UNIVERSITY TECHNICAL MALAYSIA MELAKA

The Manufacturing Process of Robo – Kidz - Toe

Thesis submitted in accordance with the requirements of the University Technical Malaysia Melaka for the Bachelor Degree of Manufacturing Engineering in Manufacturing Process

By

Eng Sze Yee

Faculty *of* Manufacturing Engineering

May 2007

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS TESIS*

JUDUL: THE MANUFACTURING PROCESS OF ROBO-KIDZ-TOE

SESI PENGAJIAN: 2006/ 2007

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Signature: .....

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Date: 10TH MAY 2007

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Karung Berkunci 1200, Ayer Keroh, 75450 Melaka

FAKULTI KEJURUTERAAN PEMBUATAN

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Sukacita dimaklumkan bahawa tesis yang tersebut di atas bertajuk ***"The Manufacturing Process Of Robo-Kidz-Toe"*** mohon dikelaskan sebagai terhad untuk tempoh lima (5) tahun dari tarikh surat ini memandangkan ia mempunyai nilai dan potensi untuk dikomersialkan di masa hadapan.

Sekian dimaklumkan. Terima kasih.

"BERKHIDMAT UNTUK NEGARA KERANA ALLAH"

Yang benar,

Ahmad Yusairi Bin Bani Hashim
Pensyarah,
Fakulti Kejuruteraan Pembuatan
(Penyelia Utama)
☎06-2333431

s.k. - **Penyelia Kedua**:
Khairol Anuar Bin Rakiman

DECLARATION

I hereby, declared this thesis entitled “The Manufacturing Process of Robo – Kidz - Toe” is the results of my own research
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DEDICATION

For My parent and supervisor.

ACKNOWLEDGEMENTS

I would like to thank for my supervisor, Mr. Ahmad Yusairi Bin Bani Hashim. He taught me how to do the PSM 1 and PSM 2. As the student of Process & System, the supervisor is based to the Automation and Robotic. The problem would have existed because both courses are totally different. Luckily, problems are solved with recommendations and solutions from supervisor.

At the same time, I would like to convey my appreciation to Puan Rohana Abdullah due to her guidance in using the Witness Manufacturing software as well as the interpretation of Witness in detailed.

I would like to appreciate Puan Sharimllah Devi a/p Ramachandran due to her guidance. She is willing to check my thesis and taught how to present. Besides that, I also want to thank Mr. Khairol Anuar Bin Rakiman who is the reader for my thesis and willing to give his recommendation.

Besides that, I would also want to thank Puan Zuraidah from the campus Industrial Engineering, UTeM (Fasa B). She is willing to share her time with me in order to teach me about the Witness Manufacturing. I am a fresh user of the Witness Manufacturing and I have to learn much by myself. Fortunately, Puan Zuraidah shared with me her understanding about the Witness as well as borrowed the User's Guidelines to me as a reference before started using the program.

Then, I would like to thank my friend, Ng Chun Hong. He taught me a lot about the skills of soldering and knowledge of electronic components. Samuel Lim Li Kiang, the person who helped me finished the time study of assembling the Robo-Kidz-Toe.

Lastly, I would like to thank my friends who were willing to spend their time to help me when I am in trouble and in need of their help.

Thank you to all of you.

ABSTRACT

"The Manufacturing Process of Robo-Kidz-Toe" is related to a process and system. The objective is to develop an assemble layout in the production line when the Robo-Kidz-Toe is manufactured in mass production. Through the design of assemble layout of Robo-Kidz-Toe, more information about the performance of each process and buffer would be understood clearly by using the Witness Manufacturing software. There have several types of manufacturing software which are used to simulate the new assemble layout before entering the production line, for example the Witness Manufacturing software and EM-Plant software. The utilization of Witness Manufacturing software is widely and broadly used due to its specified performance. Many companies or industries have applied this software such as Motorola. The percentage of idle, working time, setup time, and machine break down can be obtained through the Witness Manufacturing software. Besides that, the process or machine as well as the buffer can also be set to the desired situation which follows the type of products to be manufactured, for example, the maximum capacity of buffer can store the parts as temporary condition and the type of process or machine performs assembly, production or single. The results of the assemble layout are expressed in the terms of pie chart or bar chart as well as summary and statistics of machine or labor in the assemble layout. Witness Manufacturing is a powerful and efficient tool to understand the performance of Robo-Kidz-Toe well in order to eliminate or minimize the problems to the acceptable level and reduce the manufacturing cost.

