The Analysis for Improving Quality on The Dietary Meal Product By Applying The Practice of Quality Function Deployement (QFD) Approach Within The Food Industry

Humiras Hardi Purba[1], Siti Aisyah[2], Mohamad Riza[3], Mahandika Natakusuma[4], Hadiman Nurdin[5], Hendra Sunandar[6], Ida Bagoes Indra[7]

[1](Department of Industrial Engineering, Mercu Buana University, Jakarta, Indonesia Email:hardipurba@yahoo.com)

[2](College of Industrial Management, Ministry of Industry-Republic of Indonesia lalita1712aisyah@gmail.com)

[3](Department of Industrial Engineering, Mercu Buana University, Jakarta, Indonesia Email: muhammad.riza@dsngroup.co.id)

[4](Department of Industrial Engineering, Mercu Buana University, Jakarta, Indonesia Email:mahandika.natakusuma@gmail.com)

[5](Department of Industrial Engineering, Mercu Buana University, Jakarta, Indonesia Email:hadimannurdin@gmail.com)

[6](Department of Industrial Engineering, Mercu Buana University, Jakarta, Indonesia Email:hendrasunandar@yahoo.com)

[7](Department of Industrial Engineering, Mercu Buana University, Jakarta, Indonesia Email:bagoes.workshop@gmail.com)

ABSTRACT

The development of food products has always been a concern for active companies in the food industry. The rapid technological advancement gives the food company the ability to introduce new products to the market. However, the big concern is about the success rate of what is introduced as a new product to the market. Many methods, in product development, have been exploited by different food companies, while few concentrate on food products. Due to the different characteristics of other industrial products increase the need for guidelines for improvement of brilliant food products. This article presents some useful information for the literature review on the topic of the application of QFD in the food industry that is related to our study at Mercu Buana University in Jakarta, regarding a Quality Improvement and Six Sigma subject in Industrial Engineering Studies. This paper explains as well the description of methodologies involved through in a practice of QFD within the food industry, and then exemplified with the support of our case study on dietary food product quality improvement. Inside the Voice of Customer (VOC) or Customer Need section part for the House of Quality (HOQ), we used the numbers of weight that can be applied for describing the development dietary food product, start from 3, 4 and 5,then the figure of 5 explains that is the finest value we could put on for the Healthy Living, Legitimate and Standardization of HealthExperts; Weight of number 4 is for Quality Guaranteed, Clean& Hygienic and Delicious Taste; Weight of number 3 is for Low Price for the product, Quick Served, Available at Any Time, Assorted Types and Well Packaged. We didn't use the number of 2, 1 and 0 because these figures have low quantitative values for the quality improvement estimation in our dietary food product. The QFD approach may turn out to be an effective tool in planning customer-oriented product development processes, and therefore, achieving higher and faster

customer satisfaction levels within a very competitive world.

Keywords: *- Customer-oriented product development process, food industry, food products, quality function deployment.*

1. INTRODUCTION

Nowadays food business field could be best characterized as a technology-based environment whose continuity is constantly overwhelmed by a highly consumer-oriented market, demanding the continual development of upcoming innovative products that meet expectations. Shortening product life cycles and increased consumer demand for more variety and increasing consumer demand for greater variety and quality has led to the need for tools that can develop plan, organize and cultivate improved food quality and new product development[12,31].In a more intensive way, companies are forced to adjust to new competitive markets. The technological change took place since the 1980s brought implications for international competition, in particular the demarcation of new areas of global competition. This is due to the acceleration of technological change coupled with the shortening of product and process life cycles, in addition to increasing product differentiation. In fact, the concern is that these factors not only cause the company to restructure its production system and management type, but most importantly, to ensure delivery capacity to the market, even more sophisticated products. The ability to realize competitive alternatives in the market, develop strategies and invest in the right training, that's what ensures the sustainability and profitability of the organization in this new structure.

From the competition side of the food industry, the concern is the integrity of the product so the main focus. This means the superiority of the product, in the food industry, goes beyond merely offering goods with basic attributes. This attribute is only a prerequisite for companies to continue to play competitive games. In fact, at this time, products must not only satisfy, but most importantly, surprise their customers. What is realized is that these consumers have accumulated experience with multiple products and become sensitive to small differences in many ways. This means that innovations in products and processes enhance the excellence of product standards, making the development process an important factor for business competition.

Quality Function Deployment (QFD) is a comprehensive quality system used to achieve customer satisfaction and business growth in virtually all types of industries such as food industry, manufacturing industry, shipbuilding industry, automotive industry, product design, product service, project management and after sales service etc. Quality Function Deployment has achieved tremendous popularity worldwide in a wide range of almost all sectors. QFD identifies shortcomings and bridges the gap between the present level and the standard level of technical requirements then leads to the discovery and application of better service quality. QFD increases the number of satisfied customers in businesses that generate higher profits and business growth. As a result certain brand names and goodwill of certain industries improved among their competitors.

QFD is an innovative method that can bring quality upstream customer demand in the process of developing its production. In the context of Research and Development (R & D), QFD can be seen as a set of planning tools that help introduce new or better products or services to the market by controlling their development process and focusing on customer satisfaction[2,9,14].

QFD was discovered by Professor Yoji Akao in 1966 in Japan. In the context of TQC (Total Quality Control), the Japanese quality management system model is responsible for causing a revolution in production systems in the country. All that is possible, because of the emphasis on product quality considering the customer's point of view. QFD is the expanding, step by step, function or operation that shapes the quality of the product. This methodology seeks to address the problems inherent in the product development process at an early stage, in a way that is critical to determining the quality of the product and its manufacturing processes set at the design and control stage during the development stage. This methodology also ensures the achievement of quality as it works with a focus on consumer needs. More specifically, this translates consumer requirements into technical language and then ensures their satisfaction throughout the product development process.

