KOLEJ UNIVERSITI TEKNIKAL KEBANGSAAN MALAYSIA

ERGONOMIC ASPECTS OF DESIGN FUNCTIONAL CART

Thesis submitted in accordance with the requirements of the
Kolej Universiti Teknikal Kebangsaan Malaysia for the Degree of
Bachelor of Manufacturing Engineering (Manufacturing Process) (Honours)

By

Azrul Bin Aziz

Faculty of Manufacturing Engineering

May 2006

KOLEJ UNIVERSITI TEKNIKAL KEBANGSAAN MALAYSIA

BORANG PENGESAHAN STATUS TESIS*

JUDUL: ERGONOMIC ASPECTS OF DESIGN FUNCTIONAL CART

SESI PENGAJIAN : 2005-2006

Saya AZRUL BIN AZIZ

mengaku membenarkan tesis (PSM/Sarjana/Doktor Falsafah) ini disimpan di Perpustakaan Kolej Universiti Teknikal Kebangsaan Malaysia (KUTKM) dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hak milik Kolej Universiti Teknikal Kebangsaan Malaysia.
2. Perpustakaan Kolej Universiti Teknikal Kebangsaan Malaysia dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (√)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	TIDAK TERHAD	

(TANDATANGAN PENULIS)

Alamat Tetap:
NO 71C,KAMPUNG SRIGALA,SG. SELISEK
44020 KUALA KUBU BHARU,
SELANGOR DARUL EHSAN.

Tarikh: 28 MAY 2006

Disahkan oleh:

(TANDATANGAN PENYELIA)

Cop Rasmi: HAFIDZ FAZLI BIN MD. FAUADI
Pensyarah
Fakulti Kejuruteraan Pembuatan
Kolej Universiti Teknikal Kebangsaan Malaysia
Karung Berkunci 1200, Ayer Keroh,
75450 Melaka.

Tarikh: 29 MAY 2006

* Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana secara penyelidikan, atau disertasi bagi pengajian secara kerja kursus dan penyelidikan, atau Laporan Projek Sarjana Muda (PSM).
** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declare this thesis entitled "Ergonomic Aspects of Design Functional Cart" is the results of my own research except as cited in the reference.

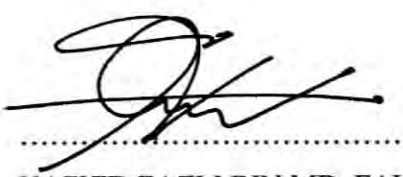
Signature : 

Author's Name : AZRUL BIN AZIZ

Date : 29 May 2006

APPROVAL

This thesis submitted to the senate of KUTKM and has been accepted as fulfillment of the requirement for the degree of Bachelor of Manufacturing Engineering (Manufacturing Process) (Honours). The members of the supervisory committee are as follows:



Signature : .....

Supervisor's Name : HAFIZD FAZLI BIN MD. FAUADI

Date : 29/5/06

DEDICATION

"Especially to my beloved family, lecturers and all my precious friends who give a big support to complete the PSM project"

ACKNOWLEDGEMENT

Uttermost gratitude goes to Almighty Allah for the abundant blessing and His willing for me to accomplished the research in this Projek Sarjana Muda. The research goes smoothly as they will.

Besides that, I would like to express my sincere to my supervisor, Mr. Muhammad Hafidz Fazli Bin Md. Fauadi and my former supervisor, Mr. Mohamad Bin Minhat for all his invaluable advise and support given to me since the beginning of the research until the completion of my Projek Sarjana Muda . I was grateful to have a support from him.

Not to forget, I would also thanks to my parents that give the opportunity to learn in this university and all my family members for giving me full of support for me. Also to staff at Faculty of Manufacturing Engineering, KUTKM that give a full suopport for completing this project. Finally, my appreciation to all other members that supporting me for this research especially Ms. Fatimah Binti Mat Ali and also my housemate for their kind help in completing this Project Sarjana Muda.

ABSTRAK

Projek penyelidikan ini berkisar berkenaan kajian aspek ergonomik di dalam reka bentuk sesuatu *'cart'*. Tujuan projek ini dijalankan ialah untuk melihat aspek-aspek ergonomik yang terdapat pada sesuatu *'cart'*. Beberapa *'cart'* yang ada dipasaran telah dianalisis dan troli pembersihan telah dipilih sebagai *'cart'* yang akan dikaji. Pemerhatian dan analisis akan dilakukan terhadap *'cart'* dan operator yang mengendalikannya. Semasa pemerhatian, beberapa perkara diambil kira seperti prestasi '*cart*', aksesori, saiz, dan penyelenggaraan. Aspek-aspek demikan merupakan sebahagian elemen ergonomik yang perlu diberi perhatian untuk reka bentuk sesuatu '*car*t'. Data anthropometri juga digunakan sebagai asas pertimbangan reka betuk sesuatu '*cart*'. Di akhir projek ini nanti, satu reka bentuk troli pembersihan('*cart*') yang menepati elemen-elemen ergonomik akan dihasilkan. Lukisan kejuruteraan dan kemungkinan prototaip produk akan dihasilkan. Kemudiannya, satu ujian dan analisa berkenaan maklum balas terhadap pengguna akan dilakukan. Kekangan yang mungkin timbul ialah ketiadaan data anthropometri yang lengkap untuk populasi di Malaysia. Untuk itu, projek ini boleh dipanjangkan lagi dengan mengambil kira keseluruhan data anthropometri sebagai asas pertimbangan untuk reka bentuk sesuatu produk.

