UNIVERSITI PUTRA MALAYSIA

QFD METHODOLOGY APPLICATION TO 'UPM-NET': A CASE STUDY

S WASIUL H RIZVI

FSKTM 2002 12

QFD METHODOLOGY APPLICATION TO 'UPM-NET': A CASE STUDY

S WASIUL H RIZVI
(GS09389)

PROJECT SUPERVISOR: MRS. NORHAYATI MOHD ALI

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN INFORMATION TECHNOLOGY

FACULTY OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

UNIVERSITY PUTRA MALAYSIA

2002

DECLARATION

I hereby declare that this thesis, submitted to University Putra Malaysia as a partial fulfillment of the rquirements for the Master of Science (IT) degree has not been submitted as an exercise for a degree at any other university. I also certify that the work described here is entirely my own except for excerpts and summaries, the sources of whom are appropriately cited in the references.

This thesis may be made available within the university library and may be photocopied or loaned to other libraries for the purposes of consultation.

20 October 2002

.....

S Wasiul H Rizvi

GS09389

ACKNOWLEDGEMENTS

During the research titled "QFD Methodology Application to 'UPM-Net': A Case Study", the researcher was greatly benefited from the comments, suggestions, and weekly evaluations from my learned teacher and supervisor Mrs. Nor Hayati Mohd. Ali, Faculty of Computer Science and Information Technology, UPM.

In addition, I would like to thank all the academic staffs, non-academic staffs and students who participated in this study because without their cooperation, it would not have been possible to complete the present research.

Last but not the least, I am highly indebted to Mrs. Marzanah Abdul Jabbar from the Computer Centre, UPM for providing me relevant information related to UPM-Net, which forms a part of this research.

ABSTRACT

Usability problems continue to offer a challenge to interactive system designers. One response has been an increasing emphasis on the role of users in design. The aim is to gain knowledge about users' work practice and the context of use of systems so as to achieve more effective designs. Experience has shown that it is a challenge to apply these techniques in practice, causing us to ask what are the special problems associated with involving users in design? The present work is planned to apply the QFD (Quality Function Deployment) technique to develop awareness of customers' needs. Quality Function Deployment (QFD) can be best described as a way of making the 'Voice of the Customer' throughout an organisation. It is a systematic process for capturing customer requirements and translating these into requirements that must be met throughout the 'supply chain'. The result is a new set of target values for designers, production people, and even suppliers to aim at in order to produce the output desired by customers. QFD is particularly valuable when design trade-offs are necessary to achieve the best overall solution because some requirements may conflict with others. QFD also enables a great deal information to be summarised in the form of one or more charts. These charts capture customer and product data gleaned from many sources, as well as the design parameters chosen for new product. In this way, they provide a solid foundation for further improvement in subsequent design cycles. In the present work, the system 'UPM-Net' was investigated by way of first identifying the specific users populations of the system, which are found to be of three types. One is the category of academic staffs, second one is of non-academic staffs and the third one is of students of UPM. Then the VOC: Voice of Customers was developed for which an inventory system in the form of questionnaire was evolved for collecting data from the end-user populations. The collected data were statistically analysed using SPSS (Statistical Package for Social Sciences), the results were obtained and discussed later in the light of the literature reviewed. The conclusions were based on such factors as connectivity, storage space needs, network features, technical services, user's features, and communication problems vis-à-vis UPM-Net. Finally, the scope for future research was presented. Thus one dimension of QFD i.e., VOC was established and it is hoped that such a study would help the people who are responsible for designing UPM-Net system in evolving a more user-friendly kind of UPM-Net system for future population of its end-users.

TABLE OF CONTENTS

CHAPTER I
INTRODUCTION

1.1 PRELIMINARIES

In the midst of striving for industrial development, economic growth, and business globalisation, it is vital that a business adopts the concept of quality and delivers quality products and services otherwise it cannot survive or thrive. Whether it is a product or a service, the quality always plays a critical role. So far as the HCI (Human Computer Interaction) field is concerned, the role of software quality cannot be over-emphasised. Usability problems continue to offer a challenge to interactive system designers. One response has been an increasing emphasis on the role of users in design. The aim is to gain knowledge about users' work practice and the context of use of systems so as to achieve more effective designs. Experience has shown that it is a challenge to apply these techniques in practice, causing us to ask what are the special problems associated with involving users in design?