Quality matrix is a tool used to manage consumer needs into technical information. The purpose of the matrix is to determine the pattern, quantitative or qualitative, each attribute of the quality of the final product. Another matrix is a quality matrix and aims to detail the project so that all factors contributing to the achievement of the final product are designed, such ascharacteristics of intermediate products, manufacturing process parameters, raw materials and inputs.

In addition, the QFD method assists in managing the product development process as it coordinates the flow of information and regulates activity in terms of function. It promotes rapid functional integration and problem solving. With all that, the purpose of this chapter is to describe the potential use of the QFD method into product development in food companies. This research initially intended to contextualize the management of product development in the food industry and demonstrate the QFD method as a tool capable of directing, in how to practice, how to plan and conduct product development process activities. So the steps of implementing QFD in food product development will be detailed. In addition, support tools in marketing research and sensory analysis will be suggested.

2. LITERATURE REVIEW

2.1. Quality Function Development (QFD) Historical Establishment

Today's millennium has been publishing several dozen papers on Quality Function Deployment (QFD) [1,4,5,23,32], for less than a dozen in the late 1960s when the new QFD drive was started. Therefore, the QFD field is described as one that grows both deeply and scope, presenting a broad spectrum of problems. Thus, there is a clear understanding that QFD is stronger today compared to four decades ago[7,8,34]. Theoretical knowledge of QFD and modeling has also increased significantly over the past two decades[27,29,35]. The QFD approach could be used as asophisticated quality tool to improve the performance of manufacturing systems appear to be spreading across several publishing outlets[3,13,24,25,33]. Moreover, the efforts made in this decade to understand how such knowledge can be integrated so that the benefit of investigators seeking to expand the knowledge area of QFD appears to have produced research published many years ago, excluding the current literature on this issue [9].

The honor of a great pioneering work on QFD research can be credited to Professor Yoji Akao who initiated the research that formed the foundation on which further research evolved. The development of the QFD concept can be traced to Japan in the late 1960s when Japanese industry escaped their post-World War II product development mode through copying and copying [5]. Intelligent Japanese manufacturers buy equipment and technology, install it and test it under various conditions to ensure their strengths and weaknesses, resulting in low-cost, high-end imitations for extensive use, but have little patronage from customers because the production is rough and unattractive. The Japanese government then controls imports and encourages Small and Medium Enterprises (SMEs) that push the current high technological status in Japan [5]. Since the beginning of development of QFD in Japan, it has spread rapidly to the US in the 1980s and then to various industries in many countries[15]. The development of the QFD field was also enhanced by the introduction of computers that made calculations very easy and prototypes easily achieved. The impact of computers on QFD is complex and multiple sides by considering some data manipulation that electronic data processing allows and can be done. The analysis of QFD data is easily assisted by computers to collect, record, retrieve, analyze simple and complex QFD problems, and distribute information about QFD in circulation.Countless years of tedious work by QFD researchers and practitioners have been rescued and the need to monitor and control the tedious and repetitive process is eliminated. Regardless of the importance of computers to QFD, its potential is not fully explored to achieve its full impact.

One of its first QFD applications was in Kobe Shipyards, by Mitsubishi Heavy Industries in 1972. It was primarily aimed at ensuring that all the actions required to ensure high quality for a product were made, and scarce resources focused on the most. Important areas Unfortunately, QFD applications on Kobe Shipyards and similar practices were not currently documented in the public interest. Thus, the use of QFD is currently limited to a number of

specialized organizations that have quality management experts with creative abilities. As a result, the dissemination of QFD information to the public affects its spread throughout the world. With the invention of Japanese Scientific Management in the West in the 1980s, QFD was discovered and adopted with enthusiasm around the world[9]. The QFD growth catalyst at this stage is that the QFD philosophy is mixed with Japanese culture. Hauser and Clausing's article (1988), and King's book (1989), among many others, catalyzed and sparked widespread adoption around the world[5]. The establishment of the QFD Institute in the United States in 1993 expanded the knowledge of QFD to many areas. The growth was later enhanced by the first International QFD Symposium of 1995, organized by the Japan Union of Scientists and Engineers (JUSE). The International Council for QFD, formed in 1996 in the US instituting the Akao Prize for outstanding contributions to the development of QFD and the German QFD Institute, established in 1996, has also led to the deployment of QFD to other parts of the world. QFD is one of the cutting-edge quality techniques used only by far-flung organizations seeking world-class quality or international competitiveness. For such an organization, an operational quality system should exist. They should use tools and techniques such as Taguchi's Experimental Design, Statistical Process Control and Concurrent Engineering (CE). They may use analytical methods such as Value Analysis, FMEA, Failure Tree Analysis, Process Capability Analysis, Pugh's concept (1981) selection methods, and others. Under these circumstances, QFD is ensured to be used to support existing tools and methods. High levels of performance and excellence are then achieved through clear strategic objectives, commitment, visionary leadership, strong focus on organizational competence development, total change in organizational culture, significant investment in information technology, and adequate resources [37].

2.2. Definition of Quality

Before we discuss about the practice of Quality Function Deployment (QFD) within the food industry, we should understand about the concept of quality because it is very important in the development activities of the enterprise in that the growth of a enterprise is determined by the quality of the products or services it produces. Indifference to quality will lead to a loss of opportunity to sell products and market share, which in turn resulted in decreased activity and growth of the enterprise [11,30,36].

In giving an attempt for understanding the cognition of the quality of a product then the five definitions of quality will be explained as follows:

1) Quality is the capability of a product or service to satisfy consumer desires easily understood, and has some characteristics that can be attributed to the achievement or not so as to elicit another person's reaction.
2) Quality is a business strategy that essentially seeks to produce a variety of goods and services that satisfy customers both internally and externally with complete and trying to meet their expectations either implicitly or explicitly.
3) Quality is the product's competency to perform its function during certain specified uses.
4) Quality is the overall characteristic of a product that supports a defined or defined satisfying potential.
5) Quality is the total of characteristics in a company's industry that matches needs and wants.