ABSTRACT

This project is about studying on ergonomic aspects and a design of functional cart. The purpose of this project is to investigate ergonomic aspects. Several cart which available at the market now has been analyzed and cleaner's trolley has been selected. The observation and analysis of the cart and operator will be conducted. During the observation and analysis the cart, several factors must be considered such as performance, accessories, size and maintenance. Several anthropometry data must also used as a design consideration for cart. In the end of this project, cart that has an ergonomics element must be produced. Besides, some technical drawing and maybe prototype of the cart also must be produces. In order to know the effectiveness of this ergonomic aspect, some observation and response from the operator will be conducted. Some constraint that has to face is there is no complete anthropometry data for population in Malaysia. For that, this project can be further studied by taking anthropometry data as a prime design consideration.

TABLE OF CONTENT

LIST OF FIGURE

LIST OF TABLE

LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

KUTKM	Kolej Universiti Teknikal Kebangsaan Malaysia.
X	Percentile value
M	Mean
F	Multiplication factor
s	Standard deviation
F	Force
m	Mass
a	Acceleration
T	Find the target
N	Total number of items in the search field
I	Constant time
BDM	*Berat Dengan Muatan*
BTM	*Berat Tanpa Muatan*

CHAPTER 1
INTRODUCTION

We all "handle" loads daily. We lift, hold, carry, push, pull and lower objects while moving, packing or storing them. The material may be soft or solid, bulky or small, or smooth or with corners and edges; it may come as bags, boxes, or containers, with or without handles. We may handle objects occasionally or repeatedly, during leisure activities or as part of our job. On the job, the ***ergonomic design*** of material, containers and workstations can help to avoid overexertion and injuries.

As a result, ***cart*** is design in order to solve and eliminate the problems that occurs. Currently, existing cart in market is normally created by consider the ergonomic aspects. Actually, some of us are don't know the ergonomic aspect that involved. For that, this project is try to come out with that ergonomic aspect for existing cart at market and to improve the existing design in order to fulfill the market demand at ***Malaysia.***

1.1 Problem statement

Nowadays, every company and organization placed the cleanliness at workplace as a major consideration. They believe by make a workplace clean, productivity will increase because of good environment can influence the working culture. For make a cleaning process, many equipment involve. For

examples brooms, mops, pail, brush, perfume, detergent, softener, waste bag and others.

Because of too many equipment involve, it needed a material handling to carry it. For that, ***janitorial cart*** is used to fulfill the demand. This janitorial cart must be able to fulfill the ergonomic aspects including the anthropometry issues, biomechanics issues and safety issues.

1.2 Objective

Generally, this project is all about to study the ergonomic aspects in order to design the janitorial cart. Study from real posture while operate the janitorial cart will used for design consideration. Design of cart that will made can influence the productivity and the efficiency of application on industry.

Janitorial cart that will design must easy to handle, high stability, ideal force required to push and pull, right posture use for handle it, location of handle, container, color of body and so many ergonomic aspects must be considered.

Main objective that must be fullfill for this project is:-

a) To conduct the full study by used a data collection, informations processing and develop the proposal.
b) To analyze ergonomic aspects at existing janitorial cart and propose the improvement process.
c) To come out with design of janitorial cart that have highly ergonomic aspects.

1.3 Scope of study

To ensure the objective is achieve, some of the imprtant elements must be considered. There is:-

a) Survey and market analysis

Survey and product investigation must be conduct where the scope of problems can fully explored. Data collection from existing janitorial cart to analysis the advantage and disadvantage of it. Also survey and analysis about posture while operate the existing janitorial cart will conduct.

b) Develop the possible solutions.

Proposal of design product that covered the whole element will proposed. Sketches and technical drawing also included.

c) Evaluation

The aim of the proposed design is to compare the possible solutions with reality. It's to ensure the proposed design and ergonomic aspect is fullfill the criteria.

d) Preparation of proposal

By consider the whole aspects above, preparation of strong and reability proposal will conduct by showing the good reasons and relevent of the design.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

In order to manage the daily work, various devices and instruments that we used to carry out a work. It's readily being seen that even in a simple work system consisting of human (H), Machine (M) and environment (E). For that, six directional interactions are possible:-
H to M, H to E, M to H, M to E, E to H and E to M. (Adi Saptari, 2005)

