

Product Development by Using Quality Function Deployment Technique (QFD): a Case Study of Goat Milk – Coffee Bean Soap

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Abstract- The objectives of this research are to study the quality processes and to develop a product, a Goat Milk - Coffee Bean Soap, by using a Four-phase Model of a Quality Function Deployment Technique (QFD). Firstly, customer's 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 30 samples which are current customers and tourists in Bangkok and Saraburi 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 shape, weight and smell are 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 5.58 to 7.55 or an increase of 35.26%.

Keywords- Product Development, Quality Function Deployment Technique, Goat Milk - Coffee Bean Soap

I. INTRODUCTION

It can be stated that a coffee soap market is a new interesting market in a soap market in Thailand. A research points out that a coffee bean can help with cellulite. Caffeine helps the circulation of blood to the skin and also acts like a diuretic. Coffee argument helps exfoliating as well as the massaging that help breaks up the cellulite [1]. Mittraphap District Indigenous Knowledge Center, which is a manufacturer of a goat milk soap for more than 13 years, decided to develop a new product, a goat milk – coffee bean soap, by using fresh goat milk from local farm and roasted coffee beans from local plant. After launching the product, the manufacturer found the problem that customers' response was very low, because this product has a high material costs and it was sale at a high price. However,

researchers recognized that the problem is a customers' perceived value. There are other market segments that will accept a high quality product at a reasonable price. Thus, the researcher suggested the manufacturer to develop this product 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.

II. OBJECTIVES

The objectives of this research are to study the quality processes in a Goat Milk - Coffee Bean Soap production process and to develop a new Goat Milk - Coffee Bean Soap 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).

III. LITERATURE REVIEW

A. Soap Production Process

Soap is made through a continuous process that requires constant addition of fats, oils and bases (solution of NaOH and H₂O called lye). The reactions that produce soap are known as saponification. There are three major process types: 1) a cold-process, that the reaction takes place at room temperature, 2) a hot-process, that the reaction takes place at near-boiling point, and 3) a boiled process, that the reactants are boiled at least once and the glycerol recovered. Smaller scale production typically uses the cold and hot processes [2].

B. Product Life Cycle

Product life cycle presents the life of a product in the market with concerns business or commercial costs and sales measures. 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].

C. Customer Satisfaction

According to Kano model, 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].

D. 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 measureable 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 measureable design inputs. 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 [7]. The QFD process is shown in Fig. 1.

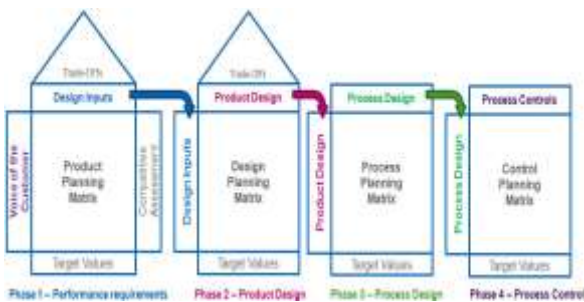


Fig. 1. Quality function deployment process [8]

IV. RESEARCH METHODOLOGY

A. Population and Sample

A research population is a current customers of Mitrphap District Indigenous Knowledge Center who used to use the goat milk – coffee bean soap and a general tourist in Bangkok and Saraburi province. A research sample is selected by using a nonprobability sampling or convenience sampling method. By using an equation below at a 95% confidence level, 50% population proportion and 20% error, a sample size is 24 samples. However, the research will be use 30 samples.

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

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

$$n = 24$$

B. 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

Factor	Tools	Output
1. Customers' satisfaction of a current product	Questionnaires	Level of customers' satisfaction of a current product
2. Customers' needs	Interviews	Voice of customers or real customer needs
3. Production process	Observation	Quality processes
4. Product properties and functions analysis	QFD technique (Four-phase Model)	Product properties and functions
5. Product design and development		Developed product
6. Customers' satisfaction of a developed product	Questionnaires	Level of customers' satisfaction of a developed product

V. RESEARCH RESULTS

A. Current Product Satisfaction and Voices of Customer

The samples' satisfaction on the current Goat Milk - Coffee Bean Soap is collected by using questionnaires. The result shows that the total average satisfaction score of the current product is 5.58 (from the full score of 10). The interviews of customer needs show that the current product need to be developed in terms of product's characteristics, shape, weight and smell, and product's

packaging.