2.3. The Performance of QFD in the Food Industry

Much the decision of applying Quality Function Deployment (QFD) in the food industry, is to carry outthe food product establishment activities has been completed, the next step is to obtain the executive commitment and organizational support needed for the project. Then, decisions must be made about the project objectives (quality improvement, new product expansion, increased customer satisfaction, etc), timeframe and schedule. The next step is to determine the concept or product that exists (or generate categories) that will be the object of the QFD project and which target customers will be targeted[9,15,16]. Finally, cross-functional teams involving members of all functions involved in product development and market introduction processes are gathered such as, market research, product and process design, engineering and production, quality management, marketing, sales and distribution[21].The facilities,

materials and time necessary to manage the program are made available by management and the team at what point they can start with[9,15,16].

There are two types of team activities involved in QFD performance program:

- The Product's Quality Deployment, referring to the activities needed to convert customer-required quality (as the customer defines it) into a product's specific attributes;
- The Deployment of the Quality Function, concerning the activities needed to assure that the customer-required quality, once put into the product, is actually achieved.

Principally, this activity connects the quality that customers need to the overall development of food products and market recognition functions at downstream by producing a cascade of matrix-shaped graphs. This matrix generation process is combined in a four-stage approach, a focused approach consisting of four matrices implicating product planning, product design, process planning and process control planning stages[2,14,18].

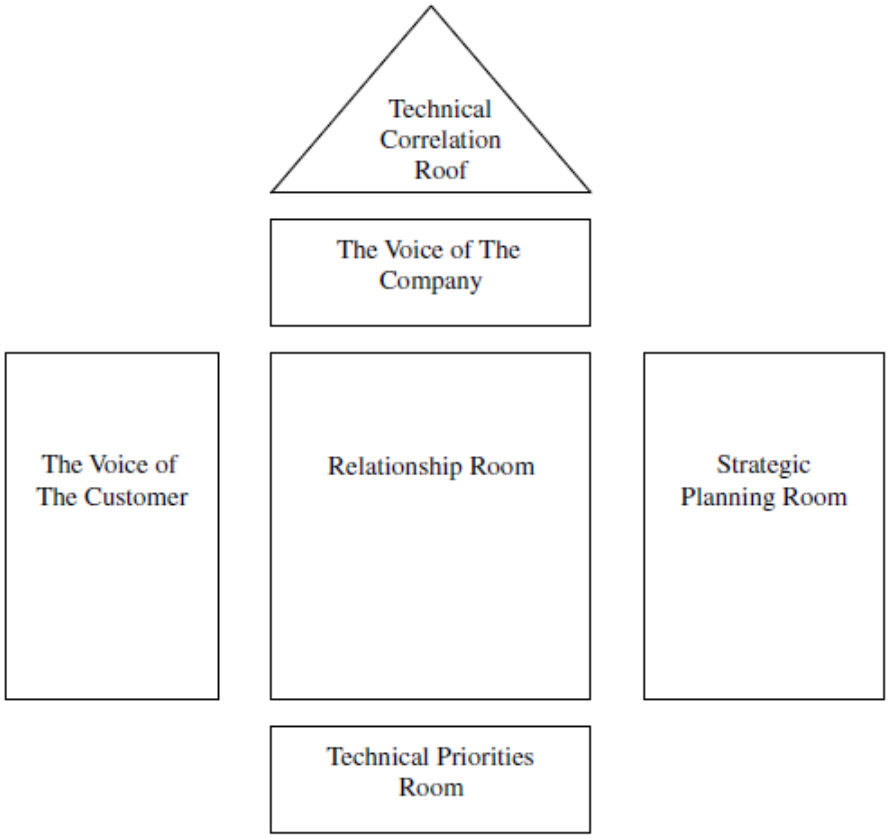


Figure 1.HOQ (Source: Kahraman et al., European Journal of Operational Research, 2004).

3. METHOD

Product's quality deployment is The House of Quality (HOQ) like shown in figure 1.Product's quality deployment is The House of Quality (HOQ) like shown in figure 1.In a four-stage QFD method, the first matrix to be built is Product Planning Matrix, also known as The House of Quality (HOQ) because of its home-like shape[18]. The goal is to interpret notable requirements concerning product quality into significant finale product control features. HOQ consists of some dissimilar sections or 'Rooms' that are filled in sequence to obtain actionable translation from requirements to features[2,6,9,14,15,19].

The HOQ's first room concerns the Voice of the Customer (VOC)[16],that means a structured list of requirements regarding the product and its attributes as the the customers describe them (also known as "Customer Requirements", "Wants" or WHATs"), together with a measure of the importance the customers attach to each requirement[2,9,14,15,18,19]. The customer requirements are loose, vague qualitative statements in the customer's own words, like 'easy to use' or "with a fresh taste'. They indicate which

benefits the customer expects to be fulfilled by the product or service. There are several possible source of customers requirements: market research data, sales data, customer complaints, retailers, focus groups, toll-free lines, opinion surveys, in-depth interviews, etc.After their identification, the customer's requirements are compiled and structured by the QFD team (and/or by the customer), using the so-called "Quality Tools"[9,18]. Finally, relative importance weightings are attached to each customer requirements by the QFD team based on quantitative market research, viz the Customer Importance Rating. This helps establish priorities in the product development process and to allocate the necessary resources[2,9,14,15,18,19]. Figure 2 shows the Voice of the Customer in a case study regarding the application of QFD in the quality of our own study in the dietary food product.

Costumer Need	Weight
Healthy Living	5
Low Price	3
Quick Served	3
Quality Guaranteed	4
Legitimate	5
Clean & Hygienic	4
Standardization of Health Experts	5
Available at Any Time	3
Assorted Types	3
Delicious Taste	4
Well Packaged	3
Technical Priorities	
% of Total Priorities	
Technical Benchmarks	**Our Product**
	Competitor A
	Competitor B
Design Targets	

Figure 2. The VOC (Source: Outcome decided from study group in a subject of the Quality Improvement and Six Sigma at Mercu Buana University in Jakarta, 2017).

