



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ERGONOMICS DESIGN OF A BABY HIGHCHAIR

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Design) with Honours.

by

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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APPROVAL

This report is submitted to the faculty of UTeM as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design). The members of the supervisory committee are as follow:

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ABSTRACT

Quality Function Deployment, QFD is systematic and efficient method for structured product planning and development which it enables the QFD development team to make clearly the customer's need. This method is used to evaluate each product or service especially in engineering field, manufacturing industry, marketing, sales, distribution and others related manufacturing and production. Besides, this case study was using the quality dimension as an evaluation or assessment to get the comparison with the current product to get more and more ideas and improvement. In this research, baby highchair is chosen as a case study to find out the solution for any problems especially in term of ergonomics design. This PSM report was explained the current issues regarding baby high chair where nowadays people are looking for good, safe and multifunction product. One of the methods that used in this project is questionnaire survey form before analyzed by quality dimension technique and Quality Function Deployment (QFD). Here all the design aspects were presented and explanations about new design were also discussed. Finally, as a conclusion from this case study, our objectives to create the ergonomic design of a baby high chair were done successful with their recommendations for future design of this baby high chair.

ABSTRAK

Quality Function Deployment, QFD adalah satu kaedah yang sistematik dan efisien untuk menstruktur perancangan dan pembangunan produk yang mana ia membolehkan kumpulan pembangunan QFD untuk menjelaskan tentang kehendak pelanggan. Kaedah ini digunakan untuk menilai setiap produk atau perkhidmatan terutamanya dalam bidang kejuruteraan, industri pembuatan, pemasaran, jualan, pengagihan dan lain-lain produksi. Dalam kajian ini, kerusi bayi telah dipilih sebagai kajian untuk mencari penyelesaian bagi setiap permasalahan terutamanya dari segi rekabentuk yang ergonomik. Laporan Projek Sarjana Muda ini telah menerangkan isu – isu semasa yang berkaitan dengan kerusi bayi ini di mana sehingga ke hari ini, ramai pengguna hendak melihat dari segi produk yang terbaik, keselamatan kerusi dan pelbagai fungsi. Salah satu cara yang digunakan untuk mengendalikan kajian ini ialah menerusi borang soal selidik sebelum di analisis menggunakan dimensi kualiti dan *Quality Function Deployment* (QFD). Di sini, turut dibincangkan juga semua aspek rekabentuk dan penerangan mengenai kerusi bayi yang baru ini. Akhir sekali, sebagai kesimpulan daripada kajian ini, objektif kajian untuk menghasilkan kerusi bayi yang ergonomik telah siap dengan jayanya dengan beberapa cadangan untuk rekabentuk kerusi bayi pada masa akan datang.

DEDICATION

To my beloved Mum and Dad,
Siti Ruzainah Binti Peseri and Ismail Bin Haji Omar

For the rest of the families, my brothers and sisters,

Thanks for your encouragement, support and motivation.

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LIST OF ABBREVIATIONS

ABS	Acrylonitrile Butadiene Styrene
DFMA	Design of Manufacturing and Assembly
HDPE	High Density Polyethylene
HOQ	House of Quality
PSM	Projek Sarjana Muda
QFD	Quality Function Deployment
SPC	Statistical Process Control
VOC	Voice of Customer

CHAPTER 1

INTRODUCTION

1.1 Project Background

Baby high chair can easily found everywhere in supermarket with reasonable price. The baby high chair is the perfect symbol of family. Thanks to modern design nowadays for creating the useful baby high chairs which are safer than ever before to be used in restaurant and also at home.

Today, there are many baby high chairs in the market. But it still can be improved or redesign especially from ergonomic point of view. It is because some of the characteristics is not suitable like table movement, hard structure and not flexible. Therefore, this is a new proposal idea of a baby highchair where it was applied the ergonomics design concept which is cover the ergonomic aspects like safety, user friendly in term of functional and cost. This project will apply the Quality Function Deployment (QFD) analysis, HOQ which is to analyze the customer requirement and manufacture provided as well as to improve the product. Start from identify, research until finalization, the design will be evaluate in order to get the good result of design product.