B. Phase I: Product Planning (Houe of Quality)

This phase is the hose of quality that the voices of customer are converted into measureable design inputs. The result of this phase is a list of technical requirements as shown in TABLE 2.

Technical Requirements		Relative Technique Requirement Importance
1.	Material mixing ratio	17.06
2.	Shape of packaging	17.04
3.	Price	15.08
4.	Color of packaging	11.11
5.	Shape of soap	7.99
6.	Essential oil quantity	7.79
7.	Essential oil scent	7.44
8.	Size of soap	6.20
9.	Packaging material (environmental friendly)	4.53
10.	Packaging variety	3.05
11.	Weight	2.72

TABLE 2. TECHNICAL REQUIREMENTS

C. 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 shown in TABLE 3.

Part Characteristics		Important Score
1.	Competitive pricing	25.93
2.	An interest of product	19.65
3.	Dangers of product	19.55
4.	Quality of essential oil	9.61
5.	Quality of coffee bean	8.48
6.	A variety of packaging	7.11
7.	Quality of goat milk	5.57
8.	Quality of fats	4.11

TABLE 3. PART CHARACTERISTICS

D. 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 soap production process. The result of this phase is shown in TABLE 4.

E. 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 process involved in the soap production which shown in Fig 2.

TABLE 4. PROCESS PARAMETERS

Process Parameters		Important Score
1.	An ability to compete with current competitors	23.97
2.	An ability to design for manufacturing	12.81
3.	An ability to control a material quality	11.44
4.	An ability to design for customer appeal	10.90
5.	Material quality	10.40
6.	An ability to supply material	8.63
7.	Resources and production hours	7.32
8.	An ability to plan the production	4.21
9.	An ability to design of product shape	3.42
10.	A reliability of production process	3.31
11.	Machine capacity and flexibility	2.19
12.	Worker skills	1.40

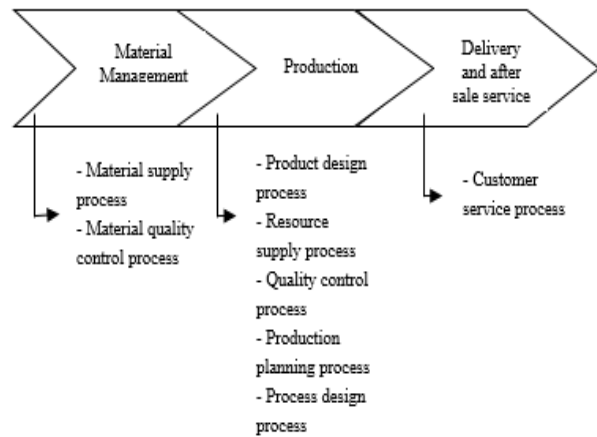


Fig. 2. Process control

F. Developed Product Satisfaction

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 7.55 (from the full score of 10). The before and after development packaging and products are presented in Fig. 3, 4, 5 and 6.



Fig. 3. Before development packaging



Fig. 4. Before development product



Fig. 5. After development packaging



VI. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

The samples' satisfaction on the current Goat Milk - Coffee Bean Soap is collected and the result shows that the total average satisfaction score of the current product is 5.58. 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, product's shape, weight and smell are developed. In term of packaging, a new design of packaging is presented. Then, samples' satisfaction on the developed product is collected. The result shows that the total average satisfaction score of the developed product is 7.55 or it is an increase of 35.26%. It can be stated that an implementation of the QFD technique can help to design and develop a new product that is able to response to customer requirements and satisfaction.

B. Recommendations

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. 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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