihasilkan oleh setiap mekanik apabila pelan susun atur yang berbeza dilaksanakan. Susun atur yang terbaik dipilih iaitu susun atur berbentuk U dan susun atur tersebut telah direka semula dengan menggunakan CATIA. Susun atur reka bentuk semula yang mengaplikasikan prinsip-prinsip ergonomik ini boleh membantu mekanik dalam meningkatkan kadar produktiviti mereka dan mengurangkan kecederaan mereka pada waktu bekerja.

ABSTRACT

This theis is abut the implementtion and analysis on the bicycle's workshop layouts. Several layouts have been invistigated and the data obtained is being recorded. The data obtained is then being inserted into a software called ARENA. ARENA help to determine the efficiency and productivity of the workers. The layouts that being investigated are Straight layout, O-shaped layouts, and U-shaped layouts. These three layouts produce different output and productivity rate. The best layout design is determined based on the cycle time, the number of output and productivity rate produced by each mechanics when different layouts are implemented. The best layouts are then being selected which is the U shaped layout and the layout was then being design by using CATIA. The layouts consider the implementation of ergonomics principles where there are sereval added equipment to the layout. These ergonomics redesign layout can help mechanics in increase their productivity rate and reduce injury during their working hour.

DEDICATION

I dedicated this thesis to my mother Mariati Binti Osman and my beloved father Mohamed Amin Bin Mohamed.

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Alhamdulillah, I would like to thank to Allah S.W.T, the Most Merciful, and all praises to Allah for His blessingin completing this thesis. Special appreciation to my supervisor, Mr. Mohd Razali Bin Md Yunos for the supervision and guidance throughout the experiment.

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TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

LH	-	Left handed
RH	-	Right handed
HCI	-	Human computer interaction
TPM	-	Total productive maintainance
CAD	-	Computer added design
DE	-	Discrete event
2D	-	2-dimensional
3D	-	3-dimensional
PCS	-	Pieces
MIN	-	Minutes
SOP	-	Standard Operational Procedure
NC	-	Numerical codes

CHAPTER 1
INTRODUCTION

1.0 Introduction

This chapter shall introduce and explained the basic concept of the project. This chapter explained more about the problem statement and limitation for this project, the main objectives that need to be fulfilled, and the scope or study area of this project. The basic concept of ergonomics principles, cycle times and worker efficiency that will effect the productivity rate will also be explained.

1.1 Project Background

Ergonomics design layouts are the design of the workplace following an appropriate standard. Ergonomics usually involve in human physical whereby the tooling system should be in the correct position so that people can reach them readily when they need to. By applying these ergonomics principles to the workplace, potential accidents, injury or health issues that may occur can be reduced simultaneously improve the worker performance and productivity (Gurunath, 2012).

Bicycles workshops nowadays are often seen to be in small spaces. When the ergonomics principles are not applied to this system, many problems may occur involving the mechanics itself and their productivity. In designing the workstation layout, many factors need to be considered such as the space under work surface for legs, inadequate lighting which can cause eyestrains when conducting the tasks. These factors can disturb the mechanics performance in completing their tasks.

Usually the mechanics arranged their workshops based on their own ideas. They arranged it based on their comfortability in reaching the tool and their comforts during conducting the tasks. However, they usually forgotten to consider the cleanliness of the workplace and the injury that may occur in the workshops.

In this project, the ergonomics principles are fully applied to the small space workshops to solve the mechanics physical problem and the mechanics productivity is measured.

1.2 Problem Statement

Cycles time and workers efficiency are usually the most related problem that occur in the industry. Cycle times are the main influenced to the productivity rate of a system, every aspect of the workers and the environment need to be measured. For example, both LH and RH worker and time required to each task by each worker need to be measured in order to identify the most precise cycle time. Cycle time give a big impacts to the productivity, thus by reducing it can increase the productivity of a system. Worker efficiency are also the main problems that occur in the industry. The awkward postures and various illnesses during completing the tasks need to be identified in order to improved the the worker performance. These problems occur because of poor workstation design and layout as material handling, tool handling, control system operation have seen significant effect on worker efficiency. The workers maybe also unaware of ergonomic principles as body postures and movements are not following standard work procedure. Thus, the workstation layout and design need to be modified for good body postures and good tool-workpiece contact.

1.3 Objectives

This project is a study on the ergonomics application on bicycles workshops whereby cycle time and the fatigue causing factor is measured. Thus, these project are completed based on these objectives.