Human factors or ergonomics is a science focused on the study of human fit and decreased fatigue and also discomfort through the product design (Scott Openshaw, Allsteel and Erin Taylor, Allsteel, 2006). Here, this project will consider the characteristic of child and of course it will be focusing on normal baby only. Subsequently, this project also consider the baby condition, baby movement, comfortability, safety and design evaluation in order to get the ergonomics design of a baby highchair.

1.2 Scopes of the Project:

It is a project limitation or project area where this project will be focusing on which is to ensure that the project is not run out and still in project scopes. Below are the scopes of the project:-

- a) Analyze and review the existing product in order to identify the advantages and disadvantages of the current design of a baby highchair.
- b) Propose the new design based on ergonomics concept.
- c) Implement the QFD tool technique; HOQ to improve the product design.
- d) Apply the Quality Dimensions as our design evaluation.
- e) The baby high chair study will be focusing in Malaysia only.

1.3 Objectives of the Project:

The objectives of this project are:

- a) To investigate and identify the advantages and disadvantages the current of a baby highchair.
- b) To compare the new design with current design of baby high chair.
- c) To apply engineering tools of QFD and Design Evaluation concept.
- d) To propose the new design concept of baby highchair that will consider the ergonomic characteristics.

1.4 Problem Statements

Lately, we always heard that many accidents happened to our baby or child like falling down from building, playing toys and so on. Nevertheless, an accident also was happen that incriminate baby high chair specifically and others furniture generally. Thus, this case study project will be focusing on baby furniture namely baby high chair. This is because some of the chair is not ergonomic, not user friendly and it possess complication to user and certain design is not safety. And nowadays, people are looking for good, safety baby chair and multifunction. One more thing is the high level of chair is not flexible. Then, the percentage of accident to happen is high. So with applying QFD concept as my analysis and other design evaluation will try to propose the flexible baby high chair that can adjust the high level. Beside that, the body structure and material used can influence the baby condition because mostly there are made from metal. For the example, the rust will come out from metal where it can effect to the baby healthy because baby is very sensitive.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A literature review is one of the research methods to review the previous history in order to get the idea, project concept development, project methods and so on. A literature review is one of the mechanisms for our references to grab and get more knowledge about some research or product or what else that has done by previous researcher. It viewed the scientific process and concept based on their experimental. Usually, it comes out like journal, books, article and so on. The component of literature review is the actual research where they use the fact and logical concept that nobody can argue their research.

This chapter will explain the QFD background, definition, approach, process, benefits and others information that related to QFD. This chapter also covers the design concept, ergonomic or human factor which is it become a topic for certain customer when choice the product. It provides a logical, practical and effective way in order to improve the quality of product and to achieve customer satisfaction as well as to fulfil the customer requirement.

2.2 Definition of QFD

There are many definitions about QFD based on my reading and research. Some others say is to improve product, to optimize the leading of organization, to fulfil customer requirement, customer satisfaction, and voice of customer (VOC) and so on. That is true. Refer to Six Sigma and Beyond Statistical Process Control (SPC) book, QFD is a conceptual map that provides the means for cross-functional planning

and communication. Beside that, it is a method for transforming customer wants and need, through the help of the Kano model, into quantitative engineering terms. (Besterfield, 2003,)

QFD is conducted because products and services should be designed to meet customer wants and need so that customer will buy and continue to buy products and services. Marketing people, design engineers, manufacturing engineers, and procurement specialists work closely together from the time that a product or service is first conceived to be able to meet customer requirements. QFD provides the framework for the cross-functional teams to work within. (D. H. Stamatis. 2003.)

L.-K. Chan, M.-L. Wu in 2002, defined QFD as “an overall concept that provides a means of translating customer requirements into the appropriate technical requirements for each stage of product development and production (i.e., marketing strategies, planning, product design and engineering, prototype evaluation, production process development, production, sales)” (Sullivan, 1986b).

