The implantation of QFD methodology in a small dairy company

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Abstract: Quality Function Deployment (QFD) was used to assess the needs and desires of consumers of pasteurized milk processed by a small dairy company and to increase its participation in the local market. Interviews were carried out with 38 randomly selected pasteurized milk consumers and 30 owners or managers of the product retailers. Quality items revealed by this survey were used to compos a structured questionnaire, which was applied to other 337 pasteurized milk consumers and 50 product retailers in a second stage of this research, in order to assess the importance weight of each quality item. The company brand performance and that of two competitor brands, for each demanded quality item, was evaluated by sensorial analyses to compare the flavor, involving 53 consumers. It was also run an analysis of aspects related to package by 103 consumers. In several meetings with company department representatives involved in the process it was built the Quality Matrix and the Conceptual Model. This allowed defining the company's weak and strong points in comparison to competitor brands and then to establish its needed quality. The actions and the control items of the process were transmitted to process managers using the 5W1H methodology.
Keywords: pasteurized milk, consumers, quality development, QFD

1. Introduction

Packaged pasteurized milk processed by a small dairy company is losing market in the last five or six years. This represented a 30% reduction in pasteurized milk sales, due to factors such as increase in UHT treated milk consumption, increase in pasteurized milk market competition and the consumption of the so-called informal milk. As well as most of small dairy industries, it would not be viable for the company to acquire the technology for UHT milk production, since for that a much larger working capacity would be needed to compensate required investments. Also, the company would need to expand its market to other cities, competing with those already established there.

For regaining lost market share, the company would need to improve its pasteurized milk quality. For that, it is necessary to identify local consumer desires and to attend them. A methodology to be used to reach such objectives is QFD (Quality Function Deployment). According to CHENG et al. (1995), QFD can assist in helping quality planning, identifying, translating and transmitting the quality needs and desires of costumers to the company. QFD can be used in the development of a new product or for improving product quality that is already important for the company that is losing market.

According to TUMELEIRO et al. (2000), the logic of QFD is to approximate the customer's demands to productive process, organizing it in agreement with the demands and increasing the chances of meeting customer satisfaction.

Quality demanded by customers can be obtained by market researches, interviews, secondary data and company's consumer complaint service data. The demanded quality is extracted from primary data and transmitted to areas in the company involved with the process through tools such as Quality Deployment Tables, Quality Matrix and Conceptual Model. QFD still allows the company to make an evaluation of its product performance and that of main competitors, in each quality item demanded by consumers. A company can also identify the quality items that consumers consider most important, the strong points in relation to competitors and use them as sales argument. The development of new products or improvement of product quality should involve professional members of several functions within a company, characterizing it as an inter-functional work (CHENG et al. 1995).

This study aimed at evaluating the practical implementation of QFD in a small dairy company, and to verify its effectiveness in supplying information for a plan of recovering sales of pasteurized milk, besides increasing its market share. The objective was also to verify whether documents generated by QFD use for improvement of pasteurized milk quality would allow the transmission of consumer desires to the pasteurized milk production process, from raw material reception to milk packing, up to product distribution and retailers.

2. Quality Function Deployment in the restricted sense

The QFD method was implanted after meetings with management and with managers of the company to choose which product to work with, to define the objectives and goals of its implantation, and to form a QFD team. QFD team was established with a representative of each area involved in the process of pasteurized milk quality improvement. After QFD team establishment a seminar was realized to present the methodology, objectives and the benefits already reached by companies applying the technology. Once established, the goals and the stages of the quality improvement project were unfolded in detailed tasks and the responsible sectors determined. The development of the work generated two documents: the Managerial Pattern for Product Quality Improvement (Table 1), and the Activities Plan for Project Quality Improvement (Table 2). After this definition the 5W1H methodology was incorporated to the job.

3. Market researches

The customers' information was obtained from qualitative and quantitative market researches. In the qualitative stage, 38 randomly

Table 1. Part of the managerial design of the product's quality improvement.

Steps in Quality Planning	Interfunctional Processes	Participant Departments
1 – Identify the client's needs	To identify the market opportunity	Customers, management, marketing, production, sales, quality
	To define the target market	Management, marketing , sales
	To analyze the technical viability	Management, production, quality, supply, logistics
	To plan the product development	Management, marketing, production, quality, sales
	To identify quality items demanded by customers	Customers, marketing, production, quality, sales
2 – Establish the product concept	To define the product's concept	Marketing, production, quality, supply, logistics
3 – Project the product and the process	To establish the product quality characteristics	Marketing, production, quality, sales, costs
	To detail the product project	Production, supply
	To build up and to test prototypes	Costumers, marketing, production, supply
4 – Proposal for standards establishment	To revise the quality improvement project	Management, marketing, production, quality, supply
	To detail the production process	Production, quality, supply, logistics, costs
5 – Think about the process of quality improvement	To set up production program	Production, supply, logistics
	To analyze the information of the clients	Management, marketing, quality, sales
	To audit the system quality improvement	Management, marketing, production, quality, sales, supply, logistics, costs

Table 2. Part of activity plan for the quality improvement project.