1 To investigate the effects of ergonomics factor on the productivity rate at bicycle workshop.

2 To simulate the cycle time and the worker efficiency based on the bicycle workshop workplace arrangement factors using ARENA.

3 To analyze the advantages and disadvantages of each layout based on the productivity rate.

4 To recommend the best workplace arrangement for bicycles workshop.

1.4 Project Scope

The project focus on the arrangements and the design layout for small bicycles workshops. The layout designs are made based on the ergonomics principles which will improve the cycle time and the workers performance. Several layouts will be designs that fulfil all the ergonomics principles. Since the spaces are limited, the layout must consider the movement of the worker and the material position. Material handling, tool handling, control system operation need to be followed based on the standard work procedure in order too increase the workers performance simoultaneously decreasing the cycle time of each tasks being completed. This system can be utilized by industries for optimization of workplaces and ergonomics application. In recognition the importance of this system, it is potentially for consultation to improve productivity rate and work quality.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter consists about the manufacturing system, ergonomics principles, productivity, methodology used by previous researcher and software available in the market in measuring the productivity rate.

2.1 Manufacturing System

A system is defined as a group of components that work together in orderly arranged toward a specific goal. A system should be systematic, observable and measurable. However, systems are regularly affected by elements outside the system which is called system environment. These elements are random such as the health of the worker, machine's breakdown and natural disaster which can cause the system to be irregular and unpredictable. However, this randomness can be predicted and stimulates by doing some research and analysis on the elements existed.

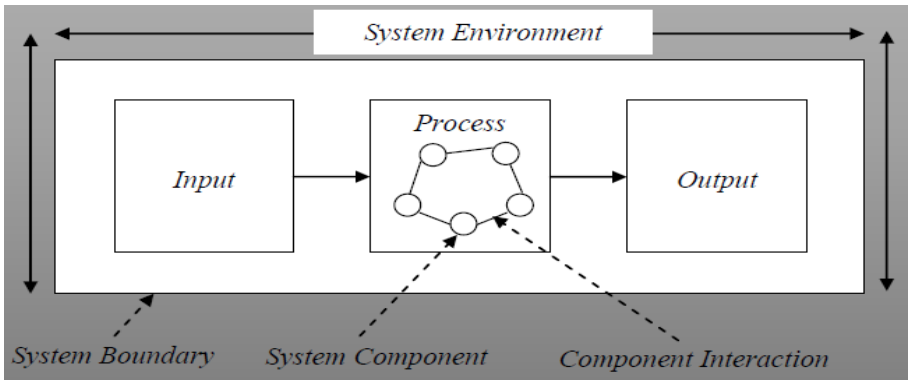

Figure 2.1: The basic concept of manufacturing

From the Figure 2.1 above, the system environment is the randomness that occurs outside the system but can give a great impact to the system. For examples, the unstable currency which will affect system where the demand will be getting lower and simultaneously the company need to reduce the cost by expelling some unnecessary workers.

Manufacturing takes place under all types of economic systems. Manufacturing is usually defined as a mass production of products to the customer for the need of profit. While in the collectivist economy, manufacturing is more frequently directed by the state to supply a centrally planned economy. In some free market economies, manufacturing is subjected to gobvernment regulations. Modern manufacturing includes process for fabrications and improvements of particular products. Engineering and industrial design are the courses that related to the manufacturing sectors (Shikdar A.,2007).

A Manufacturing system is the transformations raw materials that undergoes several processes to produce a value added products. In introducing products, there are many factors that need to be considered. Many companies try to save their budgets by reducing their raw material consumption. This is however should consider the functional of the product. For examples, if cheaper materials are used, the functional and properties of the product should be same as the previous product especially when involves the safety of the customers. Every subsystem in a company need to work together to manage and controls the flow of the systems so that the products produce will improved and simultaneously meet the customer demand.

2.2 Ergonomics

Ergonomics plays an important role in worker's productivity. The worker's efficiency can be affected by the arrangements and work design of a layout. Nowadays, many manufacturers are considering to invest in implementing the ergonomics principles to their workplaces rather than improving or investigating on man, machine, material, method (4m), by applying ergonomics principles, the manufacturers are able to fulfill the market demand in short period of time (V. Shinde G.,2012).

