



UNIVERSITI PUTRA MALAYSIA

**APPLICATION OF QUALITY FUNCTION DEPLOYMENT (QFD)
TO A LEVER OPERATED KNAPSACK (LOK)
SPRAYER**

MOHAMAD BIN AWANG

FK 2000 9

**APPLICATION OF QUALITY FUNCTION DEPLOYMENT (QFD)
TO A LEVER OPERATED KNAPSACK (LOK)
SPRAYER**

By

MOHAMAD BIN AWANG

**Thesis Submitted in Fulfilment of the Requirements for the
Degree of Master of Science in the Faculty of Engineering
Universiti Putra Malaysia**

April 2000



DEDICATION

I would like to record my deepest appreciation to my parents for their encouragement, to my beloved wife, Dr. ‘Alawiyah Abdul Rahman for her continuous support, and to my lovely kids, Abdul Muhaimin, Ahmad Muzakkir and Alia Madihah for having the patience to miss some weekends.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia
in fulfilment of the requirements for the degree of Master of Science.

**APPLICATION OF QUALITY FUNCTION DEPLOYMENT (QFD)
TO A LEVER OPERATED KNAPSACK (LOK) SPRAYER**

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MOHAMAD BIN AWANG

April 2000

Chairman: Tuan Haji Mohd Rasid Osman

Faculty: Faculty of Engineering

A need to improve the present lever operated knapsack (LOK) sprayer specifications by referring to its users' specific wants and needs or voices of customers (VOC) was proposed. Quality function deployment (QFD) was adopted to systematically determine the priority items through the construction of the Phase I matrix house of quality (HOQ). Based on customer importance rating (IR) and complaints, the priority VOC related to ergonomics, performance, safety, and economy aspects of the LOK sprayer were determined. The VOC were comfortable tank, stable, less pumping, comfortable strap, light in weight, durable strap, durable trigger, durable washer/rubber seals, durable tank, selection of nozzle, and no leaking. Through the analysis of HOQ, the priority technical requirements of the LOK sprayers were finally

derived based on their high relationship with the priority VOC. The prioritized technical requirements were overall weight, leakage limit, level of body contour, height, width, depth, setting price, tank material, lance length, strap width, length, softness level, easy to adjust, pumping frequency, setting pressure, trigger material, and nozzle compatibility. The nature and degree of change to some technical requirements as caused by changes in some others could be systematically identified through a co-relationship matrix. Through these priority technical requirements which highly correspond to the VOC of the LOK sprayers, the manufacturer will have a guideline to focus on specification improvement of the LOK sprayers in the search to systematically meet the users' requirements. Finally, these improvements are able to increase the users' satisfaction towards manufactured LOK sprayers as the prioritized technical requirements are associated with items of their concern.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains.

**APLIKASI PENGAGIHAN FUNGSI KUALITI KEPADA
ALAT PENYEMBUR GALAS**

Oleh

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April 2000

Pengerusi: Tuan Haji Mohd Rasid Osman

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Keperluan kepada pembaikan spesifikasi alat penyembur galas dengan mengambil kira kehendak dan keperluan pengguna adalah dicadangkan. Pengagihan fungsi kualiti melalui pendekatan Empat Fasa telah diterimapakai untuk menentukan ciri-ciri tertentu secara sistematik melalui penyediaan matrik Fasa I, iaitu rumah kualiti. Berdasarkan kepada tahap kepentingan dan rungutan pengguna, ciri-ciri utama tertentu melibatkan faktor ergonomik, keupayaan, keselamatan, dan ekonomi dikenalpasti. Ciri-ciri utama tersebut adalah keselesaan tangki, stabil, kekurangan mengepam, keselesaan tali penggalas, ringan, ketahanan tali penggalas, ketahanan pemetik, ketahanan tangki, ketahanan pelapik/pengetat getah, pilihan nozel dan tiada kebocoran. Melalui penganalisan rumah kualiti, ciri-ciri utama tertentu teknikal pada akhirnya

