IMPROVEMENT OF TAKE-AWAY WATER CUP DESIGN BY USING CONCURRENT ENGINEERING APPROACH

SITI MAHFUZAH BTE MOHAMAD

A thesis submitted is fulfillment of the requirements for the award of the degree of Bachelor of Manufacturing Engineering

Faculty of Manufacturing Engineering

University Malaysia Pahang

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ABSTRACT

This final year project is about improvement of take-away water cup design by using concurrent engineering approach. Take-away water cup is widely used in fast food restaurant, the customer demand to satisfy when using this product. It is because, customers is still become more and more demanding and require being the product improved in all the time. Although the take-away it is look perfect but it is still have drawback. The problem is what possible improvements of take-away water cup are and how to match voice of customer with technical description in order for improving the cup design. To proceed the project, there are several method use to get voice of customer through interviewing, analyze QFD (Quality function deployment) tool, design the product by using CAD drawing, and lastly fabricate the product by using rapid prototyping. QFD is one of the tools in concurrent engineering (CE). QFD is a system to deploy the voices of the customers in understanding their requirements into the appropriate technical requirements for each stage of product development and production. Based on the result and discussion, after analyzing the QFD, it shows that customer really need to improve the cover of the cup by adding tip on the cover in order for easy to drink and make a hole for easy to mix between sugar or creamer with the hot coffee. Finally, product prototyping of take-away water cup is demonstrated and manufactured based on market survey and QFD analysis.

ABSTRAK

Projek tahun akhir ini adalah mengenai penambahbaikan reka bentuk cawan air yang boleh dibawa pulang dengan menggunakan pendekatan kejuruteraan serentak. Cawan air yang boleh di bawa pulang dan digunakan secara meluas di restoran makanan segera, permintaan pelanggan harus dipenuhi bagi penggunaan produk ini. Ini kerana, pelanggan masih sentiasa berkehendak dan kehendak tersebut perlu dipertingkatkan sepanjang masa. Walaupun cawan air tersebut kelihatan sempurna, tetapi ia masih mempunyai kelemahan. Masalahnya ialah apakah kemungkinan penambahbaikan bagi cawan air tersebut dan bagaimana untuk memadankan kehendak pelanggan dengan keupayaan teknikal dalam usaha untuk memperbaiki reka bentuk cawan. Untuk meneruskan projek itu, terdapat beberapa kaedah yang digunakan seperti mendapatkan idea pelanggan melalui temuramah, menganalisis QFD, reka bentuk produk dengan menggunakan perisian CAD, dan akhir sekali menghasilkan produk dengan menggunakan mesin prototaip. QFD adalah salah satu alat kejuruteraan serentak (CE). QFD merupakan satu sistem untuk menempatkan kehendak pelanggan dalam memahami keperluan mereka kepada keupayaan teknikal yang sesuai untuk setiap peringkat pembangunan dan pengeluaran produk. Berdasarkan keputusan dan perbincangan, selepas menganalisis QFD, ia menunjukkan bahawa pelanggan benar-benar ingin perlu untuk memperbaiki penutup cawan dengan menambah hujung di penutup untuk memudahkan untuk minum dan membuat lubang bagi mudah untuk mengacau gula atau krimer dengan kopi panas. Akhir sekali, prototaip produk cawan air yang boleh dibawa pulang ini ditunjukkan dan dihasilkan berdasarkan kajian pasaran dan analisis QFD.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

CAD	Computer-aided drafting
CE	Concurrent engineering
DoD	Department of defense
QFD	Quality function deployment
SA	Semiconductor assembly

CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

Because of take-away water cup is widely use in fast food restaurant, the customer demand to satisfy use this product. It is because, customer is still become more and more demanding and require to be improved all the time. Based on the analysis in the world market, customer requires product functions and quality are continuously increasing. To improve the design, the customer requirement matching using, concurrent engineering as approaches.