What	Who	How	When								
			Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Defining product for quality improvement	Team	Meetings									
Carrying out market research	Researcher	Interviewing consumers									
To deploy demanded quality	Team	Meetings									
Building up Quality matrix	Team	Meetings									
Building up Quality process matrix	Team	Meetings									
To build the raw material matrix	Team	Meetings									
Building up Quality matrix parameters of process control	Team	Meetings									
Evaluating quality improvement process	Team	Meetings									

selected pasteurized milk consumers and 30 retailer establishment managers were interviewed in order to assess their quality desires and needs, besides knowing the competitive pasteurized milk brands most sold locally. The quantitative stage was also carried out with consumers and retailers. Its objectives were to evaluate the degree of importance of each quality items demanded in the qualitative stage and also, to understand perception that consumers have over our company pasteurized milk and that from two competitor brands. Analyses of product performance were made by comparative sensory tests among the company's product and those of two competitor brands.

4. Elaboration of quality matrices

The QFD team defined the Conceptual Model, Figure 1, that is, the following step to find product goals.

Demanded quality items were organized and grouped to form the Table of Quality Deployment, Table 3.

Product Quality Characteristics or Product Technical Characteristics were extracted from consumer demanded qualities, aiming at those that better would attend market demand. Quality Characteristics Deployment Table and Quality Matrix were elaborated, Table 4. Planned Quality was established based on degree of importance of Demanded Quality and on evaluation of product performance in comparison to two competitors. Thus the Projected Quality was established which is the target for the product quality, based on the degree of importance of each quality characteristic, in comparison with quality characteristics of the competitor products and the objectives of this project.

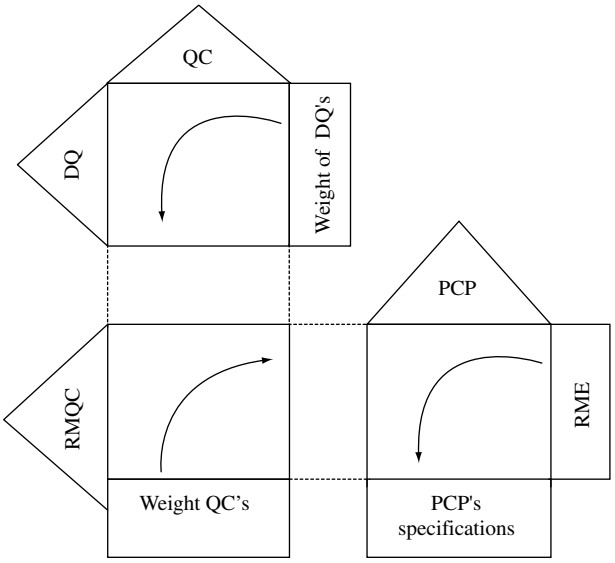
The team defined what would be the planned quality based on the importance degree, the comparative analysis and the classification of the quality items. The Improvement Index was calculated by the division of Planed Quality by the company performance scores. The item considered high sales argument received the value 1.5, the medium 1.2 and the item that is not considered sales argument received the value 1. The Absolute Weight and the Relative Weight were calculated. The quality items were divided into two other matrices: Milk Quality Matrix, Table 5 and Packaging Quality Matrix, Table 6.

From Demanded Qualities it was extracted the Quality Characteristics. Correlations were calculated between the Demanded Qualities and the Quality Characteristics. Absolute and Relative Weights of the Quality Characteristics were calculated. The Quality Characteristics of our researched company and that of competitor products were evaluated according to a bad to optimal quality scale. The projected quality was established as a goal to be accomplished by the company, for each quality characteristic.

To compose the Conceptual Model it was built the Pasteurized Milk Quality Matrix, the Raw Material Quality Matrix, Table 7 and the Process Control Parameters Matrix, Table 8.

Where PCP´s = Process Control Parameters

From these matrices the product specification standards, the product process control parameters and how to control them can altogether be transmitted to production through Technical Process Standards, Table 9.



