NATIONAL TECHNICAL UNIVERSITY COLLEGE OF MALAYSIA

Product Development Using QFD Methodology – A Case Study of Car Wiper

Thesis submitted in accordance with the requirements of the National Technical University College of Malaysia for the Degree of Bachelor of Engineering (Honours) Manufacturing (Process)

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PRODUCT DEVELOPMENT USING QFD METHODOLOGY – A CASE STUDY OF CAR WIPER

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ABSTRACT

Quality Function Deployment, (QFD) is a method for translating customer's requirements into appropriate company requirements at each stage, from research and product development, to engineering and manufacturing, to marketing, sales and distribution. It is a comprehensive method for matching customer requirements to engineering characteristic of a product. In this research, Car Wiper is chosen as a case study to find out the solution of having to rise up the wiper while parking in direct sunlight. Customers requirements are gathered through feedback from questionnaires. The survey results are then applied into the house of quality (HOQ) and the proposed product characteristics are revealed. The solution to this problem is by using special designed of the car wiper stand / holder that can up-holds the car wiper hanging from the windscreen. The designed of the up-holds device can help the customers to overcome this problem efficiently.

DEDICATION

For My beloved Mum and Dad and for the rest of the families.

ACKNOWLEDGEMENT

I would like to extend special appreciation to my supervisor, En. Abdul Rahim Bin Samsudin for his constant guidance over months, my beloved parents for their encouragement and all my friends for their help throughout the project.

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ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

HOQ	-	House of Quality
KUTKM	-	National Technical University College of Malaysia.
PSM	-	Projek Sarjana Muda
QFD	-	Quality Function Deployment
SPC	-	Statistical Process Control
TQM	-	Total Quality Management
VOC	-	Voice of Customer

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CHAPTER 1:
INTRODUCTION

1.1 Introduction

For the past decade, the impact of new technologies has added swiftness to the designing area especially in manufacturing field. Today's competition in manufacturing industry depends not just on lean manufacturing, but also on the ability to provide customers with total solutions and life-cycle costs for sustainable value. Manufacturers are now under a tremendous pressure to improve their responsiveness and efficiency in terms of doing product development, improve product design, improve operations, and resource utilization with a transparent visibility of production with higher level of quality control.

In this 'Projek Sarjana Muda' (PSM), research and studies are focused on a car wiper. Investigation was done to identify all kind of problems associated with the car wiper. This includes the car wiper main problems such as the malfunction factor, damage (wear and tear) and so on. 'Quality Function Deployment' (QFD) methodology is used in this study whereby consumers view on the application and the problems encountered with regard to the car wiper are sought. The collected data are then analyzed to find the best solutions of the problems. The survey is done through distribution of questionnaires to the public.

1.2 Problem Statements

Quality Function Deployment (QFD) is one of the techniques of product development, which aimed to produce a better quality product. The product for this case study is the Car Wiper. The project will investigate the benefits and the setback (if any) of using the approach. This study will also determine and analyze the problem associated with the car wiper. A proposed solution will be made to improve and enhance the quality / performance of the car wiper.

1.3 Objectives of the Project

The objectives of this project are as follows:

1) To investigate the product (car wiper) using the QFD Methodology.
2) To study and to investigate any obvious problem associated to the car wiper.
3) Recommend any improvement to the product.

1.4 Scopes of the Project:

The scopes of this project are as follows:

1) Gather and review literature with regard to QFD and the Car Wiper.
2) Construct, distribute and collect the questionnaires to the target groups.
3) Analyze the collected data.
4) Transform the survey results into the HOQ chart.

CHAPTER 2:
LITERATURE REVIEW

2.1 Introduction

This chapter explains the Quality Function Deployment (QFD), design methodology, its principle, concepts and process which have been used widely and successfully in many fields such as manufacturing, construction and engineering. It provides a logical, practical and effective way to improve the quality of the product.

2.2 QFD Overview

Quality must be designed into the product, not inspected into it. Quality can be defined as meeting customer needs by providing superior value. It focuses on satisfying the customer's on products or services.

QFD is a structured approach to defining customer needs or requirements and translating them into specific plans to produce products to meet those needs. The "voice of the customer" is the term to describe these stated and unstated customer needs or requirements. The voice of the customer is captured in a variety of ways such as direct discussion or interviews, surveys, focus groups, customer specifications, observation, warranty data, field reports, etc.