Figure 2 displaysthe Voice of the Customer (VOC) or it's known also as the Customer Need in a case study regarding the quality improvement for our dietary food product. The targeted market segment was for all age people who's trying to loose their fat. Results displayed are the discussed outcome of the qualitative and quantitative (study group in a subject of Quality Improvement and Six Sigma at Mercu Buana University in Jakarta, 2017) decided in the team.

The development of the Voice of the Customer is the most critical step in a QFD program[19]. On one hand, it requires obtaining and expressing what customers require of a product or service and not what the company thinks they require and how important this is for them. On the other hand, since these prioritized customer requirements are guiding the whole development process, a missinterpretation at this stage may seriously comprimises the outcome of the process [9].

Much the QFD team has established the customer requirements, the next step is to understand where the company and its competitors stand in terms of satisfying these reqaurements in the marketplace, by filling the Strategic Planning Room (Figure 3)[18,22].

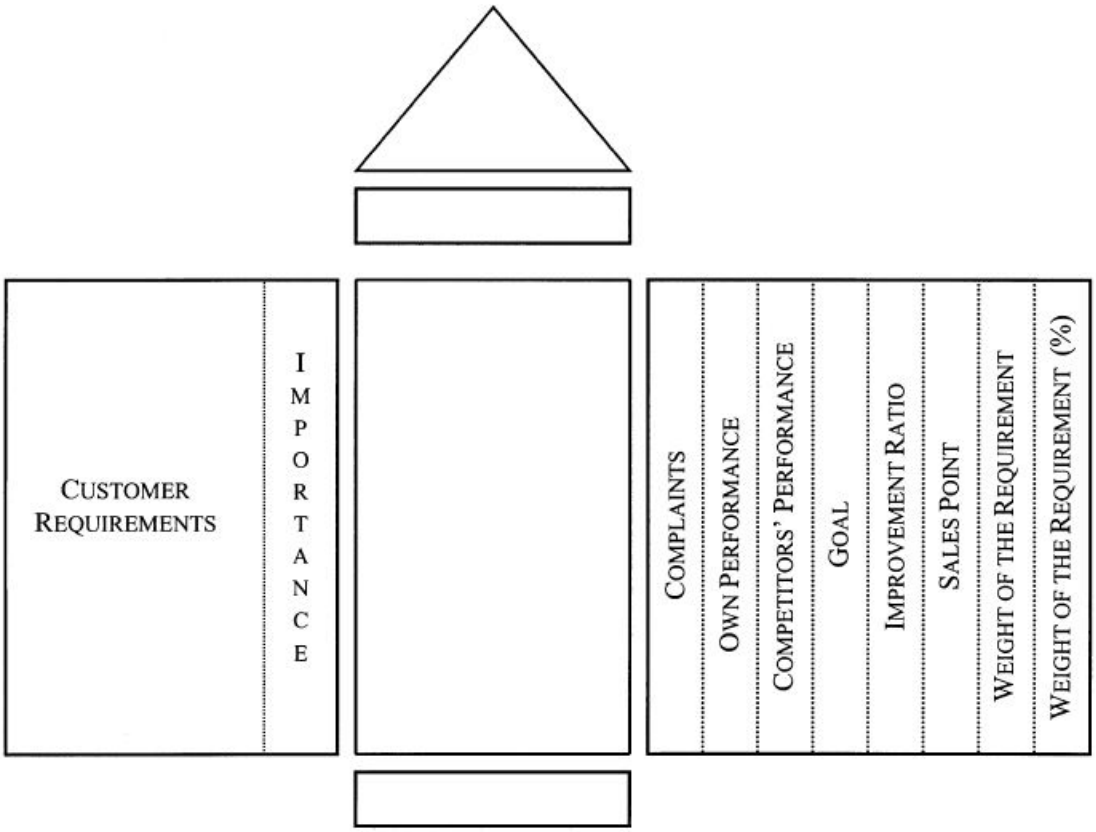


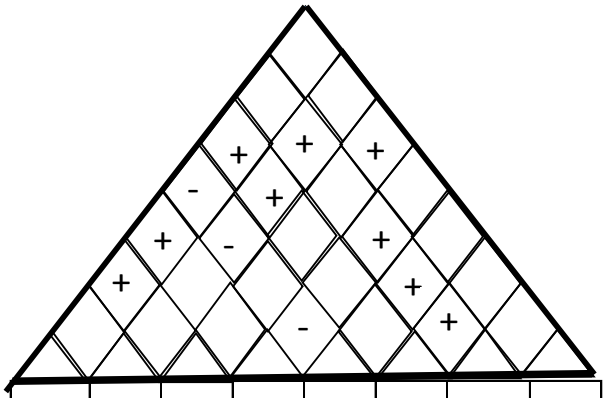
Figure 3. The Strategic Planning Room and its components (Source: Costa, 1996).

Based on qualitative and quantitative market research, the customers' perception of how the company's product or concept satisfies their requirements in comparison to other products, namely CustomerCompetitive Assessment, that is rated and graphically depicted. A Customer Complaints column may also be added. An Improvement Ratio is calculated based on the company's current and planned levels (Goals) of customer satisfaction. Finally, the Strategic Planning Room provides a link between the QFD program and the company's strategic vision by identifying market opportunities, viz the Sales Points, and priorities for Research and Development (R&D) based on the Weight of each Customer Requirement for the company [2,9,16,18,22].