QC: Quality Characteristics
DQ: Demanded Quality
RMQC: Raw Material's Quality Characteristics
PCP: Parameters of Process Control
RME: Raw Material's Specifications

Figure 1. Conceptual model for pasteurized milk.

Table 3. Part of the demanded quality deployment table by the consumers.

Product exposed carefully	Cleaned refrigerators
	Product be always refrigerated
	To expose the product in a more visible way
Packing that protects the product	Packing without leaks
	More resistant packing
Lower price	Close price to the competitors
	Smaller price than the long life
Hygiene in the production	Produced under hygienic conditions
	Cleaner packages
To have pleasant flavor	Free from chlorine taste
	To be free from whey addition
Better disposition of the production and expiration dates	Expiration date in more visible place
	The production and expiration date paint be more durable

Table 4. Part of pasteurized milk Quality Matrix for consumers.

Demanded Quality Deployment Table		Quality Planning								
		Degree of importance	Comparative analysis			Planning			Weight	
			Company	Competitor A	Competitor B	Planned quality	Improvement index	Sale argument	Absolute weight	Relative weight
Attractive product	Better product display	5.5	5.0	4.5	3.7	6.0	1.2	1.0	6.6	5.6
	To have more attractive package	5.1	4.7	4.5	5.5	6.5	1.4	1.0	7.1	6.0
	To have lower prices	6.1	4.0	7.0	6.0	4.0	1.0	1.0	6.1	5.2
	To be a more nutritious product	6.5	6.2	4.0	4.0	6.2	1.0	1.5	9.8	8.3
	To have a variety of product	5.4	5.0	4.0	4.0	6.5	1.3	1.0	7.0	6.0
	To be practical of using	5.6	4.4	4.0	4.0	4.4	1.0	1.0	5.6	4.8
Safe product	Hygienic obtaining procedures	6.7	5.5	5.2	5.3	6.7	1.2	1.5	12.2	10.4
	To publish more on product quality	5.6	5.3	4.1	3.9	6.1	1.2	1.0	6.4	5.5
Tasty product	To be pure	6.6	6.4	6.0	6.0	6.6	1.0	1.0	6.8	5.8
	To have nice flavor	6.5	5.5	5.0	4.8	5.5	1.0	1.0	6.5	5.5
Information completion of package	Label with information that motivates the product use	5.7	4.9	3.0	3.0	6.0	1.2	1.2	8.4	7.1
	Label with nutritional information	6.3	6.1	6.0	6.0	6.1	1.0	1.0	6.3	5.4
									117.2	

Table 5. Part of pasteurized milk quality matrix.

Quality Characteristics / Quality Demanded by the Costumers	1st Level	Physical-chemical analyses				Microbiological analyses		Enrichment			Fraud			Planed Quality
	2nd Level	Acidity	pH	Cryoscopy index	Fat percentual	Pattern count in plates	MPN coliforms	Calcium enrichment	Vitamins enrichment	Iron enrichment	Preservative	Water	Whey	Relative weight
To be more nutritive		3	3	3		3	3	9	9	9	3	3		8.3
To reduce fat separation					9									5.7
To be pure				9							9	9	9	5.8
To have a nice flavor		9	9	9	9	9	9					9	3	5.5
Absolute weight		129.3	129.3	156.6	100.8	129.3	129.3	74.7	74.7	74.7	77.1	156.6	68.7	1807.5
Relative weight		7.15	7.15	8.66	5.58	7.15	7.15	4.13	4.13	4.13	4.27	8.66	3.80	
Company		16	6.74	- 0.536	3.6	$3x10^4$	absent	no	yes	no	absent	absent	absent	
Competitor A		16	6.72	- 0.536	2.9	$1.5x10^4$	absent	no	no	no	absent	absent	absent	
Competitor B		15.7	6.73	- 0.540	3.4	$7.3x10^3$	absent	no	no	no	absent	absent	absent	
Projected Quality		16 °D	6.7	0.530-0.550	min.3.0	$3x10^4$	absent	no	yes	no	absent	absent	absent	

Table 6. Part of the pasteurized milk package quality matrix.