This understanding of the customer needs is then summarized in a product planning matrix or "house of quality". These matrices are used to translate higher level "what's" or needs into lower level "how's" - product requirements or technical

characteristics to satisfy these needs. From the defining customer needs or requirements, the quality products can be produced to meet those needs.

While the Quality Function Deployment matrices are a good communication tool at each step in the process, the matrices are the means and not the end. The real value is in the process of communicating and decision-making with QFD. QFD is oriented toward involving a team of people representing the various functional departments that have involvement in product development: Marketing, Design Engineering, Quality Assurance, Manufacturing / Manufacturing Engineering, Test Engineering, Finance and Product Support. (Yoji Akao, 1990b)

The active involvement of these departments can lead to balanced consideration of the requirements or "what's" at each stage of this translation process and provide a mechanism to communicate hidden knowledge – a knowledge that is known by one individual or department but may not otherwise be communicated through the organization. The structure of this methodology helps development personnel understand essential requirements, internal capabilities, and constraints in designing the product so that everything is in place to achieve the desired outcome - a satisfied customer. In short, development personnel can maintain a correct focus on true requirements and minimizes misinterpreting customer needs. As a result, QFD is an effective communications and a quality planning tool.
(Yoji Akao, 1990b)

2.3 Defining QFD

Following are the definition of QFD given by well known individuals and groups:

1) QFD has been defined as "a system for translating consumer requirements into appropriate company requirements at each stage from research and product development to engineering and manufacturing to marketing/sales and distribution" (American Supplier Institute, 1989).

2) QFD is taking the voice of the customer from the beginning of product development and deploying it throughout the firm via a sequence of phases (Cooper *et al.* 1987).

3) Through QFD, the voice of the customer aligns the company's resources to focus on maximizing customer satisfaction and minimizing waste. QFD is not just a quality tool, it is a planning tool for developing new products and improving existing products. QFD permits the "voice of the customer", rather than the "demands of management", to allocate company resources and to co-ordinate skills and functions in producing the final product. (Yoji Akao, 1990a)

2.4 History of QFD

QFD was developed in Japan in the late 1960s by Professors Shigeru Mizuno and Yoji Akao. At the time, statistical quality control, which was introduced after World War II, had taken roots in the Japanese manufacturing industry. Quality activities were being integrated with the teachings that emphasized the importance of making quality control a part of business management, which eventually became known as Total Quality Management (TQM). (Yoji Akao, 1990a)

The purpose of Professors Mizuno and Akao was to develop a quality assurance method that would design customer satisfaction into a product before it was manufactured. Prior quality control methods were primarily aimed at fixing a problem during or after manufacturing.

The first large scale application was presented in 1966 by Kiyotaka Oshiumi of Bridgestone Tire in Japan, which used a process assurance items called fishbone diagram to identify each customer requirement (effect) and to identify the design substitute quality characteristics and process factors (causes) needed to control and measure it.

In 1972, with the application of QFD to the design of an oil tanker at the Kobe Shipyards of Mitsubishi Heavy Industry, the fishbone diagrams grew unwieldy. Since the effects shared multiple causes, the fishbones could be refashioned into a spreadsheet or matrix format with the rows being desired effects of customer satisfaction and the columns being the controlling and measurable causes. (Yoji Akao, 1990a)

At the same time, Katsuyoshi Ishihara introduced the Value Engineering principles used to describe how a product and its components work. He expanded this to describe business functions necessary to assure quality of the design process itself. Merged with these new ideas, QFD eventually became the comprehensive quality design system for both product and business process. (Yoji Akao, 1990a)

The introduction of QFD to America and Europe began in 1983 when the American Society for Quality Control published Akao's work in Quality Progress and Cambridge Research (today Kaizen Institute) invited Akao to give a QFD seminar in Chicago. This was followed by several QFD lectures to American audiences sponsored by Bob King in Boston. (Yoji Akao, 1990a)

Together with the English publication of QFD books: The Customer-Driven Approach to Quality Planning and Deployment and Quality Function Deployment: Integrating Customer Requirements into Product Design written by Akao, QFD caught on across a wide variety of industries in the U.S. and Western Europe. In the U.S., in particular, because of its flexibility and comprehensiveness, the methodology was eagerly embraced by the businesses that were facing the Japanese competition. There, new and innovative applications of QFD were experimented by industries and businesses that were not reached before. (Yoji Akao, 1990a)

Today, QFD continues to inspire strong interest around the world, generating ever new applications, practitioners and researchers each year. Countries that have held national and international QFD Symposium include the U.S., Japan, Sweden, Germany, Australia, Brazil, and Turkey. (Yoji Akao, 1990a)

2.5 QFD Process

QFD begins with product planning; continues with product design, process design, and finishes with process control, quality control, testing, equipment maintenance, and training. As a result, this process requires multiple functional disciplines to adequately address this range of activities. It can provide a structured process for these teams to begin communicating, making decisions and planning the product.