The concurrent engineering (CE) concept has been introduced in 1988 by the US Department of Defense (DoD) in order to help supplier to produce better product at lower cost within a shorter time frame. Concurrent engineering also called simultaneously engineering approach allowed the design and prototype process being performed simultaneously**.** CE also is a systematic approach to the integrated and concurrent development of a product and its related processes that emphasizes response to customer expectations and embodies team values of cooperation, trust, and sharing the decision making by consensus involving product design, process design, marketing in parallel from the beginning of the product life cycle. Concurrent design involves the consideration and integration of various design activities throughout the product life cycle. The life cycle refers to the period from the product's first launch into the market until its final withdrawal and it is split up in phases. During this period significant changes are made in the way that the product is behaving into the market. It is consists of five major steps or phases which are product development, product introduction, product growth, product maturity and finally product decline. All activities of product and process design are performed in parallel by using the technique of Quality Function Deployment (QFD) defined product specifications and rapid prototyping to verify the function, manufacturability, and usability.

With such fast-paced change occurring nowadays, especially in our social and economic development, many companies are facing rapid changes in industrial caused by technological innovation and changing consumer trend. In this stage, these companies are finding that the effort to develop new products is important for their survival. If they not take serious their company will close because they should compete with other companies at the same industry. QFD provides specific methods for ensuring quality throughout each stage of the product development process, starting with design. It is means that, QFD is the method for developing a design quality aimed at satisfying the customer and then translating the customer demand into design target. QFD also is a way to assure the design quality while the product is still in the design stage. Others definition is, QFD is a technique to transform user demands into design quality, to deploy the functions forming quality, and to deploy methods for achieving the design quality into subsystems and component parts, and ultimately to specific elements of the manufacturing process. QFD is designed to help planners focus on characteristics of a new or existing product or service from the viewpoints of market segments, company, or technology-development needs. Based on baseline definition Sullivan (1986), there are six key terms associated with QFD, which are shown in Figure 1.1.

i) a concept for translating customer wants into the product.

ii) a requirement to understand 'what' the customer 'wants '.

iii) the requirement to identify 'how' to technically deliver the 'what' the customer wants.

iv) the requirement for a 'team' to carry out the 'translation' of 'whats' into 'hows'

v) the requirement for a 'team' required to 'deliver' the hows into the product.

vi) the requirement for 'charts' that facilitate the translation of whats and hows into the product.

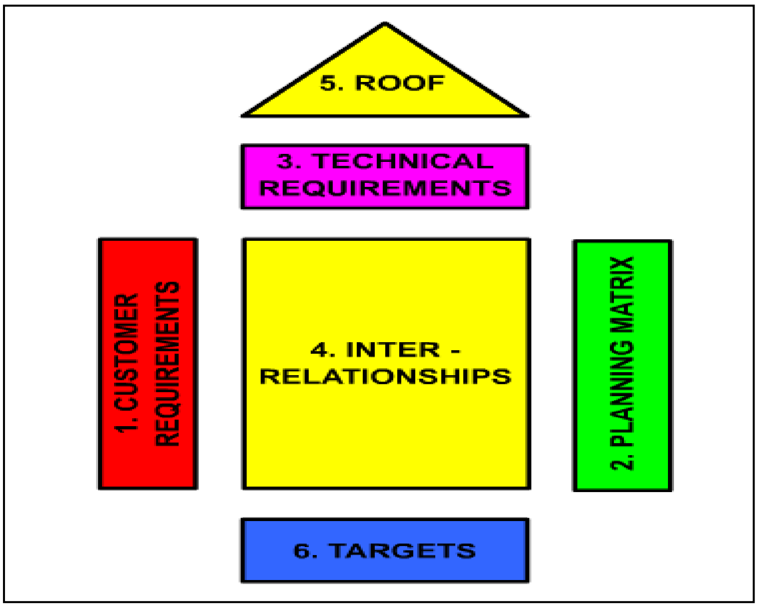

Figure 1.1: Main item on QFD

Source: Dr. A. J. Lowe 2000

Example, QFD is work based on the research by Chee-Cheng Chen (2010) about application of QFD in the semiconductor industry. The development of a QFD-based expert system that assists a decision-maker in selecting the appropriate semiconductor assembly (SA) processes for a given combination of material (wafer) and product features. Therefore, the selection of the most appropriate SA process depends on the degree to which the process characteristics are able to meet the requirements of the desired product characteristics. The process characteristics that are relevant for achieving the required product characteristics in the semiconductor industry are listed below:

1) *material application*: the extent to which a particular SA process can be used on a given material

2) *efficiency*: the ratio between the quantity of output and the material input (in terms of line balancing) and

3) *process capability*: how efficiently a given process can: (i) maintain close tolerance; (ii) achieve high accuracy and precision; and (iii) achieve optimal yield with minimum damage and loss.