ditentukan berdasarkan hubungan yang tinggi dengan ciri-ciri utama kepada pengguna. Ciri-ciri utama teknikal tersebut adalah berat keseluruhan, kadar kebocoran, tahap bentuk badan, tinggi keseluruhan, panjang keseluruhan, lebar keseluruhan, harga, bahan tangki, panjang joran, kelebaran tali penggalas, panjang tali penggalas, tahap kelembutan tali penggalas, kemudahan melaras tali penggalas, kekerapan mengepam, tekanan pam, bahan pemetik, dan kesepadanan nozel. Keadaan dan tahap perubahan terhadap ciri-ciri teknikal tertentu disebabkan terdapat perubahan kepada sesuatu ciri teknikal yang lain dapat dikenalpasti secara sistematik berpandukan matrik hubungan. Melalui ciri-ciri utama teknikal tersebut yang ada hubungan yang tinggi dengan ciri-ciri utama pengguna, pengeluar alat penyembur gelas akan mempunyai satu panduan bagi melakukan pembaikan spesifikasi alat penyembur gelas untuk memenuhi kehendak dan keperluan pengguna secara sistematik. Akhirnya, pembaikan ini berupaya meningkatkan kepuasan pengguna terhadap alat penyembur gelas yang dikeluarkan kerana ciri-ciri utama teknikal tersebut berkaitan dengan perkara-perkara di dalam perhatian mereka.

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I certify that an Examination Committee met on 29th April, 2000 to conduct the final examination of Mohamad bin Awang, on his Master of Science thesis entitled "Application of Quality Function Deployment (QFD) to a Lever Operated Knapsack (LOK) Sprayer" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any degree at UPM or other institutions.



(MOHAMAD BIN AWANG)

Date: 29-5-2020

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LIST OF ABBREVIATIONS

CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CE	Concurrent Engineering
CEO	Chief Executive Officer
DOE	Design of Experiment
FELDA	Federal Land Development Authority
HOQ	House of Quality
IR	Importance Rating
ISO	International Standards Organization
LOK	Lever Operated Knapsack
QFD	Quality Function Deployment
SPC	Statistical Process Control
TQM	Total Quality Management
VOC	Voices of Customers

CHAPTER I

INTRODUCTION

Product Development

Every product has a life cycle. Kotler and Armstrong (1994) states that a typical product life cycle has five distinct stages: product development, product introduction, product growth, product maturity, and product decline. The length of a product life cycle varies depending on the types of product (Mazda, 1998). Some products are introduced and withdrawn from the market instantly. Some enjoys growth and maturity stages for a lengthy period and some products re-enter the growth stage after the decline stage due to some improvements to the products.

Being the first stage in a product life cycle, product development is very important in ensuring the success of a product in the market. Wright (1998) refers the product development stage as the period between commencing investigation into a new product and launching the product onto the market. Generally, it involves costly activities of market research, technological research, design, testing as well as manufacturing preparation.

Besides the importance of technical expertise in developing a product, understanding what the customers' needs and wants, and ensuring that the product reflects these requirements, is an essential part of the product development process. This notion is reflected in the definition of design process itself. Bebb (1988) describes design as the set of processes that translates customer requirement into manufacturable outcomes. Hollins and Pugh (1990) describe total design as a multidisciplinary iterative process that takes an idea or market need forward into a successful product. Design is concerned with making things people want (Gregory, 1966).

Customer Requirement

Customer requirements are usually things attributed directly to the product/service or feel of using it, e.g. how it looks, ease of usability, how it feels, how comfortable it is, its durability, how it compares to other products and services available (Zairi, 1994).

Determination of customer requirements is the first part of the design process. Regardless whether the subsequent design processes are carried out linearly or concurrently, the determination of the customers' wants and needs becomes the prime input to proceed further in the development of products or services. The simple diagrammatic model of the various stages represented in Figure 1.1 (broadly attributed to French, 1971) indicates that the first part of the process is the determination of customer requirements (Wright, 1998).