At this stage, the QFD team should have a clear picture of what the customer requires from the product or concept and how this can be related to the company's strategy. The team had to decide how these requirements can be incorporated into the final product so that the customer is satisfied. This is represented in the House of Quality (HOQ) by the Voice of the Company Room[2,6]. Here, the end-product's technical characteristics directly related to the customer's requirements are listed, that is the "design requirements", "quality functions" or "HOWs". They must be measureable parameters that will be used to evaluate objectively the product's quality, since their outputs are going to be controlled and compared with target values to ensure customer requirements are being met[2,9,14,15,18,19,22]. Often these parameters are correlated in a product, therefore in the Technical Correlation Roof [6] the QFD team has to determine the effects of changing one product characteristics on the others attributes, enabling the team to identify and react to synergistics (positive interdependence) situations. Trade-off situations often point out R&D needs and should always be solved in the way that most favours the customer [6].

The QFD team must now fill the core of the HOQ, namely the Relationship Room where the relationships between each customer requirement (Voice of the

Consumer) and the product characteristics (Voice of the Company), as well as their intensity, are depicted. The team seeks consensus on how much each product characteristic affects each customer requirement based on their own expertise, customer surveys or data from statistical studies and controlled experiments. This widely recognized complex task is another critical stage in the HOQ building process. On one hand, it shows whether or not the company is adequately addressing the customer requirements that are not being addressed by any of the product's technical characteristics. Therefore, a product characteristics may be missing or may have to be modified in the final product. An empty column indicates either a waste of resources, by showing that there is aproduct characteristic not satisfying any of the listed customer requirements, or missing customer requirements.Figure 4 represents a diagram of the Voice of the Customer, the Voice of the Company, the Relationship Room and Technical Correlation Roof in the field of dietary food product improvement case study.



Costumer Need	Weight	Certified Food Safety	Routine Checking Calories	Reliable Suppliers	Routine Audits	Affordable Cost	Working Together with Nutritionists	Owning a Team in R&D	Adequate Distribution
Healthy Living	5		◎				?		
Low Price	3					◎			Δ
Quick Served	3			?					◎
Quality Guaranteed	4	◎			?				
Legitimate	5	◎		?					
Clean & Hygienic	4	?			◎				
Standardization of Health Experts	5						◎		
Available at Any Time	3								◎
Assorted Types	3					Δ		◎	
Delicious Taste	4			Δ	Δ			◎	
Well Packaged	3							◎	

Figure 4. The Voice of the Customer or the Customer Need, the Voice of the Company, The Technical Correlation Roof and the Relationship Room in a case study regarding the quality improvement for our dietary food product (study group in a subject of the Quality Improvement and Six Sigma at Mercu Buana University in Jakarta, 2017).

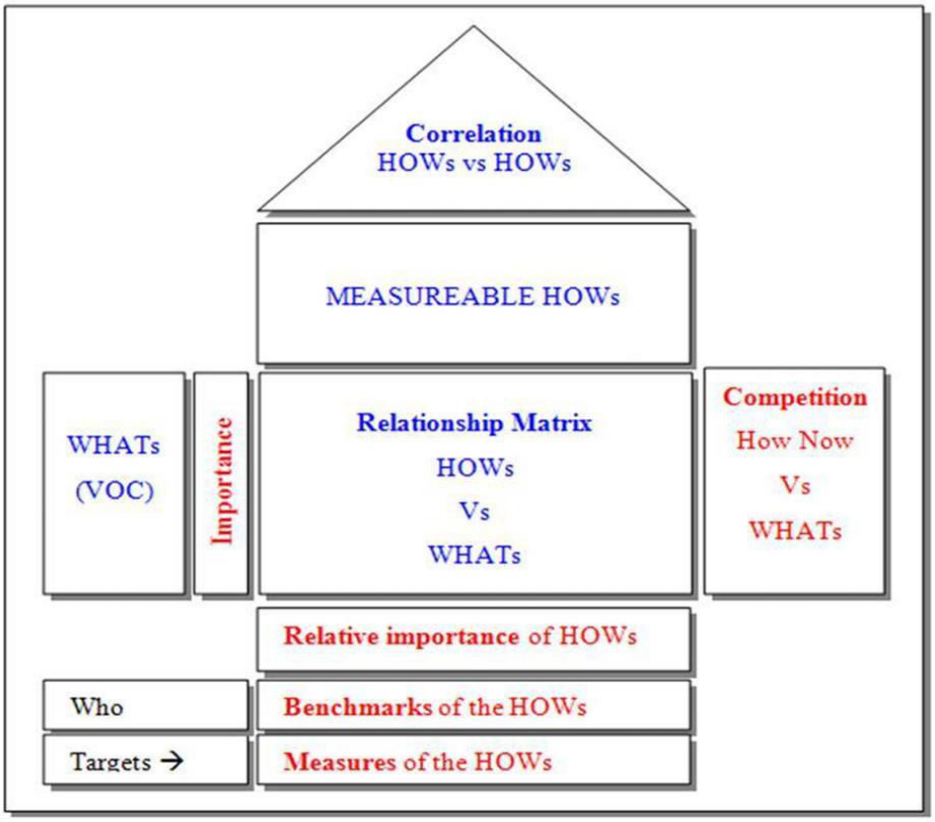


Figure 5. The Technical Priorities' Room and its components (Source: Costa, 1996).

The last task in building the HOQ is filling the Technical Priorities Room as shown in figure 5. It starts with a Technical Competitive Assessment of the end-product's characteristics (Voice of the Company) in currently marketed products[9]. In this way, the QFD team can view the competitors' and their own technical performance level regarding product characteristics directly affecting customer reqairements[18]. 'In-house' product testing usually provides the data necessarry for this assessment, which again should be expressed in measurable terms. For each product characteristic, the comparison between the company's and the competitors' technical performance level of organizational difficulty related with realising each end-product characteristic can also be added [6,19].

The Technical Competitive Assesssment is then compared with the Customer Competitive Assessment (Strategic Planning Room). This is done to determine inconsistencies between how the customers and the company are evaluating existing products. For example, let us say that the Customer Competitive Assessment indicates that a competitive product is best meeting a certain requirement fro the customer's point of view. Meanwhile, the Technical Competitive Assessment and the Relationship Room indicate that because of the company's current performance level in a certain end-product characteristic that requirement is better fulfilled.