ABSTRAK

"The Manufacturing Process of Robo-Kidz-Toe" adalah berkaitan dengan proses dan sistem. Objektif utama untuk tesis ialah menciptakan proses pemasangan yang baru untuk Robo-Kidz-Toe. Daripada proses pemasangan ini, kita ketahui kesesuaian proses untuk Robo-Kidz-Toe dihasilkan dalam kilang. Terdapat banyak program komputer (*software*) yang boleh dirujuk untuk mengujikaji kefasihan satu proses pemasangan atau proses pembuatan sebelum mula dioperasikan dalam bahagian penghasilan di kilang. Program ini termasuklah *Witness Manufacturing* dan *EM-Plant. Witness Manufacturing* akan digunakan untuk mengkaji kefasihan dan kesesuaian proses pemasangan Robo-Kidz-Toe yang dicipta. *Witness Manufacturing* adalah satu program komputer yang banyak digunakan dalam kilang unutk mengujikaji atau memeriksa proses pembuatan bagi satu produk baru. Maklumat seperti peratusan untuk kesibukan proses (*busy*), kekosongan proses (*idle*), mesin rosak dan sebagainya dapat diketahui. Selain daripada itu, proses atau kotak (*buffer*) juga boleh diubahsuaikan kepada keadaan yang sesuai dan mengikut kehendak pengguna seperti masimal kemuatan untuk kotak (*buffer*) dan juga jenis proses yang dirujukkan seperti proses pemasangan, penghasilan atau tertunggal. Selepas itu, data atau maklumat ini akan ditunjukkan dalam cara graf bar atau pai untuk senang dirujukkan. *Witness Manufacturing* adalah alat ujikaji yang unggul bagi satu produk yang baru ataupun yang sedia ada (untuk diubahsuaikan). Tujuan program ini adalah untuk merendahkan atau meminimalkan masalah yang akan wujud kepada tahap yang boleh diterima.

TABLE OF CONTENTS

F Process 2 (stp_gs_sdg02)

G Buffer 2 (bff02)

H Process 3 (fee_sdg01)

I Process 3 (fee_sdg02)

J Buffer 3 (bff03)

K Process 4 (wh_wh)

L Photo of Time Study

M Components of Robo-Kidz-Toe

N Time study Form

O Technical Drawing (CATIA) of Robo-Kidz-Toe

LIST OF TABLE

LIST OF FIGURE

LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

TPS	–	Toyota Production System
QFD	-	Quality Function Deployment
PCB	-	Printed Circuit Board
FMS	-	Flexible Manufacturing System
QC	-	Quality Control
BOM	-	Bill of Material
CMS	-	Cellular Manufacturing System
WIP	-	Work In Progress
FCFS	-	First Come First Serve

LIST OF APPENDIX

CHAPTER 1

INTRODUCTION

The manufacturing of Robo-Kidz-Toe is considered as the intermediate acceptable process. The robot is produced in small batches due to expensive cost but performed in high quality curiosity if the robot is produced at the factory.

The company that is involved in producing the Robo – Kidz – Toe is called Solarvore Robotic Ltd Company. Its headquarters is located at the United State and the branch is at Malaysia, located at Malacca – Cheng Town. The company is a multinational company and has many branches nationwide. The company has produced many outstanding robots.

The company always looks forward to the Japanese's company system and implements the suitable system to the Toyota Production System (TPS) and Quality Function Deployment (QFD). The quality policy of the Solarvore Robotic Ltd Company is continuously improved to meet customers' requirements for high quality product and services at the optimum cost.

The constructing of Robo-Kidz-Toe is expected to be quite easy if the robot is built-up for self interest. The estimate time to build it is within 2 to 3 hours. The processes involved are the:

a. PCB assembly
b. Modifying the clocks
c. Mechanical assembly and adjustment

However, the process of producing Robo-Kidz-Toe is different at the factory; it would involve the following processes:

a. Molding the cases
b. PCB assembly

c. Mechanical assembly
d. Quality control
e. Packaging

For mass production, clocks would not be modified, instead the stepping motor and gears as used in certain clocks from the manufacturer have to be ordered. Besides that, a plastic case is designed to hold the PCB, the clock bits and the solar panel. The cases and PCB would be mass-produced by companies specialized in such work.