For example, a knife as a machine to enhance the efficiency of changing the size and shape of objects: -

a) H > M (the usability of the knife)
b) H > E (the fertile soil is eroded)
c) M > H (the fit between the hand and the knife)
d) M > E (the knife makes it possible for the human to fell trees)
e) E > H (the eroded environment may no longer sustain human life)
f) E > M (the knife become blunt through continued use)

(Adi Saptari, 2005)

In 2 ways relationship inter Human and machine, its need for design that can satisfy and needed of the human and machine. For that, human need for a devices or instruments that have a:-

a) Comfortable
b) User friendly
c) Safety
d) Ease of duty

2.2 Keyword

Ergonomic, design, janitorial cart, anthropometry data, Malaysia

2.3 Discussion

2.3.1 What is ergonomic?

Ergonomic is defined by Chandler Allen Phillips, 2000 as **"Ergonomic is the engineering concerned with the analysis, design, and development of human technological systems in which primary emphasis is on the human"**. Ergonomic also defined **as "Ergonomics (or human factors) is the scientific discipline concerned with the understanding of the interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well being and overall system performance"**. (Alan Hedge, 2005)

By referring the definition above, it show that by considering the ergonomic aspects, it can influence and match the design of equipment, occupational and work place with ability, lack and human needed. Alan Hedge, 2005 said that to be "Ergonomic" a design must:

a) Fit the user
b) Be easy to use
c) Improve comfort
d) Improve performance (speed, accuracy, reliability)
e) Improve health and safety

2.3.2 Anthropometry

Anthropometry is the study and measurement of human body dimensions. Anthropometric data are used to develop design guidelines for heights, clearances, grips and reaches of workplace and equipments for the purpose of accommodating the body dimensions of the potential workforce. Examples include the dimensions of workstations for standing or seated work, production machinery, supermarket checkout counter and corridors. The workforce includes men and women who are tall or short, large or small, strong or weak, as well as those who are physically handicapped or have health conditions that limit their physical capacity.

Anthropometric data are also applied in the design of consumer products such as clothes, automobiles, bicycles, furniture and so on. Because products are designed for various types of consumers, an important design requirement is to select and use the most appropriate anthropometric database in design. Grieve and Pheasant (1982) note that "as a rule of thumb, if we take a smallest female and tallest male in a population, the male will be 30-40 percent taller, 100 percent heavier, and 500 percent stronger." Clearly, products designed on the basis of male anthropometric data would not be appropriate for many female consumers.

In ergonomics, another use of anthropometric information is found in occupational biomechanics. Anthropometrics data are used in biomechanical models in conjunction with information about external loads to assess the stress imposed on worker's joints and muscles during the performance of work. Considering human variability in design is very important. Human variability is:-

a) Age variability - Everyone knows that the stature of a person changes quickly from childhood to adolescence. In fact, a number of studies have compared the stature of people at each year of age. The data indicate stature increases to about age 20 to 25 (Roche and Davila, 1972) and starts to decrease after about age 35 to 40, and women show more shrinkage than men (Trotter and Gleser, 1951; VanCott and Kinkade, 1972). Unlike stature, some other body dimensions such as weight and chest circumference may increase through age 60 before declining.

b) Sex variability – Adult men are, on average, taller and larger than adult women. However, 12 year old girl are, on average, taller and heavier than their male counterparts because girls see their maximum growth rate from ages 10 to 12, whereas boys see theirs around ages 13 to 15. Girls continue to show noticeable growth each year until about age 20. (Stout et. al., 1960). On average, adult female dimensions are about 92 percent of the corresponding adult male values (Annis, 1978). However, significant differences exist in the magnitude if the differences between males and females on the various dimensions. Although adult men generally larger than adult women on most dimensions, some dimensions, such as hip and thigh measurements, do not show major differences between men

and women, and women exceed men on a number of dimensions, such as skin fold thickness.

c) Racial and ethnic group variability – Body size and proportions vary greatly between different racial and ethnic groups. Comparisons of the U.S. Air Force data with the Japanese Air Force data (Yokohari, 1972) found that the Japanese were shorter in stature, but their average sitting height did not differ much from the American data. On the basis of these differences, (Ashby, 1979) states that if a piece of equipments was designed to fit 90 percent of the male U.S population, it would fit roughly 90 percent of Germans, 80 percent of Frenchmen, 65 percent of Italians, 45 percent of Japanese, 25 percent of Thai and 10 percent of Vietnamese.

d) Occupational variability – Differences in body size and dimensions can be easily observed between people working in different occupational groups. Professional basketball players are much taller than most American males. Occupational variability can result from a number of factors, including the type and amount of physical activity involved in the job, the special physical requirements of certain occupations, and self evaluation and self selection of individuals in making career choices.

e) Generational or secular variability – (Annis, 1978) graphed the trend of change in stature of the American population since 1840 and noted that there has been a growth in stature of about 1 cm per decade since the early 1920s. Improved nutrition and living conditions are offered as some of the possible reasons for this growth.

f) Transient diurnal variability – (Kroemer, 1987) notes that a person's body weight varies by up to 1 kg per day because