This contradiction points out to one of the following situations, viz:

a) The Technical Competitive Assessment may have been inadequately performed;
b) There was a mistake in filling the Relationship Room and the end-product characteristic is not related with the customer requirement;
c) The customer's evaluation of the product has no real substance and the product's characteristic satisfies better the requirement than the competition should be envisaged [14].

The Customer and Technical Competitive Assessments, the Sales Points, the Relationship Room and the Customer Importance Ratings all contribute to determine the Target Values or How Much's [9]. The Target Values represent, in measurable terms, the level of performance for each end-product characteristic the company has to provide in order to maximize customer satisfaction. These performance levels are critical control points to be measured at each stage of the product development and market intoduction processes. Thus, the Target Values provide not only an objective means of assessing requirements' compliance but also specific goals for further R&D. A final Technical Importance Rating for each end-product characteristic can also be calculated based on the Customer Importance Rating for each requirement and the strength of the realtionships between that characteristic and each customer requirement (Relationship Room). These ratings indicate the relative importance of each end-product characteristic in obtaining the collective consumer requirements. As the absolute values are meaningless, they are often expressed as a percentage [6,22].

The HOQ has been the main focus of QFD-related literature, because it contains the most critical information a company needs regarding its relationships with customers and its competitive position in the marketplace. However, and in order to trully drive the wole product development process, the Voice of the Customer must be still systemataically cascaded into the remaining product/process design activities and marketing stages through the use of additional matrices [17].

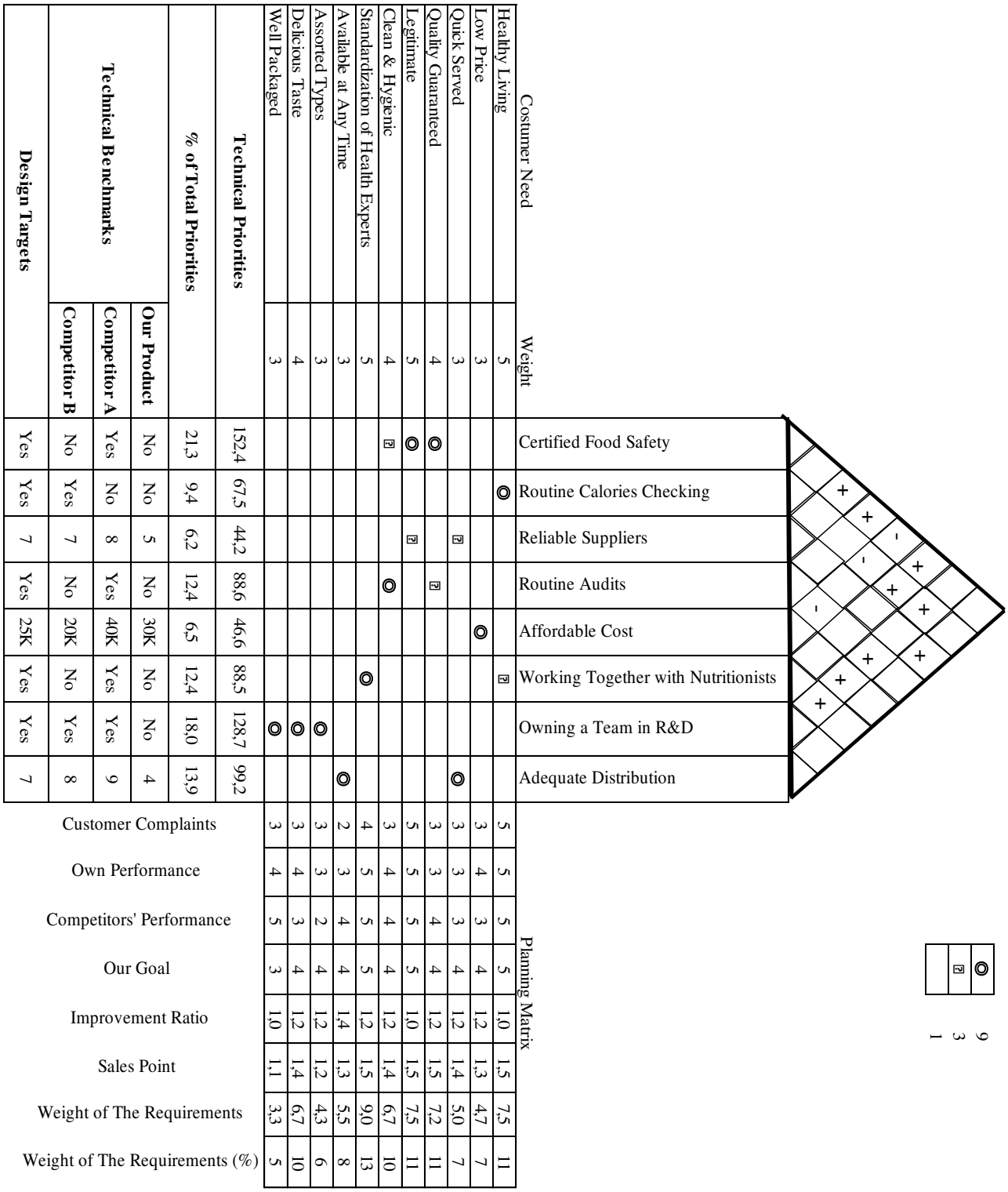


Figure 5. End outcome design for the House of Quality's QFD related to a case study about the quality improvement of dietary food product (study group in a subject of the Quality Improvement and Six Sigma at Mercu Buana University in Jakarta, 2017).