The scenario pertaining to the software quality, particularly the Intranet kind of systems is fast changing today. The end-users of these systems have to have the final say in the design of such interactive systems. Consequently an organisation must design its systems effectively and efficiently and be able to deliver quality systems. Striving for excellence in various aspects of quality network has become increasingly important. The concepts and principles of total quality management (TQM), which are effectively used in today's competitive production and business environments, have become indispensable in today's business of software quality. Many organisations have already recognized this fact.

The question now is not how important quality in Intranet kind of environment is, but how to deliver quality in such systems. Quality function deployment (QFD) is a methodology for the development or deployment of features, attributes, or functions that give a product or service high quality. QFD can be very helpful in answering the question how to deliver quality products and services based on the needs of customers, or the voices of customers (VOC). In the present work, we seek to demonstrate how an institution in higher education specifically University Putra Malaysia can apply the adapted QFD to translate the voices of customers (VOC) in stages into operational requirements of the UPM-Net. We focus on applying the adapted methodology at the operational level and demonstrating how to fit customers requirements into technical requirements (Network Performance) by using the relationship matrix.

1.2 GOAL OF THE PROJECT

To identify the customers' requirements regarding the usage of UPM-Net, and assess the user satisfaction with the present services offered by UPM-Net.

1.3 SCOPE

The QFD method can also be used to fulfill the needs of the customers, which they have identified, as was surveyed by the researcher. It can be done by arranging the whats and hows in the form of a matrix by making a *Home of Quality,* as explained in Chapter 2:Literature Review. However, this project doesn't deal with 'Hows', rather it addresses to the 'Whats' part of QFD technique. This project, thus has scope limited to only the customer's needs which are to be known by using the ubiquitous QFD analysis. The project does not tell, how to meet those needs being identified by the user before.

1.4 PROBLEM STATEMENT

In the last two decades, in the major industries, most of the organizations including the educational institutions have been implementing the concepts and practices of Quality in order to improve the quality of the goods or services they produce. Total Quality management (TQM) is one of the major principles of Quality which nowadays is widely used to adopt a strong customer focus as one of its major initiatives in the transformation of the organizational culture toward quality. Oflate, the literature indicated many attempts where various quality management and planning tools are being used in the area of software quality management.

What is equally surprising is that many organizations' networks managed to identify their customers but lacked strategies to survey the customer needs and requirements which are important to satisfy the customer needs for the future . This was true, indeed many organisations have initiated the quality implementation of their network to attract customers more efficiently.

The computer network within the University Putra Malaysia (UPM) is more popularly known as the UPM-Net. It is the intranet of UPM having almost 5000 users at any particular peak time.

Organisational networks deal with multiple levels of customers and, therefore, must address, in some fashion, the needs and concerns of all of its customers. A particular vexing dilemma for the networking nuous is that the role of students, clerks and lecturers of UPM as customers, who should be heard, and are capable of judging whether the network is being

properly implemented and the facilities related to it are properly delivered has never been considered.

With resources becoming more limited, efficiency and effectiveness in meeting the needs of the customers become more critical. The purpose of this project is to demonstrate how the quality function deployment (QFD) method can be used in any organisation's network to identify the customers' needs and requirements properly. Specifically, this project reviews QFD concepts in the context of computer networks, and briefly summarizes the application of these concepts in UPM-Net, and demonstrates how one of the major constituents of QFD system (i.e., assessment of the customer's voice) can be developed for the final application of the QFD system in totality. By using the QFD method as a model, the complex process of evaluating the network in UPM would become manageable, and vital information would be possible to be tracked from problem development stage to the resolution of issues stage.

As the field of network evaluation is concerned recently, researchers have not shown enough interest in applying the QFD to this field. Present work is an attempt in this very direction. The UPM-Net was studied for the QFD application in this present research. The subject matter related to QFD was explored in literature as presented in the next chapter (Chapter II). In light of the literature, problem for the present work was formulated as presented in the present chapter. The research methodology evolved for handling the problems is put forth in Chapter III. Following the methodology, data were collected and analyzed as presented in Chapter IV. The thesis concludes with the discussion, conclusion and scope for the future work as presented in the last chapter (Chapter V).