After that, the Solarvore Robotic can assemble these major components into the semi-finished robot and packaging. Before that, the inspection of robot is important to ensure that the robot performs in good performance well so that the desired characteristics could be achieved as excellently as possible.

Once the master mold is done well, the expected time of making the case only consumes a few seconds. Automated production of PCB takes a similar amount of time. Assembly, quality control and packaging will take longer; the estimate time for these processes is within 10 minutes and half an hour.

1.1 Objective of the Project

This project is confined to the primary aspect, which is:

1. To design the assemble process of the Robo – Kidz – Toe.
2. Ro develop the assemble process of the Robo-Kidz-Toe.

1.2 Problem Statements

When a new robot is designed and manufactured at the production line, it would involve many stages and the estimation of cost is higher than other products. Before the mass production, many planning and investigations are prepared to ensure the investment is valuable and available, without these aspects, the factory will encounter many unexpected problems or loss of money.

As mentioned before, the production of Robo-Kidz-Toe involves in five stages if implemented in the Solarvore Robotic. The first stage is designing the plastic mold – to make the master mold. It would involve large investment because plastic molding is a difficult process. The cases and PCB would be mass-produced by companies specialized in such work.

Then the mechanical assembly, quality control and packaging are done by the factory. If the factory designed and produced the plastic molding, they have invested in large expenditure as well as the problem of quality control. When the task is sub-contracted to the specialized company, the factory can order the case which depends upon the necessity.

Architecture of assembly systems refers to the spatial arrangement of the workstations. Many varieties exist. Each of them has different advantages and disadvantages. There include:

- Single serial line
- Team assembly
- Fishbone serial line with sub-assembly feeder lines
- Loop Architecture
- U-Shaped Cell
- Cellular Assembly Line

A U-shaped architecture is a variation on a line and can be used if the line is short. All the operators are near each other and can communicate. Especially important is the fact that the end and beginning are near each other so that problems discovered at the end but originating earlier can be discussed and fixed quickly. Normally the factory will apply

the U-shape manufacturing system to produce the robot[1]. While the production of the Robo-Kidz-Toe is referred to the using of Single Serial Line. The Single Serial Line is more efficient than U-shaped layout.

The advantages of Single Serial Line include:

- Save cycle time
- Save manufacturing cost
- Reduce idle time
- Ease to control
- Ease to detect problems and solve problems

The limitations of U-shaped layout:

- Higher manufacturing cost
- Difficult to detect problems
- Only detect problems at the final work station
- Higher idle time
- Higher work-in-progress (WIP)

