Product Development by Using Quality Function Deployment Technique (QFD): A Case Study of Coconut Milk Ice-Cream (SMEs Product)

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Abstract

The objectives of this research are to study the quality processes and to develop a product, a coconut milk ice-cream (SMEs Product), by using a Four-phase Model of a Quality Function Deployment Technique (QFD). Firstly, customer' voices are collected by interviewing, then the results from the interviews are used as a basis for designing questionnaires to collect samples' satisfaction on the product. At a 95% confidence level, a sample size is 31 samples which are current customers and tourists in Nakhon Pathom province. Secondly, the results from the questionnaires are analyzed using four phases of QFD which are: 1) Product Planning, 2) Design Deployment, 3) Process Planning and 4) Production Operations Planning. The results from an analysis of QFD point out that the product should be developed in terms of product's characteristics and packaging. In term of the product characteristics, product's variety of flavors is developed. In term of packaging, a new design of packaging is presented. Then, samples' satisfaction on the developed product is collected. The results show that the total average satisfaction score of the product is increased from 6.54 to 8.08 or an increase of 23.73%.

Keywords: Product Development, Quality Function Deployment Technique, Ice Cream

Introduction

It can be stated that a coconut milk ice-cream market is an interesting market in an ice-cream market in Thailand. A research points out that an ice-cream market in Thailand has a very high market value, which about 15,958.4 million baht in year 2018 and there was a growth rate of 7.2% [1]. Lobster Ice-Cream, which is a manufacturer of a coconut milk ice-cream for more than 5 years, now has a problem about its sales growth rate. After launching the products for long, the manufacturer found the problem that its customers' response was very low in the past few years and sales were down around 20%. An analysis of

the product shows that this product has a high material costs and it was sale at a high price in a low-income market segment. After an analysis of the problem, researchers recognized that the problem of Lobster Ice-Cream is a customers' perceived value that the cause of the problem is a product's marketing mix.

Objectives

There are other market segments that will accept a high-quality product at a reasonable price. However, for launching the product in a new market segment, the product itself has to be developed based on real customers' needs with the expect results of a new higher perceived value product that will be able to response to customers' needs and satisfaction. Thus, the objective of this research is to develop a new coconut milk ice-cream product that will be able to response to customer needs and satisfaction by using a Four-phase Model of a Quality Function Deployment Technique (QFD).

Scopes of research

This research studies the quality processes of a coconut milk ice-cream production process only. And to study a product development process using only a Four-phase Model of a Quality Function Deployment Technique (QFD). At a 95% confidence level, the primary research data are collected from 31 samples of Lobster's current customers in Nakhon Pathom province, where is the location of the factory and its current main market place.

Literature Review

An ice-cream Production Process

A general manufacturing procedure of an ice-cream consists of 9 steps: 1) Blend the Ice Cream Mixture, 2) Pasteurize Mix, 3) Homogenize, 4) Age the Mix, 5) Add Liquid Flavors and Colors, 6) Freeze, 7) Add Fruits, Nuts and Bulky Flavorings, 8) Package and 9) Harden/Store [2].

Product Life Cycle

Product life cycle presents the life of a product in the market with concerns business or commercial costs and sales measures [3]. There are four major product life cycle stages. 1) Market development stage, it is a stage that the product is first brought to market which sales are low and slowly creep along. 2) Market growth stage, it is a takeoff stage that size of the total market rapidly expands and the demand begins to accelerate. 3) Market maturity stage, it is a stage that the product price has been decreased, because of an increase of product volume. The demand level offs and grows only at the replacement and new family-

formation rate. 4) Market decline stage, it is a stage of sales drift downward, because product begins to lose consumer appeal [3].

Customer Satisfaction

According to Kano model [4], there are three categories of customer preferences. 1) Basic quality or expected quality: the requirements that the customers expect. If done poorly, customers are very dissatisfied and if done well, customer are neutral. 2) Performance quality or desire quality: the features that give a proportionate increase in customer satisfaction as they are invested in. 3) Excitement quality or attractive quality: the needs that are not expected by customers, if the product can provide, the customers are excited [4].

Quality Function Deployment (QFD)

Quality Function Deployment is a process and set of tools that used for defining customer requirements that provides a defined set of matrices for converting voices of customer into measurable design targets and then convert them into engineering specifications and plans to produce the products that will be able to fulfill those requirements [5]. There are four phases in the QFD process which are 1) Product planning or performance requirements, 2) Product design, 3) Process planning and 4) Process control. Relationships between elements are evaluated and a more specific aspect of customer requirements are represented in each phase, whereas only the most important aspects from each phase are deployed into the next phase [6]. The most important phase is the first phase that is called "The House of Quality" which concerns converting voices of customer into measurable design inputs [7]. The design inputs will be used in the next three phases for identifying detailed engineering specifications and plans to produce the products. Whereas only the most important aspects (the high important score) from each phase are deployed into the next phase [8]. The QFD process is shown in Figure 1 [9].