CHAPTER II

LITERATURE REVIEW

The literature related to the present work was found to be highly scattered in nature. The same has been reviewed in a systematic manner as presented below.

2.1 WHAT IS QUALITY FUNCTION DEPLOYMENT?

From the previous chapter, Quality Function Deployment (QFD) can be best described as a way of making the 'voice of the customer' heard throughout an organization. It is a systematic process for capturing customer requirements and translating these into requirements that must be met throughout the 'supply chain'. The result is a new set of target values for designers, production people, and even suppliers to aim at in order to produce the output desired by customers.

QFD is particularly valuable when design trade-offs are necessary to achieve the best overall solution, e.g. because some requirements conflict with others. QFD also enables a great deal of information to be summarized in the form of one or more charts. These charts capture customer and product data gleaned from many sources, as well as the design parameters chosen for the new product. In this way they provide a solid foundation for further improvement in subsequent design cycles.

QFD is sometimes referred to by other 'nicknames' - the voice of the customer (from its use as a way of communicating customer needs), or the House of Quality (from the

characteristic house shape of a QFD chart). Although the Japanese have experienced early success with QFD, US industry did not begin implementing it until the late 1980s. Prior to that point, Brown had written that product/service realization in the USA had been done using traditional, sequential approaches that involved many interactions and were characterized by work groups having their own set of ideas. The USA used system design characteristics that did not focus on customer intent.

2.2 BACKGROUND OF QFD

QFD was developed during the late 1960s in Japan by Yoji Akao. It was first applied at Mitsubishi Kobe Shipyards in 1972 to assure customer satisfaction. Masao Kogure and Yoji Akao introduced QFD to the USA in the article "Quality function deployment and CWQC in Japan" which appeared in *Quality Progress* in the October issue of 1983. The creation of QFD is generally attributed to Mitsubishi's Kobe shipyard in Japan. The original approach, conceived in the late 1960's, was adopted and developed by other Japanese companies, notably Toyota and its suppliers. In 1986 a study by the Japanese Union of Scientists and Engineers (JUSE) revealed that 54% of 148 member companies surveyed were using QFD. The sectors with the highest penetration of QFD were transportation (86%), construction (82%), electronics (63%), and precision machinery (66%). Many of the service companies surveyed (32%) were also using QFD. Specific design applications in Japan range from home appliances and clothing to retail outlets and apartment layouts.

In the USA the first serious exponents of QFD were the 'big three' automotive manufacturers in the 1980's, and a few leading companies in other sectors such as electronics. However, the uptake of QFD in the Western world appears to have been fairly