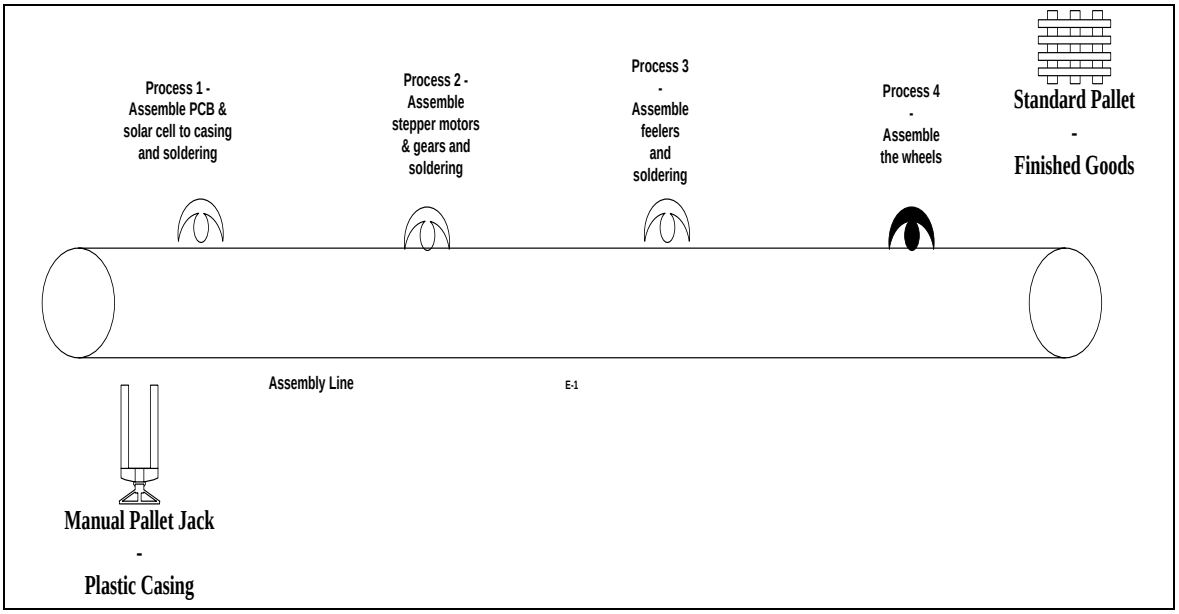

Figure 1.1: Single Serial Line of Robo – Kidz – Toe

Legend:

Process 1 - Assembling the PCB & solar cell to the plastic casing and soldering

Process 2 - Assembling the stepper motor & gear to the plastic casing and soldering

Process 3 – Assembling the feelers to the plastic casing and soldering

Process 4 – Assembling the roller wheels to the plastic casing

Process 5 – Quality Control

Process 6 – Packaging

 - Operator

Three basic types of assembly resources can be distinguished: people, fixed automation and flexible automation. The production of Robo – Kidz – Toe is referred to the manual assembly due to its advantages than using others automation.

Manual assembly is the most flexible, adaptable, innovative and dexterous and responsive to the challenging tasks. The use of these characteristics depends on the product's design, physical layout, variability of incoming parts and other reasons.

The assembling of Printed Circuit Board (PCB) and solar cell have to "assembled" manually because those sub-assemblies are more sensitive and easily broken.

People can also do several operations at once, something that machines usually cannot. For example, a person can move a part while simultaneously reorienting and inspecting it. This saves time and makes the required cycle time shorter. Thus, the mistakes or defections at the semi-finished part or sub-assemblies could be found easily than using automation except when the vision machine is used but the manufacturing cost will increase sharply. Totally all processes involve the manual assembly due to its special characteristics than fixed or flexible automation.

Furthermore, the production of PCB also can be done by the electronics company because the company's facilitator and machines are better than other companies. Moreover, the operation is fully automated but not manual. The lead time producing the PCB is expected to reduce slightly but is performed in the same quality product.

The assembly of robot manually could be done instead by automation too if the mass production is needed as well as the investment is sufficient and free of capital flow. The risk is higher and would be encounter many unexpected problems.

Due to the production of robot is involved in large investment; the batch process and mass production are not suitable especially for the Robo-Kidz-Toe.

There are many kinds of robot in the market whether cheap or expensive. The important fact is that it can attract it child or teenager to persuade their parent purchase it. The interest of child or teenager to the new things does not last forever, if diminished. The production of robot cannot exceed the requisite, but should be always investigate the requirement of customers in order to improve the previous ones. The two unknown systems should refer to: Quality Function Deployment (QFD) and Toyota Production System (TPS).

QFD is aimed to translate the requirements from customers to the real products, the product is improved continuously. After doing some research as well as search the information from Internet and Journal, the information indicated mostly robot is operated by the battery. Then, the robot would be halted to any motion if battery has depleted. The replacement of solar to the battery can solve this problem. Nowadays, the rechargeable battery is also used to replace the common battery, such as AA or AAA.

TPS means producing the robot depends upon the order from the suppliers and is not over produced to avoid any problem such as competition to other robots.

As the preliminary of constructing the Robo-Kidz-Toe, there three aspects which should be referred to succeed in the project. When the latest robot enters the market, the respond from public is an encouragement to the manufacturer to whether continue to produce or vice-versa.

1.2.1 Properties of Robo – Kidz – Toe

a. Electronics:-

It goes without saying, but this is what will be used to drive the creations. EAM Robo – Kidz - Toe, though, strives for rich behaviors from simple circuits. Here is the key: simple and understandable circuits, surprisingly complex in behavior.

b. Aesthetic:-

Good-looking design is stressed. Besides, if a design looks "clean," it's more likely to work (and easier to test / debug) than a design that is tangled and unruly.

c. Mechanics:-

Robo–Kidz–Toe is a solar-powered robot and its run without programming. This is the less-than-obvious secret of Robo – Kidz - Toe - with a clever mechanical design; it reduces the complexity of rest robots (reducing the number of motors and sensors, for example).