QFD, by its very structure and planning approach, requires that more time should be spent up-front in the development process making sure that the team determines, understands and agrees with what needs to be done before plunging into design activities. As a result, less time will be spent downstream because of differences of opinion over design issues or redesign because the product was not on target. It leads to consensus decisions, greater commitment to the development effort, better coordination, and reduced time over the course of the development effort. (Yoji Akao, 1990b)

QFD requires discipline. It is not necessarily easy to get started with. It is not a paperwork exercise or additional documentation that must be completed in order to proceed to the next development milestone. It not only brings the new product closer to the intended target, but reduces development cycle time and cost in the process.

2.6 Description of the QFD Process

QFD is a structured, multi-disciplinary technique for product definition that maximizes value to the customer. The application of the QFD process is an art that varies somewhat from practitioner to practitioner. Figure 2.1 shows a concept called the QFD House of Quality (HOQ), a device for organizing the flow of thinking and discussion that leads to finished product specifications. The HOQ is built by a firm's own multi-disciplinary team under guidance from a trained QFD facilitator (preferably a facilitator with both marketing and technical experience). Given one or

more specific objectives, the QFD process starts with obtaining customer requirements through market research. These research results are inputs into the HOQ. (Marcum, 1995)

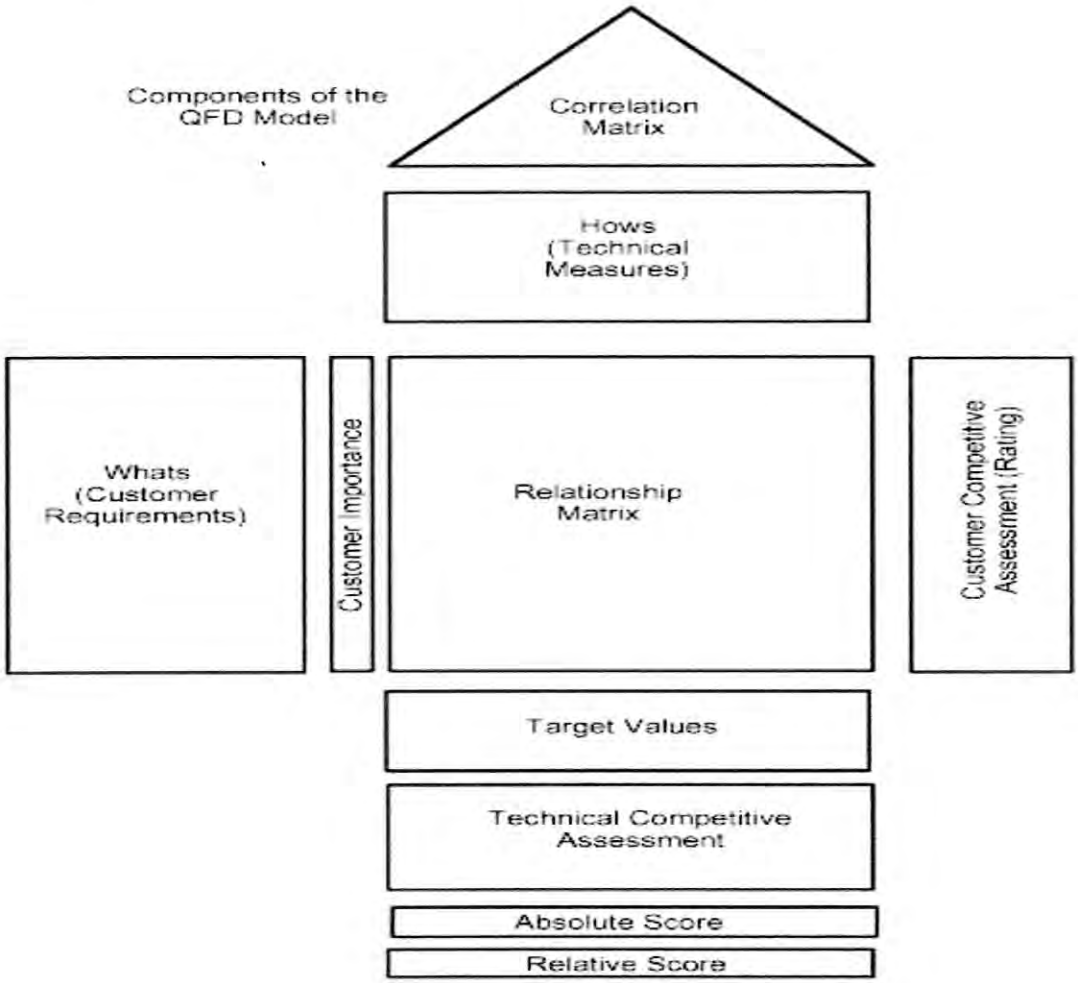
Below is a discussion of each of the rooms of the HOQ and how they are built as explained by Marcum (1995).