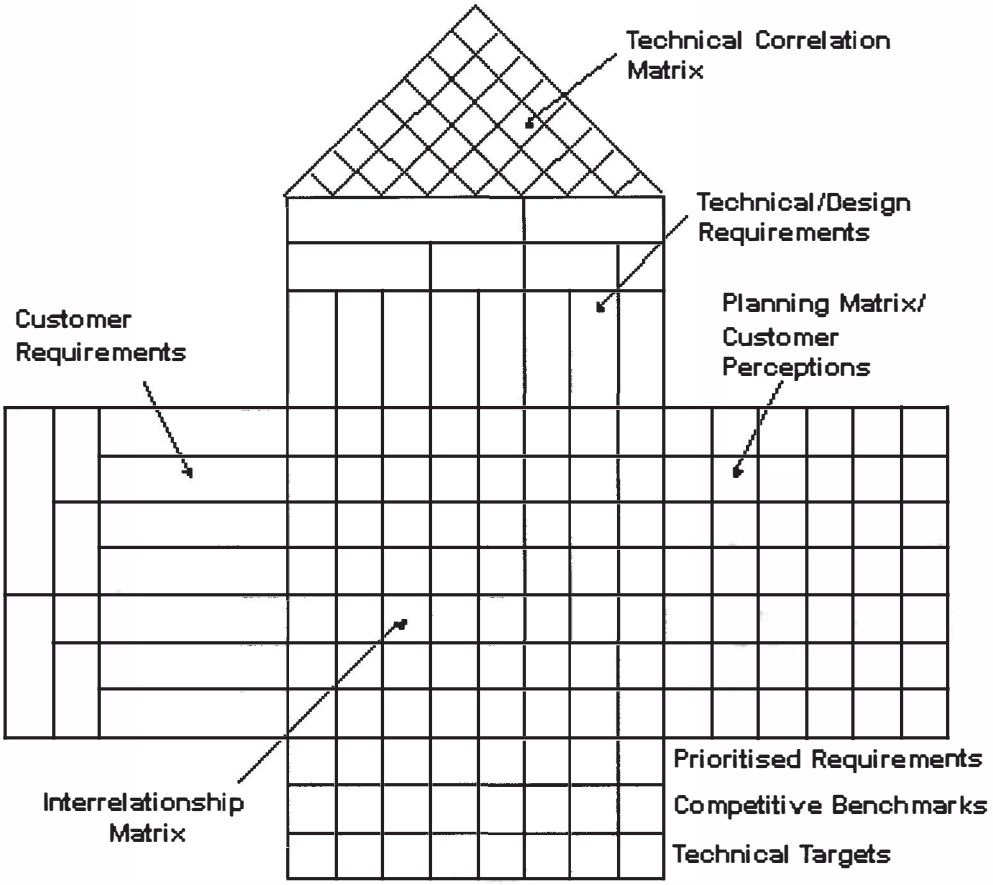
slow. There has been no survey comparable to the JUSE study regarding the spread of QFD in North America, and there are relatively few sources of literature and case studies, compared with other methodologies such as Benchmarking.

There is also some reluctance among users of QFD to publish and share information much more so than with other quality-related methodologies. This may be because the data captured and the decisions made using QFD usually relate to future product plans, and are therefore sensitive, proprietary, and valuable to competitors QFD is a structured approach to seek out customers and understand their needs. It begins by matching customer requirements with the necessary corresponding design requirements, which in turn match with the necessary corresponding production requirements, and so on, to ensure that the needs of the customers are met. If done right QFD is likely to be one contributing factor to product or service success. When products are designed to meet or exceed customer needs, sales go up. The ultimate benefits of QFD are increased market share and higher profits. **[1]**

In using QFD, organizations will be able to achieve reduction in the number of design changes, lower startup costs, shorter design cycles, fewer warranty claims, improved internal communications, and increased sales. Another key benefit of QFD is that engineering knowledge is retained in a systematic manner so that it can be easily applied to future similar designs **[2]**. Also, it helps to identify specific, competitive advantages and create the opportunity to supply niche products **[3]**. The whole QFD procedure uses a series of matrices sometimes called houses to express the linkages between inputs and outputs of different phases of development. However, the majority of QFD applications stop with the completion of the first matrix **[4]**. Many companies, such as Volvo, have found that a great deal of benefit can be achieved from just completing the first matrix. Cox (1992) indicates that no more than

5 per cent of companies go beyond the first matrix which is also known as the house of quality (see below).

Figure 2.2 : House of Quality



This chapter gives an overview and the background of Quality Function Deployment (QFD). The next chapter that is the Literature Review gives further explanations the meanings of QFD, benefits of using the QFD, the objectives of implementing the QFD and the review processes by which the QFD can be implementing step by step correctly in order to maximize its performance to the organizations.

2.3 BENEFITS OF QUALITY FUNCTION DEPLOYMENT (QFD)

The main 'process' benefits of using QFD are:

1. Improved communication and sharing of information within a cross-functional team charged with developing a new product. This team will typically include people from a variety of functional groups, such as marketing, sales, service, distribution, product engineering, process engineering, procurement, and production.
2. The identification of 'holes' in the current knowledge of the design team.
3. The capture and display of a wide variety of important design information in one place in a compact form.
4. Support for understanding, consensus, and decision making, especially when complex relationships and trade-offs are involved.
5. The creation of an informational base which is valuable for repeated cycles of product improvement.
6. Production/service is far more focused; waste is minimized
7. QFD is customer and market oriented and therefore aiming at competitiveness and performance from the outset
8. Many (abstract) customer requirements are made explicit
9. Internal constraints become obvious through the practice of HoQ. Training needs, teamwork and quality issues are therefore built into QFD
10. QFD can be integrated with existing practices, e.g. TQM, QC's and benchmarking.