4. RESULTS AND DISCUSSION

Based on the information described in the House of Quality (HOQ), the Quality Function Deployment (QFD) team has now selected the final product characteristics to be used through remaining R & D activities and market introductions. The characteristics of the final product indicating a Technical High Rank above a predetermined threshold (indicating a relatively strong interest in obtaining collective

consumer requirements) are selected for further application. The same is true of the final product characteristics associated with customer requirements, which are strong Sales Points or have poor Competitive Performance. End product characteristics that have either Organizational or Technical Difficulties levels can also be selected.

The characteristics of the final product chosen will now be brought from the entire poduct level to the component level through the construction of the Deployment Matrix, Product Design Matrix or the Section Deployment Matrix. This matrix shows how and to what extent the relationships between components and product characteristics are important. The structure is similar to HOQ, which is the final product characteristic sequence selected, which is now a design requirement, while the column lists the characteristics of the components depicted in the matrix core. The critical component characteristics are selected based on the strength of this relationship and will be used further into production planning and control systems.

An important component characteristic becomes the third connection matrix series, the Process Plan and Control Chart or Process Planning Matrix, in which the column is a related processing operation. If the critical component characteristics are strongly influenced by the process operation, these characteristics become the control points in the quality control plan. In addition, if the process operation parameters must be monitored to achieve the characteristic level of a particular component, this parameter becomes the checkpoint in the process control plan. In the last matrix, the Operation Instruction or Production Planning Matrix, which means the control point and check point derived from the previous matrix are related to the operating instructions managed during production.

By means of the Deployment of Quality Function activities, QFD teams have promoted operational means to control product characteristics and key components (control points) during product development and market introduction. This information can now be integrated into the company's quality assurance system, bringing customer trust and upstream quality assurance for product expansion.

5. CONCLUSION

Quality Function Deployment (QFD) is a systematic approach to assist facilitate the product development process by ensuring the customer's needs are considered during the process, and then reflecting his voice in the final product. One of the industries through which QFD is the food industry.At the present time, food business field can be the best characterized as a technology-based environment whose continuity is constantly overwhelmed by a highly consumer-oriented market, demanding the continual development of upcoming innovative products that meet expectations.QFD was inventedby Professor Yoji Akao in 1966 in Japan. In the context of TQC (Total Quality Control), the Japanese quality management system model is responsible for causing a revolution in production systems in the country. All that is possible, because of the emphasis on product quality considering the customer's point of view.QFD is an innovative method that can bring quality upstream customer demand in the process of developing its production. In the context of R & D, Quality Function Deplyment (QFD) could be seen as a set of planning tools that help introduce new or better products or services to the market by controlling their development process and focusing on customer satisfaction.The methodology used for the QFD ensures the achievement of quality as it works with a focus on consumer needs.Quality matrix is a tool used to manage consumer needs into technical information. The purpose of the matrix is to determine the pattern, quantitative or qualitative, each attribute of the quality of the final product. Another matrix is a quality matrix and aims to detail the project so that all factors contributing to the achievement of the final product are designed, such ascharacteristics of intermediate products, manufacturing process parameters, raw materials and inputs.It is very important to know about the concept of qulaity because, in the development activities of the enterprise in that the growth of a enterprise, is determined by the quality of the products or services it produces. Indifference to quality will lead to a loss of opportunity to sell products and market share, which in turn resulted in decreased activity and growth of the enterprise.Then,in order to understand the concept of the quality of a product, the five definitions of quality, namely (i) quality is the ability of a product or service to satisfy consumer desires

easily understood, characteristics related to achievement or Not in the case of other people's reactions, (ii) quality is a business strategy that essentially seeks to produce a range of goods and services that satisfy customers both internally and externally in full and strive to meet their expectations either implicitly or explicitly, (iii) quality is the product's ability to perform its function during certain predetermined uses, (iv) quality is the overall characteristic of a product that supports a defined or defined satisfying ability, and (v) quality is the total characteristic of an industrial organization according to needs and wants.

A major weakness of the Quality Function Deployment (QFD) method is that it might be very hard, or even impossible, to use the Four-Phase model for the improvement of food products. This is because of the complexity of food products, the many interactions between the ingredients and the influence of processes on functional properties of the product. This results in the fact that it is not possible to give precise target values (HOW MUCH) for the product requirements (HOWs). Besides, many ingredients are still physiologically active, leading to a change in the quality of the ingredients during the production process. Food ingredients also show a natural variation in composition. This results in the fact that food ingredients have a larger standard deviation compared to the standard deviation of parts used in other industries. For example, a screw can be precisely specified in length, weight, and composition of the material. While the milk of a cow differs per cow and even during the day, it can be standardised but the milk still shows variation. Moreover, one is forced to deploy only the most important consumer demands and the demands new to the company since there are so many consumer demands and design characteristics for each product. The hazard is that interactions are overlooked and that, as a result, the final product is not what the consumer asked for. However, the first matrix, namely the House of Quality, is very useful to get insight in what information is necessary to make trade-off decisions and to improve the product. A positive feature of using QFD is that the matrices can provide a link between the quality characteristics as demanded by the consumer and the actors in the production chain.

REFERENCES

[1] Y. Akao, G.H. Mazur, The leading edge in QFD: past, present and future, *International Journal of Quality & Reliability Management*,*20 (1),*2003, 20-35.

[2] American Supplier Institute (ASI), *"Quality Function Deployment",* 3-day workshop, American Supplier Institute, Dearborn, Michigan, 1987, ASI.

[3] E. Bottani, A fuzzy QFD approach to achieve agility,*International Journal of Production Economics*, *119*, 2012, 380-391.

[4] J.A. Carnevalli, P.C. Miguel, Review, analysis and classification of the literature on QFD – Types of research, difficulties and benefits,*International Journal of Production Economics, 114 (2),*2008, 737-754.

[5] L.K. Chan, M.L. Wu, A systematic approach to Quality Function Deployment with a full illustrative example,*Omega:The International Journal of Management Science*, *33 (2)*, 2005, 119-139.