The team was selected 12 fundamental SA processes that are required in the process deployment and also product characteristics in order to fulfill customer requirement. Then, they set scale rating or priority for the product characteristic. For this purpose, a scale of 1-9 is used. The most important product features and applications are assigned the maximum value of 9, whereas relatively less-important characteristics are accorded a lower value. Table 1.1 shows the prioritized customer requirements.

Table 1.1: Prioritized customer requirements

Row no.	Features and applications	Priority value	Possible range of priority value
1	Trench FET[R] power MOSFET	9	8–9
2	ESD protected	6	6–7
3	Battery protection circuitry	8	7–8
4	1-Cell Li-ion battery pack	6	6–7

Source: Chee-Cheng Chen (2010)

The QFD team must now fill in the core of the QFD -the ‘relationship room’-where the nature and intensity of the relationships between each customer requirement (‘voice of the customer’) and each product characteristic (‘voice of the company’) are depicted. This complex task is another critical stage and project checkpoint in the QFD building process because it shows whether the company is adequately addressing customer requirements from a technical perspective. Figure 1.2 shows voice of the customer, voice of the company, technical correlation roof, and relationship room in the case of the semiconductor industry.

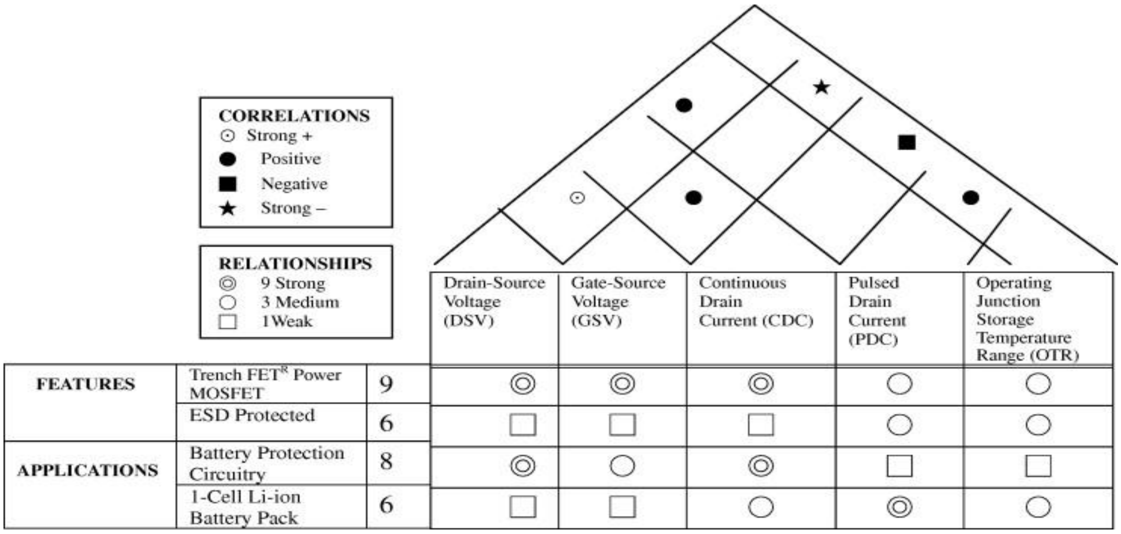

Figure 1.2: Voice of customer, voice of company, technical correlation roof, and relationship room

Source: Chee-Cheng Chen (2010)

This project is about improvement of take-away water cup design by using concurrent engineering approach. QFD is one of the tools for concurrent engineering approach. Take-away water cup is widely used either for hot or cold water. Many people today are too busy for preparing meal for breakfast. The more easily way is just going to Mc Donald, Star Bucks, and etc to get their breakfast. For sure they will buy take-away drink such as hot coffee, hot tea, cold drink, and etc. It is why take-away water cup was designed to ensure it is design to be eased for bring anywhere and faster compare than make it by our own. Although it is look perfect but it is still have drawback.

Therefore, this project purpose is to improve of take-away water cup design for more effective and meet the customer requirement and expectation. Customer just want better product without paying more. In order to start this project, customer feedback is needed to act as guideline before preceding this project. For example, this feedback likes what problem the customer facing during buy take-away water cup.