2.4 THE QUALITY FUNCTION DEPLOYMENT PROCESS

To thrive in business, designing products and services that excite the customer and creating new markets is a critical strategy and while growth can be achieved in many different

ways—selling through different channels, selling more to existing customers, acquisitions, geographic expansion—nothing energizes a company more than creating new products or upgrading existing products to create customer delight.

Quality Function Deployment (QFD) is a methodology for building the "Voice of the Customer" into product and service design. It is a team tool which captures customer requirements and translates those needs into characteristics about a product or service.

The origins of QFD come from Japan. In 1966, the Japanese began to formalize the teachings of Yoji Akao on QFD. Since its introduction to America, QFD has helped to transform the way businesses:

- plan new products
- design product requirements
- determine process characteristics
- control the manufacturing process
- document already existing product specifications

QFD uses some principles from Concurrent Engineering in that cross functional teams are involved in all phases of product development. Each of the four phases in a QFD process uses a matrix to translate customer requirements from initial planning stages through production control.

2.4.1 The Objective Of Implementing Quality Function Deployment (QFD)

QFD should be viewed from a very global perspective as a methodology that will link a company with its customers and assist the organization in its planning processes. Often, an

organization's introduction to QFD takes the form of "how to build a matrix." A common result is that building the matrix becomes the objective. Companies must avoid this pitfall. The purpose is not to build matrices; it is to get in touch with the customer and to use this knowledge to develop products which satisfy the customer. The QFD process will help in the organization and analysis of all the pertinent information associated with a project. The priority items selected from the matrix during its analysis are items that will measurably improve the level of customer satisfaction. The net effect is that the items that drive the company's actions are driven by the customers' requirements. There is an increased focus on customers and an increased awareness of their wants. Because of this focus, the process leads to improved customer understanding and increased customer satisfaction.

2.4.2 Overview Flowchart Of The QFD Process

The following pages provide a brief overview of this process that will lay a foundation subsequent chapters.