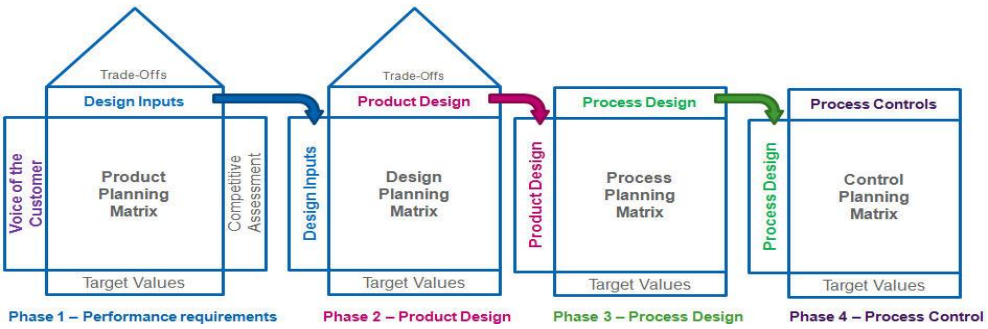

Figure 1: Quality function deployment process
Accessed on https://www.l-e-a-n.com/qfd

Research Methodology

Population and Sample

A research population is a current customers of Lobster ice-cream who are in Nakhon Pathom province and used to taste the coconut milk ice-cream of the Lobster brand. A research sample is selected by using a nonprobability sampling or convenience sampling method [10]. Because the population cannot be identified, an equation (1) is used to calculate the sample size of the study [10]. At a 95% confidence level, 50% population proportion and 20% error, a sample size calculated is 24 samples. An error is accepted at 20%, because the research focused on a group of regular customers of the Lobster Ice-cream, there is not lot of number of customers in this group. However, the research will be use 31 samples.

$$n = \left(\frac{z_{\alpha/2}}{e}\right)^2 p(1-p)$$

$$n = \left(\frac{1.96}{0.2}\right)^2 0.5(1-0.5)$$

$$n = 24 \qquad (1)$$

Conceptual Framework and Research Tools

The research is conducted follow these steps by using research tools as shown in a conceptual framework in Table 1.

Table 1: Conceptual framework and research tools

Research goals	Factors	Tools	Outputs
1. To find customers' satisfaction of a current product	1. Customers' satisfaction of a current product	Questionnaires	Level of customers' satisfaction of a current product
2. To find real customer needs	2. Customers' needs	Interviews	Voice of customers or real customer needs
3. To study an ice-cream production process for development of product	3. Production process	Observation	Quality processes
4. To analyze product properties and functions for development of product	4. Product properties and functions analysis	QFD technique (Four-phase Model)	Product properties and functions

Research goals	Factors	Tools	Outputs
5. To develop the product	5. Product design and development		Developed product
6. To find customers' satisfaction of a developed product	6. Customers' satisfaction of a developed product	Questionnaires	Level of customers' satisfaction of a developed product

Research Findings and Results

Current Product Satisfaction and Voices of Customer

The samples' satisfaction on the Lobster's current coconut milk ice-cream is collected by using questionnaires. The result shows that the total average satisfaction score of the current product is 6.54 (from the full score of 10). Then, the interviews about customers' needs are conducted [11]. The interviews show that the current product need to be developed in terms of product's variety of flavors, and product's packaging.

Phase I: Product Planning (Houe of Quality)

This phase is the house of quality that the voices of customer are converted, by using new 7 QC tools techniques [12], into measurable design inputs. The result of this phase is a list of technical requirements and their relative importance scores as shown in Table 2.

Table 2: Technical requirements and relative importance scores

	Technical requirements	Relative technique requirement importance scores
1.	Color and pattern of packaging	22.71
2.	Material mixing ratio	18.47
3.	Color of ice-cream	15.13
4.	Product price	13.42
5.	Ice-cream scent	12.61
6.	Shape of packaging	10.10
7.	Size of product	3.36
8.	Packaging material (environment friendly)	2.53
9.	Product weight	1.68

Phase II: Product Design

In this phase, the design inputs or technical requirements, which is a result of phase I, are converted into part characteristics that explain the detailed characteristics of each product component or part. The result of this phase is a list of product's part characteristics and their importance scores as shown in Table 3.