But, in Chapter 21 Quality Function Deployment, of the second edition of Gower Handbook of Quality Management edited by D. Lock, Hill (1994) wrote similarly, “QFD evolved from a number of different initiatives between 1967 and 1972, but the two main drivers which led to its creation in Japan were those:

- a) To improve the quality of design.
- b) To provide manufacturing and field staff with the planned quality control chart (showing the points to be controlled within the production process) before the initial production run.”

There’s lots of definition about QFD and what I can conclude here is, QFD is a planning tool like combination or incorporates the voice of the customer (VOC) into features that satisfy the customer. It is portraying the relationships between product and process *what’s* and *how’s* in a matrix form that called the House of Quality (HOQ) – see Figure 2.1. The terms of HOQ will be discussed in detail at Chapter 3.

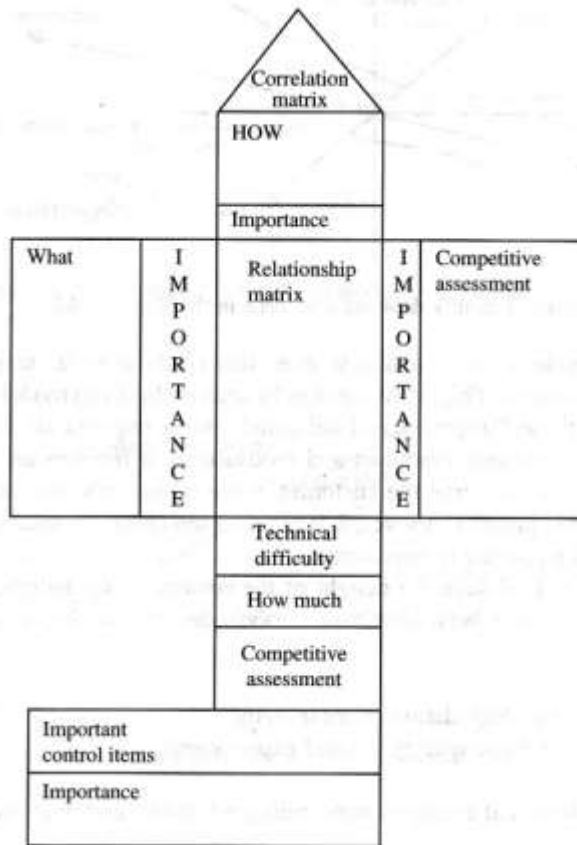


Figure 2.1: A typical House of Quality matrix.

2.3 History of QFD

For the initial stage, I would like to observe about this powerful system and according to writing by L.-K. Chan, M.-L. Wu / European Journal of Operational Research 143 (2002) 463–497, in the preface from J. Terninko’s book Step by Step QFD (Terninko, 1997), B. King wrote, “In the 1960s, Quality Control and Quality Improvement had a distinctively manufacturing flavour in Japan. In the late 1960s and early 1970s, Joji [Yoji] Akao and others went to work on improving the design process so that when the new product was introduced to manufacturing, it was high quality from the beginning. The process for improving design was called QFD. From 1975 to 1995, this tool / process were integrated with other improvement tools to generate a mosaic of opportunities for product developers.”

Dr. Mizuno, professor emeritus of the Tokyo Institute of Technology, credited with initiating the QFD system. The first application of QFD was at Mitsubishi, Heavy Industries, Ltd., in the Kobe Shipyard, Japan, in 1972. QFD was successfully

implemented in the production of mini-vans by Toyota. Using 1972 as a base, a 20% reduction start-up costs was reported in the launch of the new van in October 1979, a 38% reduction by November 1982, and a cumulative 61% reduction by April 1984. At United State, the QFD was introduced in 1984 by Dr. Clausing of Xerox (Akao, Yoji. 1990.)