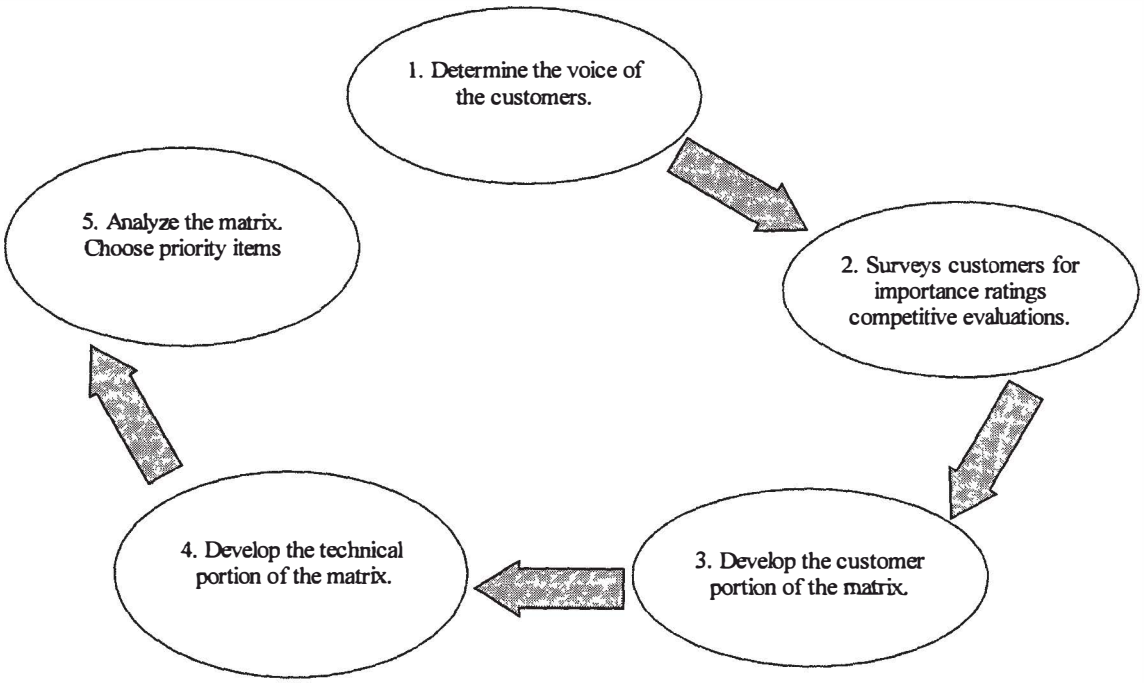


Figure 2.4.2 : Overview Flowchart of the QFD Process

In planning a new venture or revisions to an existing one, companies need to be touch with the people who buy and use their products and services. They need to determine the voice of their customers. This is vital for hard issues, such as a product whose sales are dependent on the customers' evaluation of how well their needs and wants are satisfied. It is equally crucial for softer issues, such as site selection and business planning. In these cases, the customers are the people in the organization who are responsible for determining how to accomplish the task.

Once the customers' wants and needs are known, the company can obtain other pertinent customer information. Through surveys, it can establish how its customers feel about the relative importance of the various wants and needs. It can also sample a number of customers who use its product and competitors' products. This provides the customers' evaluation of both the company's performance and that of its chief competitors. Records can be examined to determine the presence of any customer complaint histories. This can be the result of letters of complaint, 800-number complaints, or other inquiries and comments. Once this information is available, it can be organized and placed in the horizontal customer information portion of the QFD matrix. The voices of the customers represent their wants and needs-their requirements. These are the inputs to the matrix.

2.4.3 THE VOICE OF THE CUSTOMER

The objective of the survey process is to determine the wants and needs of the customers. This may be referred to as the customers' wants and needs, customer requirements, or simply the voice of the customer.

2.4.3.1 Determining Which People to Survey

The first step in this direction is to establish the target market. This will dictate who should be surveyed. This is a complex issue. Persons with knowledge and experience in market research should be involved. The target market must be established before any survey work is undertaken. It is important to talk to owners of products similar to those planned for introduction. For example, if the company plans to introduce a new sports car, the audience should include people who own or have interest in sports cars. Surveying an audience of large luxury sedan owners would not disclose the voice of the real Sports car enthusiast. When plans involve introducing a new or updated version of an existing product, the surveys will typically involve existing customers. Companies wishing to expand their market will want to interview people who represent potential customers. Surveys should include some of the competitors'.

1. Determine the target market (involve existing customers or potential customers)
2. Determine the demographics (e.g. Age distribution, income level etc.)
3. Determine the geographical distribution (environment)
4. Use a nonaffiliated survey organization (prevent bias from the customer)
5. Survey people external to the organization (decision influence by knowledge of cost, management expectations, service capabilities etc.)

2.4.3.2 Obtaining the Voice of the Customer

An organization can obtain the voice of the customer in a number of ways once the issues of segments, demographics, and methods have been decided. Various ways are as follows:

1. Focus groups
2. Interviews - telephone

   - one – on - one

3. Mail questionnaires
4. Product clinics
5. Murmurs, observations
6. Root wants

Focus group usually involve eight to 12 people. A number of discussion 'Issues are agreed on in advance. A facilitator works with the group to develop conversation on the attitudes, wants, and needs of the participants relative to each discussion Issue. The facilitator needs to exercise care to keep the discussion moving, to avoid domination by more vocal members, and to take advantage of the natural synergy developed in groups of discussion.

2.4.3.3 Customers of UPM-Net

A critical step in implementing QFD is to identify current and potential customers. Customer focus provides direction for improvement initiatives. Conversely, lacking customer focus or misidentifying customers often leads to diffused quality efforts or failed quality initiatives. Although identifying students as the primary customers and striving to meet their genuine needs is an important step to developing quality programmed in the university network, recognizing the needs of other customer groups is important. **[5]**

Customer groups of a typical university computer network may include the students, lecturers, clerks, outsiders, alumni groups, etc. Unfortunately, in typical computer networks, there is a lack of unifying focus on satisfying various customers' needs. The customer-driven focus is an important lesson that a network system should learn from on-going trends in this industry.