The above semiconductor case study will act as a guide in order to build up the QFD for this project. This project will use the same concept like getting voice of customer, voice of company, customer rating for each product characteristic and so on. It will be discuss on chapter 4 which is result and discussion.

1.2 PROBLEM STATEMENT

Customer now is more demanding and wants everything is perfect. Similar to take-away water cup, it is look like perfect and no more improvement is needed. However, when the customer has opportunity to give feedback, many improvements are proposed. It is because “customer is like a king and always right”. The problem is what possible improvements of take-away water cup are and how to match voice of customer with technical description in order for improve the cup design. Figure 1.3 shows take-away water cup (hot cup).

Figure 1.3: Take-away water cup (hot cup)

1.3 PROJECT OBJECTIVES

The purpose of current project is to improve a take-away water cup design using CE. The objectives of this project are:

1) To get feedback from the customer and analyze each of the feedback using QFD.

2) Propose a new design of take-away water cup and fabricate the model using rapid prototyping

1.4 PROJECT SCOPE

Before start the project, scope of the project is proposed. The project scopes are:

1) Literature review

2) Surveying by interview

3) Analysis QFD

4) Design and fabrication

Flow chart and gantt chart for this project will be shown in appendix A and B.

CHAPTER 2

LITERATURE REVIEW

2.1 DEFINITION OF CONCURRENT ENGINEERING

Concurrent engineering is a project design approach which all phases of manufacturing operate at the same time. Both product and process design run in parallel and occur in the same time frame. Concurrent engineering is not a new term. It is generally understood to embrace a collection of approaches, techniques, tools, and methods aimed at improving the total value chain in product development (Leppitt, 1993). Concurrent engineering has been set up mainly by the US Department of Defense (DoD) to enable its suppliers to produce better products at lower cost within shorter time. This was mainly due to the decreasing DoD budget. The winner defines concurrent engineering as: Systematic approach to the integrated, concurrent design of products and their related processes, including manufacturing and support. This approach is intended to cause the developers, from the outset, to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule, and user requirements (Dicesare, 1993). Other definition is concurrent engineering is a systematic approach to the integrated and concurrent development of a product and its related processes, that emphasizes response to customer expectations and embodies team values of cooperation, trust, and sharing in such a manner that decision making proceeds with large intervals of parallel working by all life-cycle perspectives, synchronized by comparatively brief exchanges to produce consensus (Cleetus, 1992).

2.2 CONCURRENT ENGINEERING TRILOGY

There are 3 concurrent engineering trilogies which are technology, teams, and techniques. For the technology, there must be a cohesive understanding of the technology needed to produce the product. Then, teams need to include the customer from every beginning for example get customer feedback to improve future product. Last trilogy is technique. There are several techniques of concurrent engineering which are design for manufacturability (process capabilities), design for reliability (maintenance and life cycle), designs to cost (product cost and marketing price), design to application (consumer product/production product), and design to quality.

2.3 GOALS OF CONCURRENT ENGINEERING

An analysis of the world market has shown that the customer requirements regarding functions and quality of products are continuously increasing but the customers are not willing to pay more for better products. Customers are becoming more and more demanding and their requirements are changing all the time. It is because “Customer is the king”. One of the ways to meet the customer demand is using concurrent engineering because it will save time, save cost, and etc. When use this approach, it can produce product with high quality that was aimed by the customer and at the same time will meet their demand or requirement. This statement was agreed by (T.P. Sai, H.C.Yang, P.H. Liao, 2011). The statement are although the concept of concurrent engineering has been widely applied in the manufacturing industry, there is growing awareness and interest in the adoption of CE in the Construction Industry because CE has the potential to make construction projects less fragmented, reduce project duration, improve project quality, reduce total project cost and increase project competitiveness (T.P. Sai, H.C.Yang, P.H. Liao, 2011).

The concurrent engineering system is developed to meet the demand of the customer for the better quality products with lower production cost and time. The goal of concurrent engineering is to improve quality, reduce manufacturing costs, or improve reliability. Not all companies have reached the goal of concurrent engineering, but one can identify three main goals of concurrent engineering which are lower product costs throughout the total life cycle, better product quality, and shorter time-to-market. Competitive pressures and decreasing commercial product life cycles are spawning a new vision. Product Development is now the critical factor in influencing product cost. As a result, designers are adopting tools and techniques that enhance their ability to evaluate cost and development criteria, such as manufacturability (Bogard et al., 1991). If concurrent engineering approach is implemented, it means that most product changes occur in the early stages.