Table 3: Product's part characteristics and importance scores

	Part characteristics	Important scores
1.	Competitive pricing	36.29
2.	An attractiveness of product	23.86
3.	Quality of packaging	19.57
4.	Quality of scent and color materials	11.31
5.	A variety of flavor	5.93
6.	Quality of coconut milk	3.05

Phase III: Process Planning

In this phase, the part characteristics, which is a result of phase II, are converted into process parameters that explain the detailed engineering parameters concerned in the coconut milk ice-cream production process. The result of this phase is a list of process parameters and their importance scores as shown in Table 4.

Table 4: Process parameters and importance scores

	Process parameters	Important scores
1.	An ability to compete with current competitors	31.39
2.	Machines, tools, resources and labor hours	14.94
3.	An ability to design of packaging for customers' attractiveness	14.40
4.	An ability to design of product shape	10.31
5.	Materials quality	7.82
6.	An ability to control materials quality	7.64
7.	An ability to supply materials	6.89
8.	An ability to plan and control the production	5.04
9.	Worker skills	1.57

Phase IV: Process Control

In this phase, process control planning is created for controlling the process parameters, which is a result of phase III. There are eight processes involved in the coconut milk ice-cream production which shown in Figure 2.

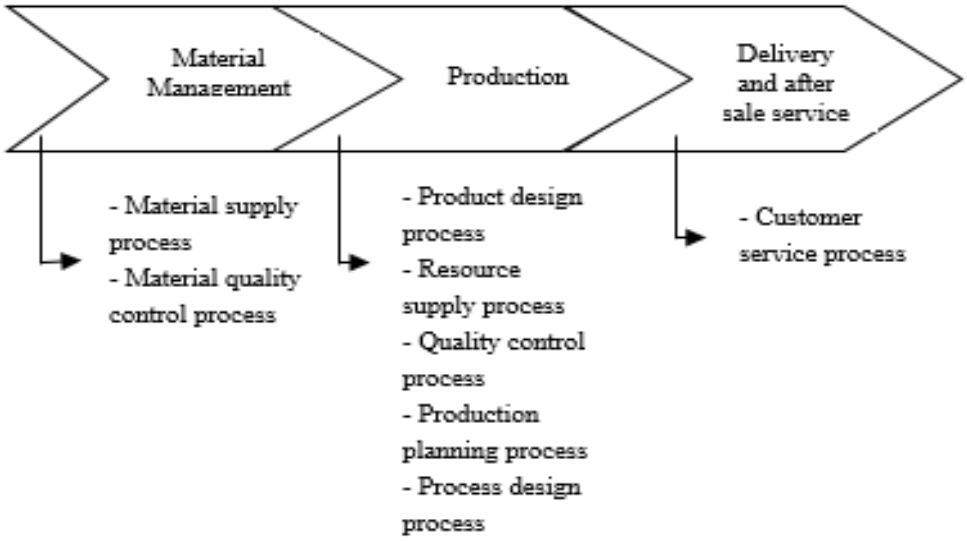

Figure 2: Process control planning

Developed Product Satisfaction

The product is developed by 1) designing a new packaging in terms of shape, color, and logo pattern and 2) by creating product's variety of flavors with high quality materials. The new product will be launched in a new target market, which is has more purchasing power than the brand's current market. The samples' satisfaction on the developed product is collected by using questionnaires. The result shows that the total average satisfaction score of the developed product is 8.08 (from the full score of 10). The before and after development packaging and products are presented in Figure 3 and 4.

Figure 3: Before development product

Figure 4: After development product

Discussion and Conclusions

It is found that the current product of Lobster Ice-cream is in the market decline stage. The product is in a stage of sales drift downward, because product begins to lose consumer appeal. The samples' satisfaction on the coconut milk ice-cream is collected and the result shows that the total average satisfaction score of the current product is 6.54. The results from an analysis of customer requirements using QFD technique point out that the product should be developed in terms of product's characteristics and packaging. In term of the product characteristics, it is developed by creating product's variety of flavors with using high quality materials. In term of packaging, a new design of shape, color, and logo pattern is developed. Then, samples' satisfaction on the developed product is collected. The result shows that the total average satisfaction score of the developed product is 8.08 or it is an increase of satisfaction of 23.73%. It can be stated that a theory of product life cycle and a theory of customer satisfaction can help to analyze the marketing problems. As a result, it can be concluded that an implementation of the Four-phase Model of QFD technique can help to design and develop a new product that is able to response to customer requirements and satisfaction.

Recommendations

Policy recommendation

There is a high business competition in the current business environment. End users have lots of choices and their requirements are changed quickly. Thus, manufacturers should continuously develop their products for maintaining an ability to response to customer needs.

Management recommendation

The manufacturer should continuously develop their manufacturing process, such as machine, tools and other equipment used in the process. New production technologies should be selected and applied for being a standardized process.

Academic Recommendation

For further research, the QFD technique and this research methodology can be repeatedly conducted for developing other different types of products in other business areas.

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