The customer represents the stakeholder group acquiring various kinds of input in order to produce its products. Therefore, it is a customer of those who provide the input. The

processor represents the stakeholder group processing those inputs in order to produce its products. Therefore, it is the processor of the products. The supplier represents the stakeholder group supplying its products to its customers **[5]**. Therefore, it is a supplier to its customer. An institution must realize that it is in a business to satisfy many parties and that it is important to identify all customer groups and address their concerns through its computer network. In this paper, however, only three perspectives, i.e. those of the student, Lecturers and non-teaching staffs as customers of the university network (UPM-Net) system will be discussed.

2.4.3.4 Customers' Requirements

Customer requirements are the driving force in QFD, considerable effort has to be committed to properly identify those requirements. Once identified, there must be a rational basis for evaluating the customer requirements. In this step, the voice of the customer is transformed into customer requirements on the basis of a clear image of what the customers are doing with the product i.e., how it will be used. There are different methods such as market research, in-depth qualitative interviews, and concept engineering that are available as techniques to be used in this step **[6]**. Concept engineering is a conceptual model that provides methodological guidance for clarifying the fuzzy front end of the product or service development process **[7]**. The goal of concept engineering is to move from the invisible or vague feelings of the customers to clear, grounded customer requirements that serve real customer needs (**[8]**; **[9]**).

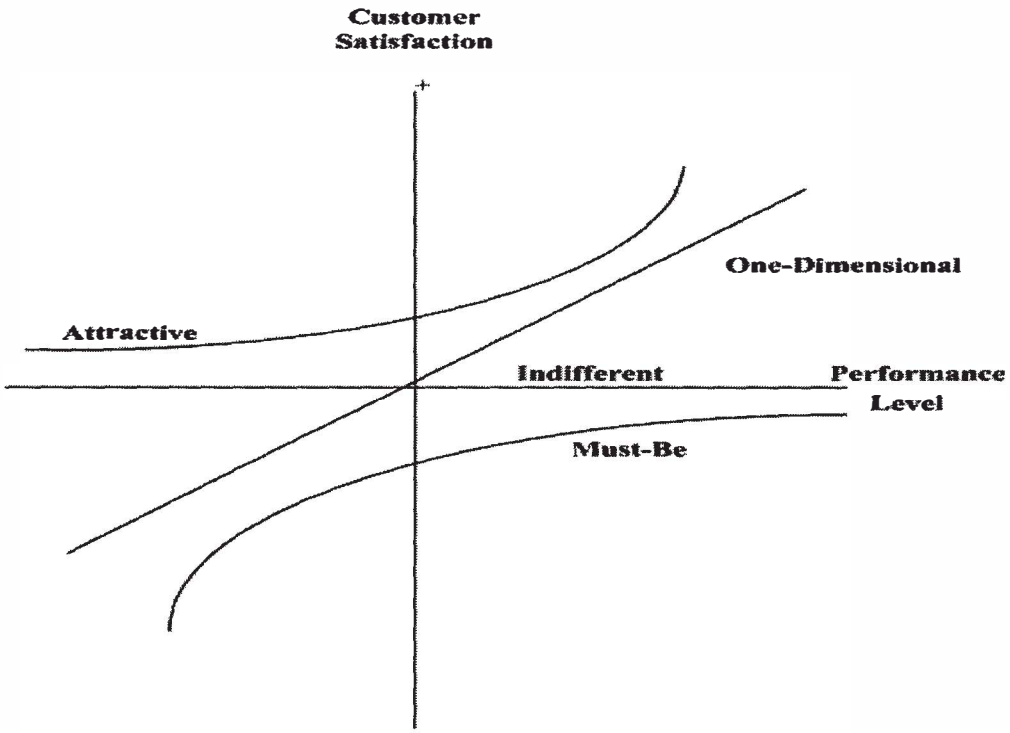
Then the QFD team have to categorize those customer requirements into four classifications: one-dimensional, must-be, attractive, and indifferent. Customer satisfaction for certain customer requirements is proportional to how fully functional the product is with

respect to a requirement. If there is a proportional relationship between functionality and satisfaction, such customer requirements are known as one-dimensional customer requirements. Customer requirements that do not lead to satisfaction when fulfilled but cause dissatisfaction when not fulfilled are known as must-be customer requirements. Customer requirements that create satisfaction when fulfilled, but not dissatisfaction when not fulfilled, are known as attractive customer requirements. Customer requirements that result in neither satisfaction nor dissatisfaction regardless of whether they have been fulfilled are known as indifferent customer requirements (see figure 2.3.3.4). Kano's analysis is often used in this step.