1) **The "Whats" Room:** Typically there are many customer requirements, but using a technique called affinity diagramming, the team distills these many requirements into the 20 or 30 most important needs. The affinity diagramming process is critical to the success of QFD in that there is vigorous discussion to reach consensus as to what the customers really meant by their comments. This is a powerful technique for reconciling the different interpretations held by marketing, design engineering or field service. The affinity diagramming process usually takes about one to two solid team days to complete, depending on how narrow or global the objective is. The results from the affinity diagramming are placed into the "*Whats*" room in the HOQ.

2) **The Importance Ratings and Customer Competitive Assessment Rooms**: Marketing and /or the market researcher designs the market research so that the team can use the results as inputs to successfully complete the *Importance Ratings* and *Customer Competitive Assessment* rooms. These rooms are located on the matrix where benefit rankings and ratings are assembled for analysis. The *Importance Rankings* provide the team with a prioritization of customer requirements while the *Customer Competitive Assessment* allows us to spot strengths and weaknesses in both our product and the competition's products.

3) **The "Hows" Room:** The next step is the completion of the *"Hows"* room. In this activity the entire team asks for each "*What*", "How would we measure

product performance which would provide us an indication of customer satisfaction for this specific *'What'?"* The team needs to come up with at least one product performance measure, but sometimes the team recognizes that it takes several measures to adequately characterize product performance.



Sources: Lou Cohen *et al.* (1988)

Figure 2 .1: The QFD House of Quality (HOQ)

4) **The Relationships Matrix Room:** After the *"Hows"* room has been completed, the team begins to explore the relationships between all *"Whats"* and all *"Hows"* as they complete the *Relationships Matrix* room. During this task the team systematically asks, "What is the relationship between this specific 'how' and this specific 'what'?" "Is there cause and effect between the

two?" This is a consensus decision within the group. Based on the group decision, the team assigns a *strong, medium, weak* or *no* relationship value to this specific *"what/how"* pairing. Then the team goes on to the next *"what/how"* pairing. This process continues until all *"what/how"* pairings have been reviewed.

5) **The Absolute Score and Relative Score Rooms:** Once the *Relationships Matrix* room has been completed, the team can then move on to the *Absolute Score* and *Relative Score* rooms. This is where the team creates a model or hypothesis as to how product performance contributes to customer satisfaction. Based on the *Importance Ratings* and the *Relationship Matrix* values, the team calculates the *Absolute* and *Relative Scores*. These calculations are the team's best estimate as to which product performance measures (*"hows"*) exert the greatest impact on overall customer satisfaction. Engineering now begins to know where the product has got to measure up strongly in order to beat the competition. The last three rooms receive the most input from the technical side of the team, but total team involvement is still vital.

6) **The Correlation Matrix Room:** There are times in many products where customer requirements translate into physical design elements which conflict with one another; these conflicts are usually reflected in the product *"hows"*. The *Correlation Matrix* room is used to help resolve these conflicts by highlighting those *"hows"* which have are share the greatest conflict. For example, let's say that the *"how"* called "weight" should be minimized for greatest customer satisfaction. At the same time there might be two other *"hows"* titled "strength" and "power capacity". The customer has expressed preferences that these be maximized. Based on what we know about physics, there may be a conflict in minimizing "weight" and maximizing "strength" and "power capacity". The analysis that takes place in the *Correlation Matrix*