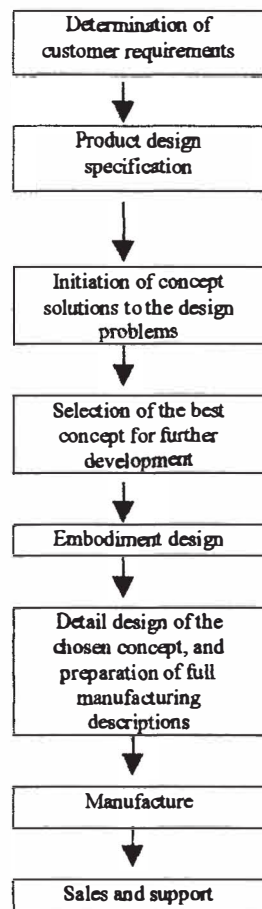


Figure 1.1: The Design Process as a Linear Activity (Wright, 1998)

As the customer requirements are the prerequisite for subsequent design processes, they should be identified and interpreted accurately in order not to lose the voices of customers (VOC) in all activities. There should be a systematic approach to identify and translate VOC into relevant company actions at each stage of the development process. Without it, it is difficult to understand and fully satisfy customer wants and needs, which eventually results in losses to the company.

Project Background

The project is to apply quality function deployment (QFD) technique in the design of a lever operated knapsack (LOK) sprayer. The sources of inputs to the QFD process are the LOK sprayer users in Malaysia. Discussions with LOK sprayer manufacturers reveal that they have received numerous complaints about the present condition of LOK sprayer as well as product returns. This indicates that the users are far from satisfied with the present LOK sprayers.

LOK sprayer is well-known agricultural equipment. It is widely used for the applications of herbicide, pesticide and other related activities. In Malaysia, LOK sprayer is the most popular pesticide applicator among small-scale farmers (Heong, 1984, Md Jusoh et. al., 1987, Heong et. al., 1985). Among Malaysian made LOK sprayer the basic design is the same, originated some 30 to 40 years ago and has remained relatively unchanged till today (Md Jusoh, 1987).

This project covers Phase 1, which is product planning of the Four-Phased approach i.e. product planning, design deployment, manufacturing planning and production planning developed by the American Supplier Institute. In this phase, the customer requirements or VOC of lever operated knapsack sprayer are identified and handled. Then, the VOC are translated into technical requirements of design specifications in the company's internal technical language.

In the Phase 1 of the Four-Phased approach, Day (1993) states that there are basically 5 steps to follow in constructing the House of Quality (HOQ) or QFD matrix. The first step is to determine the VOC. This is important, as the inputs are the customers' wants and needs. The second step is to survey customers for importance rating (IR) of various wants and needs and competitive evaluations using questionnaires. The sample of questionnaires is attached in Appendix A. This reveals how customer feels about the relative importance of wants and needs. At the same time, it provides customers' evaluation of performance of various products. The third step is to develop customer information portion of the QFD matrix based on the information from the previous steps. The fourth step is to develop the technical information portion of the QFD matrix. The last step in the Phase 1 is to analyze the completed QFD matrix. It is an integrated decision to choose priority items.

Objective of the Project

The objectives of this project are summarized below:

- i) To identify the priority items of LOK sprayers based on users' feedback, which become the inputs to the subsequent QFD processes in the pursuit to increase users' satisfaction.
- ii) To identify the customer requirements, the level of importance of each requirement, complaints, relationship of customer requirements with technical requirements of a LOK sprayer, and translation of the customer requirements into the LOK sprayer technical requirements.

- iii) To assess general customer satisfaction towards a range of LOK sprayers from different manufacturers.

Significance of the Project

The finding of this project brings forth its own importance to the users and the manufacturers of LOK sprayers. It becomes the inputs to the development of subsequent phases: product development, process planning, and process control planning. Also, it serves as input to the improvement of present technical specifications of LOK sprayers, which at the end satisfies users. Besides, it provides benchmarking of customer satisfaction towards some identified LOK sprayers.

CHAPTER II

LITERATURE REVIEW

Introduction of QFD

Definition

QFD is one of the methods in product or service design, which provides a structured approach in ensuring the VOC are considered whenever decisions that affect those needs are taken. It helps to build in quality in the early stages of new product development. It promotes proactive rather than reactive development. This is crucial as it helps the company to avoid pitfalls of committing to one concept and beginning the iterative process of prototyping, testing, and changing the design. A study by British Aerospace suggests that decision made in the first 5 percent of the design effort determine 85% of the product's quality, cost, and manufacturability (Wood, 1988).

QFD comes from the Japanese characters. According to Cohen (1995), the Japanese characters for QFD are, phonetically,

- Hinshitsu, meaning “quality”, “features”, “attributes” or “qualities”
- Kino, meaning “function” or “mechanization”