Redesign of a product is costly and time-consuming when it has to be done after the design phase. This redesign can be necessary because of manufacturing restrictions, or to streamline the manufacturing process (Engel, 1991). Concurrent engineering exposes the costs of the design process early in the development stage. It reduces expenses and schedule over-runs, enabling more projects to be completed on time and within budget (Davis, 1992). Some companies implement concurrent engineering for quality reasons. For example, quality improvement is the driving force for concurrent engineering at Ford (Anderson, 1993; Izuchukwu, 1992). Quality improvement can be obtained when the multiple disciplines responsible for product development are working in a team.

Some companies found that although the original goal was to improve their manufacturing productivity and quality, it had now shifted to improving time-to-market (Anonymous, 1993e). Shorter time-to-market is the main driver and the most important goal for companies to implement CE (Anonymous, 1993d). To get competitive, companies might have to divide their time to market by two (Anonymous, 1993d). The importance of getting through each turn of the product development cycle quicker than a competitor can make a company start overtaking the industry leader, even if they start out with an inferior product (Izuchukwu, 1992). Time to market can mean competitive success or failure (Kirkland, 1992).

2.4 CHALLENGERS OF CONCURRENT ENGINEERING

There are many challengers to still remain in market place. It is because nowadays many companies are facing rapid changes in industrial structure cause by technological innovation and changing customer trends. So, these companies are finding that the effort to develop new products is important for their survival. Beside technological innovation and changing customer trends, competition between other companies in the same area is one of the challenges that should be faced (Leppitt, 1993). The challenge facing American and European management today is to ensure that their organizations remain competitive in a rapidly changing and volatile climate (Leppitt, 1993).

Many competitors exist and markets are not homogeneous, but fragmented into increasingly focused niches requiring greater flexibility in the product mix, shorter production runs and higher product quality (Stephan S.A Willaert, Rob De Graaf, Simon Minderhoud, 1998). One of the reason why some companies are losing or bankrupt because they are still not realize how to meet customer demand and just do what they are do. Nothing about improvement of their product. This is approved by (Lewis,O Neal, Stuelpnagel, 1993) where the western engineering companies were losing market share because they did not respond to the market, the customers, in the way the Japanese did. Satisfying customers requires capturing the needs of these customers and looks at the whole product life cycle, until the needs are satisfied (Handfield, 1993; McClenahen, 1993; Hof, 1992; Cook, 1991; Evanczuk, 1990).

2.5 DIMENSION OF CONCURRENT ENGINEERING

The main elements of concurrent engineering are the attention to the customer, the organization of the company and the supplier. The first one is customer. It is because customer will give the profit to the company. More customers buy the product so more profit they get. It is proved by (Lewis, 1993) where the primary motive of a business is to make a profit and the customer is the only person who is willing to pay for the company's products. The reason why the customer does not want to buy the product is because that the products not meet their requirement for example the product is not friendly use, difficult to handle and etc. So, the company will lose and inventory will hide. As known, inventories contribute hidden cost. Customers are demanding innovative products with exceptional quality at competitive cost. Surviving for engineering companies depends on getting to the market first with products that the customer wants (Anderson, 1993; Handfield, 1993; McClenahen, 1993; Mills et al., 1993; Smith and Jones, 1993; Yesersky, 1993). One of the reasons companies were not customer focused is because they have never had to compete and hold a monopolistic position. Therefore the company had forgotten how to put the customer's needs first (Baskerville, 1993; Stuelpnagel, 1993).

Second is organization. The most important items in relation to concurrent engineering are management and teams (Brown, 1993; Trygg, 1993; Anonymous, 1992b; Yeh, 1992; Alter, 1991; Ziemke and McCollum, 1990). Management is very important because when the company does not have support from the top management it is difficult to implement the concurrent engineering approach because they are the one who should take the responsibility when something happen. The aim of management is to provide the framework in which teams can perform and must stand up and take personal responsibility for innovation (Anonymous, 1993f; Evans, 1993; Garrett, 1990). The main role of management's in the concurrent engineering are to commission, to counsel, motivate and mediate when they need to keep the teams focused on their goals.