Ergonomics has a vast field of activities in varying disciplines from medical & health to design & productivity. Human muscle and physical activities, Fatigue and somatic performance, Workstation design, Hand tool design, Product design, Occupational health, Psychology and cognitive ergonomics, Anthropometry and Kinesiology, Human computer interaction (HCI), Interface design, Manual material handling, Work/Rest schedules, Aesthetics, and Environmental ergonomics are included in the ergonomics scope (Naeinia H.S.,2013). Ergonomics focusses on the interaction between the worker and their work. Ergonomics priciples always concerned about the worker or peoples where their limitation are taken as the number one consideration and making sure that their work is suitable for the workers. The considerations include the equipment, information, environment and tasks.

To investigate between the worker and their tasks, a wide range of factors need to be considered which is the workload, workspace, activities, work pacing, fatigue, and shiftwork. Second factors are the subjected to the equipment used where the design is in terms of size, shape, controls, displays, and how appropriate it is for the task. Thirdly, is the information used on how it is presented and changed appropriately so that the workers have a clear understanding about the do ad donts during completing their tasks. The environment of the workplace can also influence the worer. For examples, the environmental hazard is including the lighting, noise, vibration, and temperature.

Next, The individual's physical and psychological characteristics are also taken into account in the ergonomics principles. The body posture, size, shape, strength, touch, knowledge and especially vision are the examples of psychogical and physical characteristics that important when handling with ergonomic principles. For social environment or in organization, teamwork, leadership, supervision, communications are really important to build a stable and productive team members. When all this specification are applied, the worer's productivity and efficiency can be increased. The safety and heath of the workers can also be maintained and simultaneously reduces the medical cost of company (Naeinia H.S.,2013).

In this context, the mechanic's comforts in completing the tasks are taken to account as these factors will help in reducing the cycle time of the mechanics and thus increasing the productivity rate or the system. Since the workplace for the bicycles workshops are quiet small, a proper arrangement should be applied to reduce injury and fatigue to the mechanics.

2.2.1 Study on ergonomics application

The ergonomics application have become an important factors in designing the workplace as it can increase the worker productivity and increase safety and health of the human factors.

Ergonomics can also reduce the potential for ill health at work, such as aches, pains and damage to the wrists, shoulders and back, noise-induced hearing loss and work-related asthma. Consider the layout of controls and equipment as they should be positioned in relation to how they are used. Place those used most often where they are easy to reach without the need to stop, stretch or hunch. Making sure protective measures such as extraction hoods or respirators are easy and comfortable to use means they are more likely to be effective at reducing exposure to hazardous substances (Mital A.,1997).

Ergonomics is typically known for solving physical problems. For example, ensuring that emergency stop buttons are positioned so that people can reach them readily when they need to. But ergonomics also deals with psychological and social aspects of the person and their work. For example, a workload that is too high or too low, unclear tasks, time pressures, inadequate training, and poor support from managers can all have negative effects on people and the work they do.

The following examples highlight some ‘typical’ ergonomic problems found in the workplace. The design of tasks which is the work demands are too high or too low, the employee has little say in how they organise their work, badly designed machinery guards (awkward to use or requiring additional effort) slow down the work, conflicting demands, eg high productivity and quality, these problems can lead to employees failing to follow procedures or removing guards, causing accidents, injury and ill health.

Physical injuries such as injury to the arm,hands, fingures and low bak pain may be caused by poor standard work procedure in manual handling where the task involved in lifting heavy objects, awkward body posture where the workers need ecessive banding, repetition of tasks which can cause fatigue to the workers, the loads can be held properly which can cause injury to the workers and uneven or slippery floor surfaces that can cause trips, falls, and slips of the workers during completing their tasks.

Workstation layout should consider the items that are used frequently are out of convenient reach, inadequate space under work surface for legs, work surface height inappropriate for the tasks causing awkward and uncomfortable postures, inadequate and prolonged lighting can cause eyes soreness, the chair are not adjustable where different height of workers may be affected by these factors. Lastly by managing the working day, where the schedule have not enough recovery time, appropriate shifts, enough rest time can help in improving the worker's productivity in completing the tasks. These problems may lead to exhaustion, fatigue, and tiredness of te workers which will then increase the percentage of accidents and ill health in the workplace (Mital A.,1997).

Individuals may not be able to work as hard as they would like. Some work-place arrangements may make self-control problems more severe, while others may ameliorate them (Mital A.,1997). The evidence is described from a field experiment broadly supportive of the self-control perspective. An argue rises that many work arrangements can be understood differently through this perspective. Specifically, a self-control consideration is used to interpret the productivity increases and changes in work organization that accompany the shift from agrarian to industrialized production.