Thus, QFD can apply to all service or manufacturing industry. It's become like a standard practice as well as a practical for most organization, which also require it of their supplier or customer.

Historically, Japanese industry began to formalize the QFD concepts when Mr. Oshiumi of the Kurume Mant plant of Bridgestone Tire produced a processing assurance chart containing some of QFD main characteristics in 1966 and K. Ishihara developed the ideas of “functional deployment of business” similar to those of QFD and applied them to Matsushita in the late 1960s (Cohen, 1995; Hill, 1994; Marsh et al., 1991).

However, it was Akao who first realized the value of this approach in 1969 and wanted to utilize its power during the product design stage. So, the product design characteristics could be converted into precise quality control points in the manufacturing quality control chart (Hill, 1994).

After several industrial trials, Akao wrote a paper on this new approach in 1972 and called it *hinshitsu tenkai* (quality deployment). This paper and Nishimura (1972) were the first two papers fostering the then new concept of QFD known to the West.

That's a lot of history and application by many industries that was successful. A Japanese book on QFD edited by Mizuno and Akao, *Deployment of the Quality Function*, was published in 1978, showing the fast development and wide applications of QFD in Japan. Two years later, Kayaba won the Deming Prize with special recognition for applying QFD to bottleneck engineering (Cohen, 1995; Marsh et al., 1991).

Today and forward, QFD system was broadly used at all production industries generally and manufacturing industries specifically. This system is like an inspirer to all organization leaders in order to optimize their company or industry. Other than that, it's also generating a new applications, practitioners and researchers each year. Most of big companies like from U.S, Germany, most of Asian industries, Sweden and others advance industries has been implement this quality system.

2.4 QFD Overview

QFD was introduced about thirty years ago in Japan as a quality system focused on delivering productions and services that satisfy customers. To efficiently deliver value to customers, it is necessary to listen to the “voice” of the customer throughout the product or service development process. The late Dr. Shigeru Mizuno, Dr. Yoji Akao, Dr. Tadashi Yoshizawa and other quality experts in Japan developed the tools and technique of QFD and organized them into a comprehensive system to assure quality and customer satisfaction in new products and services. (Mizuno, Shigeru and Yoji Akao. 1994)

QFD focuses on customer expectations or requirements, often referred to as the voice of customers. It is employed to translate customer expectations, in terms of specific requirements, into directions and actions, in term of engineering or technical characteristics, which can be deployed through (Akao, Yoji. 1990.):

- a) Product planning
- b) Part development
- c) Process planning
- d) Production planning
- e) Service industries

2.5 QFD Process Overview

The easiest way to think of QFD is to think of it as a process consisting of linked spreadsheets arranged along a horizontal (Customer) axis and intersecting vertical

(Technical) axis. Referred to Six Sigma and Beyond book, there are an important details include the following:

- a) From a micro perspective, the horizontal arrangement is referred to as the Customer Axis because it organizes the Customer Wants.
- b) Customers are the people external to the organization that purchase, operate, and service and your products. Customer can also be internal the end users of your work within the organization.
- c) The vertical arrangement is referred to as the Technical Axis Customer Wants into technical metrics.
- d) The intersection of the axes (referred to as the Relationship Matrix) identifies how well engineering metrics correlate to customer satisfaction.
- e) A closer look reveals that the interrelated matrices build upon one another beginning with a validated list of Customer Wants.

2.6 Application of Quality Function Deployment (QFD)

Today, this quality technique is widely used at all engineering industry and company especially manufacturing industries. QFD is the good technique application because it can control and manage properly for industry production. As with any versatile tool, the applications of QFD are limited only by one's imagination. The original intent of QFD was providing product developers with a systematic method for "deploying" the Voice of the Customer into product design. The need to evaluate potential response against needs is universal, however, and in the United States a wide range of applications sprang up quite rapidly. Table 2.1 is the summary of several of journal that consists of categories, author, description and application or implementation based on journal reading about QFD and Ergonomic.