Management has to define and present the team goal (Baskerville, 1993; Hume, 1993; Evanczuk, 1990). Management has to make clear to support and believe in the team (Anonymous, 1993e; Kochan, 1991). When they give clearly support to the team, so, team will do their job properly and achieve their goal. As a human, when someone believe and give high expectation to us, we should give the best result to him/her. It is same in this case. When management give fully support team will happy and give best result to the management. But if managers are not capable or willing to make and support these changes, then there is no other choice but to replace them. Management should also empower the teams, that is, their decisions must not be overridden by management (Mills, 1993; Anonymous, 1990a). Beside management, the team is also the best contributor to achieve the concurrent engineering goals. It is agreed by (Isbell, 1993; McCune, 1993) where teams are the most important issue in product development.

A good team has synergy and the foresight to identify, address, creative and innovative to resolve issues through the entire product life-cycle. However, putting a team together does not guarantee teamwork. A team that exists in name only is not a team (Sharples, 1993;Stewart, 1993 Stewart, D., 1993). It is because team should have team leader. When team do not have team leader it is like a ship without captain. The ship will go anywhere without know the destination. When team have team leader, they will clearly where their direction. The team leader's goal is to emphasize the key issue for the project for example manufacturability. The qualifications for the team leader differ from the qualifications of the individual team members. The team leader should have a broad-based background, diverse contacts, and technical expertise.

Most importantly, he or she must have leadership abilities to successfully drive the project through to completion (McClenahen, 1993; Biancini, 1992; Gorman, 1992; Schamisso, 1992). Teams with team leaders whose functional jobs and team responsibilities have a high degree of overlap tend to be the most successful (Anonymous, 1992b). To be successful, team should be discipline in term of attitude and etc. When the team have good attitude it will give the good result. A multidisciplinary team must balance all aspects of the Product Development (Sharples, 1993; Yeh, 1992). Team also should have a strong background in their area of work for example design, manufacture, and etc. When they have all of this, management will strongly believe on the team and give fully support to them. This is agreed by (Anonymous,1993f; Beckert,1993; Krishnaswamy and Elshennamy, 1993; Anonymous, 1990a; Garrett, 1990; Greene, 1990) where team members must have a strong background in the product's design, manufacture, or support.

Team members should be multi-functional, experienced, disciplined, and open to negotiation. The team should be formed as early as possible in Product Development (Anderson, 1993; Evans, 1993; Yesersky, 1993; Braham, 1992). It is because when the teams form early, the implementations concurrent engineering can start early and do not do redesign the product after product development. Redesign will costly more. The size of a team also is an important factor. If teams are too large, it may becomes unmanageable and require a structure to perform in. If teams are too small, this may limit the creativity. A workable team has between six and fifteen members depending on the size of project and complexity of the product (Baskerville, 1993; Yesersky, 1993;Hof, 1992). This number is good for problem-solving, decision-making as well as open and spontaneous communications. The number of teams depends on the type of company. For instance, the 1992 Buick Lesabre was simultaneously designed by 50 teams, averaging six members per team (Moskal, 1992). A team member also must have specific qualifications to work in a team. A team member must have technical skills, but must not be a specialist (Anonymous,1990a). Japanese companies avoid overspecialization of engineers and other functions by routinely moving people among various projects and functions (Stewart, 1993).

The third one is supplier. Focusing on core competencies requires manufacturers to involve suppliers in the development of complex products, especially in electronic design (Robert de Graaf, Luuk Kornelius, 1996). To achieve the full advantages of concurrent engineering the role of the supplier is important. It is not sensible to improve the design to manufacturing process without paying attention to the company's suppliers. Suppliers play an important role in the success or failure of implementing concurrent engineering. Failing to communicate with suppliers can found very costly, because it can direct to unnecessarily complex components to manufacture, late deliveries and quantity problems (Guy and Dale, 1993; Schamisso, 1992; Bergstrom, 1990). When this happen product will not produce on time and cost will be increased.

Good suppliers not only supply parts. But, also supply process knowledge and product component innovation, which is their real stock-in-trade. To develop a successful relationship with a supplier, it is necessary to reduce the number of suppliers in the suppliers base, involve these suppliers in product and process design decisions, and create an environment of mutual trust (O Neal, 1993; Rasmus, 1993a; Meade, 1989). Reduce number of supplier will reduce cost. Suppliers will know the criteria of the components or parts for their customer when they involve in the product and process design decision. So, the quality of components or parts will good. The basic criteria for selecting suppliers are technical capability, track record, financial strength and their flexibility. The supplier base must be treated as an extension of the organization. A good relationship must and can be financially rewarding for both parties (Engel, 1991). The supplier performance is naturally measured by accuracy, product cost, quality, and on-time delivery. Product cost only is not a good determinant of supplier performance. The two significant measures of supplier performance observed were incoming product quality and on-time delivery. Of these two factors, quality is critical for selecting the supplier.