[6] W.P. Charteris, Quality Function Deployment: A Quality Engineering Technology for the Food Industry,*Journal of the Society of Dairy Technology 46*, 2013, 12-21.

[7] L.H. Chen, W.C. Ko, Fuzzy linear programming models for NPD using a four-phase QFD activity process based on the means-end chain concept,*European Journal of Operational Research*, *201*, 2010, 619-632.

[8] K.S. Chin,Y.M. Wang,J.B. Yang, and K.K.G. Poon,An evidential reasoning based approach for quality Function Development under uncertainty,*Expert Systems with Applications*, *36*, 2009, 5684-5694.

[9] L. Cohen, *In Quality Function Deployement: How to Make QFD Work for You*, Addison-Wesley Publishing Company, Reading, MA, 2012.

[10] A.I.A. Costa, *Development of Methodologies for Quality Modelling: An Application on Tomato Ketchup*, master of science thesis, department of agrotechnology and food sciences, integrated food technology, Wageningen University, Wageningen, 2012.

[11] H. David, *Quality Systems Handbook*, Boston: Butterworth – Heinemann, 1994.

[12] M. Dekker, A.R. Linnemann, *Innovation of Food Production Systems: Product Quality and Consumer Acceptance, Product Development in the Food Industry*, (Jongen WMF, Meulenberg, MTG, eds), Wageningren Pers, Wageningren, 67-86, 1998.

[13] E.K. Delice,Z. Gungor, A new mixed integer linear programming model for product development,*Computers and Industrial Engineering, 57*, 2012, 906-912.

[14] J.R. Evans, W.M. Lindsay, *The Management and Control Quality*, 3rd ed., West Publishing Company, St Paul, MN, pp.155-165, pp. 248-259, 2013.

[15] C.P.M. Govers, What and How about Qulaity Function Deployment (QFD),*International Journal of Production Economics*, *46 (47),*2012, 575-585.

[16] A. Griffin, Evaluating QFD's use in US firms as a pocess for developing products,*Journal of Product Innovation Management*, *9,* 2012, 171-187.

[17] A. Gustafsson, *QFD and Conjoint Analysis: The Key to Customer Oriented Products*, master of science thesis, division of quality technology, departement of mechanical engineering, Linköping University, Linköping, 2013.

[18] J.R. Hauser, D.Clausing, *"The House of Quality"*,The Harvard Business Review, May-June, 1988 , (3), pp 63-73.

[19] K.R. Hofmeister, *Food Product Development: From Concept to the Marketplace*, Quality Function Deployment: Market Succsess Through Customer-driven Products, (Graf, E, Saguy, IS, eds.), pp 189-210, Van Nostrand and Reinhold, New York, 1991.

[20] C. Kahraman, T.Ertay, G. Büyüközkan, A fuzzy optimization model for QFD planning process using analytic network approach,*European Journal of Operational Research*, Elsevier, 2004.

[21] R. King, *"Listening to the Voice of the Customer: Using the Quality Function Deployment System"*,Summer, 1987, National Productivity Review, pp 277-281.

[22] B. King,"*Better Designs in Half the Time: Implementing Quality Function Deployment in America"*, 1989,GOAL/QPC, Methuen, MA, USA.

[23] T. Lager, The industrial usability of Quality Function Deployment: A literature review and synthesis on a meta-level,*R&D Management, 35 (4)*,2015, 409-426.

[24] Y. Li, J.Tang,X. Luo, J. Xu, An integrated method of rough set, kano's model and AHP for rating customer requirements' final Importance,*Experts System With Applications, 36*, 2012, 7045-7053.

[25] H.T. Liu, The extension of fuzzy QFD: From product planning to part development.*Expert Systems With Applications*, *36*, 2012, 11131-11144.

[26] S.A. Oke, Manufacturing Quality Function Deployement: Literature review and future trends.*Engineering Journal, 17 (3)*, Bangkok, Thailand, 1 July 2013.

[27] T. Park, K.J. Kim, Determination of an optimal set of design requirements using House of Quality,*Journal of Operational Management,16*, 2012, 569-581.

[28] S. Pugh, *"Concept selection - A method that works"*,International Conference on Engineering Design ICED 81, Rome, Italy, 9-13 March 1981.

[29] R. Ramanathan, J.Yunfeng, Incorporating cost and environmental factors in quality function deployment using data envelopment analysis,*Omega: The International Journal of Management Science, 37*, 2009, 711-723.

[30] R. Tenner, D. Toro Arthur, &J. Irving, *Total Quality Management: Three Steps To Continuous Improvement*, Addison-Wesley, Cop., 1992.

[31] H.C.Mv. Trijp& J.E.M. Steenkamp, *Innovation of Food Production Systems: Product Quality and Consumer Acceptance.Consumer-oriented New Product Development: Principles and Practice,* (Jongen, WMF, Meulenberg, MTG, eds.), pp. 37-66, Wageningren Pers, Wageningren, 1998.

[32] I.B. Utne, Improving the environmental performance of the fishing fleet by use of quality function deployment,*Journal of Cleaner Production, 17 (8)*, 2009, 724-731.

[33] S. Vattharakul, K.Jangchud, N. Therdthal, and B. Wilkinson, Gold kiwi fruit leather product development using quality function development approach, *Food Quality and Preference, 21 (3)*, 2013, 339-345.

[34] S.Y. Wang, Constructing the complete linguistic based and gap-oriented quality function deployment,*Expert Systems with Applications, 37 (2),*2010, 908-912.

[35] G.S. Wasserman, On how to prioritize design requirements during the QFD planning process,*IIE Transactions, 25 (3),*2012, 59-65.

[36] P.S. Wilton, *The Quality System Development Handbook*, New York: Prentice Hall, 1994.

[37] R. Wolniak, The history of the QFD method,*Organization and Management Series, 100*, 2017, Silesian, Poland.