Usually, there are too many customer requirements to be manageable. Thus, classifying the customer requirements can be beneficial. Customer requirements that belong to the indifferent group are removed from further consideration. Only the remaining customer requirements are considered in the next step. This can reduce the size of the first matrix considerably. The main objective here is to develop an awareness for which customer requirements should receive greater attention in later design efforts and how to best set target levels for them in the second stage. For example, improving performance on a must-be customer requirement that is already at a satisfactory level is not as beneficial as improving performance on a one-dimensional or attractive requirement **[9]**. However, usually must-be requirements need to be satisfied before one-dimensional requirements. Classifying customer requirements into different categories can help focus on the vital few where the most leverage exists.

Lastly the QFD team have to prioritize the remaining customer requirements from the customers' perspective. Since these may easily total to more than 200 arranging them in the

descending order of importance is essential for the subsequent analyses. This allows the QFD team the flexibility of basing its analysis on those customer requirements that are deemed most critical. Only those customer requirements selected in step 3 are considered in the next stage. This can considerably reduce the efforts needed to complete the QFD planning process. Analytic hierarchy process (AHP) has proven to be effective in establishing the priorities of customer requirements for using a group of customers (**[10]**; **[11]**). AHP takes into account subtle attribute preferences of the customer that are otherwise difficult to include.



Source: Adapted from Shiba *et al.* (1993)

Fig 2.3.4.4 Kano's Anaysis

2.4.3.5 Understanding the Voice

The process of questioning people will not reveal everything involved in understanding the customers' wants and needs. The work of Noritaki Kano provides a model that helps us understand the overall spectrum of customer expectations and satisfaction. Figure 2.3.3.4 illustrates the Kano observations. The horizontal axis shows how well the customers think the company's product or service met their expectation. The vertical axis shows the degree of actual customer satisfaction with the product or service. The lower curve will serve as an example for explanation. The arrow tip at the extreme right of this curve represents customers who feel that the manufacturer of the product (or the provider of the service) fully met their expectations. Note, however, that the level of satisfaction for these customers does not reach the maximum represented by the top of the vertical axis. This is because this lower curve represents issues that are basic functions or "givens" for the product or service. These are things that customers have learned to expect. Their presence does little to promote major satisfaction. Their absence, on the other hand, will lead to dissatisfaction. Failure to provide a basic functional requirement represents a built-in dissatisfied. Failure to meet these expectations moves an organization down the curve toward dissatisfaction. This is why it so important to know the real needs of the customer. When Tech Industries talked to customers about their wants and needs in a fish finder, it discovered what had to be done to respond. Effective response moved the company toward the arrowhead on this curve.

One of the principles of the QFD process is that it forces companies to talk with their customers. In the process, they learn what customers want and need and can plan their strategy for increasing customer satisfaction. The upper curve involves things that represent exciting quality. Customers seldom mention these directly in the interview process. These are things that go beyond the customer's expectations. Many industries today talk about their desire to go "beyond customer expectations," go "beyond satisfaction," or to create "exciting quality." Exciting quality is generated by making a "creative leap" based on some customer comment or some observation of customer behavior. The concept embodied in the upper curve is extremely significant. As companies listen to their customers, they should search very carefully for clues that may spark a creative idea that produces exciting quality

2.4.3.6 Handling the Voice

Handling the voice:

1. determine root wants
2. capture "verbatims"
3. abbreviate the voices as necessary
4. consolidate the voice

The idea of determining the root want involved in Customers' comments is crucial to the success of the interview process. Customers tend to mix needs, solutions, and problem concerns. They will frequently tell the interviewer what they want without stating why they want it.