Concepts of concurrent engineering such as high quality, fast respond, and low cost. In this project, CE is use to get high quality and fast respond. Example, when finish the QFD, next step is doing the prototype. When it is finish, prototype will be analyzed. From the analysis, it can show that either it meet the requirement from customer or not. If not, it can be redesign again and do prototyping again in short time before fabricate the real product.

2.6 QUALITY FUNCTION DEPLOYMENT (QFD)

2.6.1 Definition of QFD

QFD is one of the concurrent engineering tools. QFD is a system to deploy the voices of the customers in understanding their requirements into the appropriate technical requirements for each stage of product development and production. QFD was used in many areas like industries, software, health care, and etc. QFD is a management technique aimed at facilitating companywide quality control which has proven valuable in the fields of manufacturing and service production (I Erikkson & F McFadden, 1993). QFD is "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). QFD is a tool for bringing the voice of the customer into the product development process from conceptual design through to manufacturing (John J Cristiano, Jeffrey K Liker, & Chelsea C White III, 2000). QFD is an innovative approach bringing quality—as demanded by the customer—upstream in the product development process (A.I.A Costa, M Dekker, & W.M.F Jongen, 2000).

2.6.2 History of QFD

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's 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 that 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.QFD is said to have been first proposed in Japan by Yoji Akao in 1966 (A.I.A Costa, M Dekker, & W.M.F Jongen, 2000).

2.6.3 Case study

According to the researched by J Viaene and R Januszewska, they make a case study QFD in chocolate industry. The aim of their study is to build a structured approach to food development through the QFD with application to chocolate covertures. The final concept relates to filled (composite) chocolate that, according to definition, is a chocolate with filling (praliné) covered by chocolate couverture of not less than 15%. The research procedure that consists of the five steps was developed in association with the QFD. First, the market research was conducted to determine the segment of filled-chocolate consumers. As a result, a target group of people between 20 and 29 years old was found. Second, the behavioral motives of the consumers in the target segment were analyzed. Then product objective specifications were established through physic-chemical and instrumental methods. Finally, sensory analyses were performed involving both consumer and trained panels. A few significant correlations between instrumental and sensory scores were established. The last step of research relates to analysis of the mutual relations between technical and sensory measurements and integration of results in the QFD. Figure 2.1 shows the relation presented on the QFD.

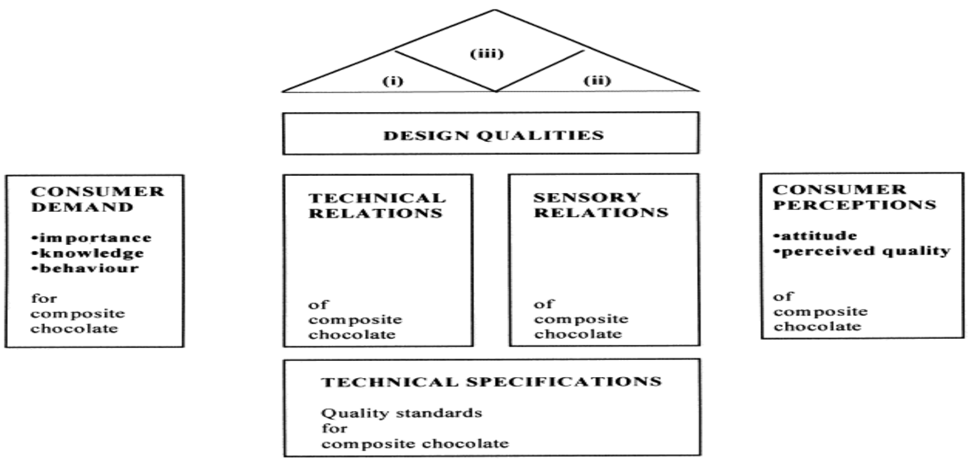

Figure 2.1: Relation presented on the QFD.