Quality Characteristics / Quality Demanded by the Costumers	1st Level	Package					Main panel					Subsequent panel								Planed Quality
	2st Level	Safe use	Safe transport	Kind of material	Distance between them welds	Resistance of the weld	Denomination of the product	To have a slogan	additional information	Call	Visual legibility	To contain mark	Call center	Visual legibility	Visibility of the dates	Nutricional declaration	Positioning of the dates	Informative calls	Conservation information	Relative weight
To be practical of using		9	9	9	6	3	3				9		3	9		3	9		6	4.8
Label stimulate the use							9	9	9	9	9	3	6	9		3		9	9	7.1
Label with nutritional information									9	9	6			9		9		3		5.4
Easy to find the production and expiration dates														9	9		9			6.7
Absolute weight		9	9	9	6	3	12	9	18	18	24	3	9	45	18	15	24	12	15	297
Relative weight		3.03	3.03	3.03	2.02	1.01	4.04	3.03	6.06	6.06	8.08	1.01	3.03	15.15	6.06	5.05	8.08	4.04	5.05	
Company		G	G	LDPE	23 cm	G	R	no	no	no	T	no	T	T	R	R	G	T	T	
Competitor A		G	R	LDPE	24 cm	G	B	no	no	no	T	no	R	T	G	R	G	T	R	
Competitor B		G	B	LDPE	23 cm	G	GR	yes	no	no	R	no	G	R	T	R	T	T	T	
Projected Quality		G	G	LDPE	23 cm	G	GR	yes	yes	yes	GR	yes	GR	GR	G	GR	B	GR	GR	

Where: T: Terrible, B: Bad, R: Regular, G: Good, GR: Great, LDPE: Low Density Polyethylene.

Table 7. Part of the raw material quality matrix.

Quality Characteristics of the raw material	Quality Characteristics of the pasteurized milk										Absolute weight	Relative weight	Specifications
	Acidity	pH	Cryoscopy index	Fat percentual	Pattern count in plates	MPN coliforms	Calcium enrichment	Vitamins enrichment	Presence of neutralizatiors	Presence of sludge			
Acidity	9	6	9		9						33	11.8	16 °D
Temperature	9	6	6		9						30	10.8	Max. 8 °C
Antibiotics	9	6	6		9						30	10.8	ausent
Relative density to 15 °C	6	6	9	6							36	12.9	1.027 a 1.033
Cryoscopy index	3		9	6							27	9.7	- 0.530 a - 0.550 °C
Stability to the alizarol	9	9	9		9			3	9		48	17.2	Stable
Fat				9							9	3.2	Min. 3%
Dirtiness	6				6					9	21	7.5	absent
Total count	9	6	9		9					3	45	16.1	Max. 100 000/ml
											279		
Absolute weight	129.3	129.3	156.6	100.8	129.3	74.7	74.7	77.1	93.6	97.2	1276.5		
Relative weight	7.2	7.2	8.7	5.6	7.2	4.1	4.1	4.3	5.2	5.4			

Table 8. Part of the items of process control parameters matrix.

Quality Characteristics of the milk	Control Process of the Items									Absolute weight	Relative weight	Specifications
	Temperature of cooling of the crude milk	Holes in the filtration screen	Pasteurization temperature	Pasteurization time	Storage temperature	Packing temperature	Transport temperature	Clarification	Outflow of the centrifuge			
Acidity										249.5	12.5	16 °D
Temperature	9									223.5	11.2	Max. 8 °C
Antibiotics										223.5	11.2	absent
Relative density to 15 °C										275.2	13.8	1.027 a 1.033
Cryoscopy index										210.8	10.6	de - 0.530 a - 0.550 °C
Stability to the alizarol										330.4	16.6	Stable
Fat									9	50.2	2.5	Min. 3%
Dirtiness		9						9		134.2	6.7	absent
Total count	9		9	9	9	9	9			294.2	14.8	Max. 100.000 un/ml
Absolute weight (PCP's)	233.91	60.66	132.93	132.9	132.93	132.93	132.93	60.66	22.68	1175.5		
Relative weight	19.90	5.16	11.31	11.31	11.31	11.31	11.31	5.16	1.93			
Specifications of the PCP's	Max. 4 °C	Absence	Min. 72 °C	15 sec.	Max. 4 °C	Max. 4 °C	Max. 7 °C	Clean	Variable			

Where PCP's = Process Control Parameters.

Table 9. Part of the technical process standard.

Process	Specifications and Correlation with the items of the Insured Quality						Level of Control		Verification of the Item of Control		Corrective Action	
	Acidity: 16 °D	Cryoscopy index: 0.530 to 0.550 °H	Total count: Max. 30000 un/ml	Sludge: absent	Hygiene: Great	Visibility dates: Good	Control items	Standard value	Instrument of measure or analysis method	Responsible	What	Who
Milk reception	⊙	⊙	△	⊙			Acidity	16 °D	Titillation	Laboratorist	To reject lot	Production responsible
							Cryoscopy index	- 0.530 a - 0.550 °H	Cryoscopy	Laboratorist	To reject lot	Control Quality Responsible
							Alizarol test stability	Stable	Alizarol test	Production worker	To reject lot/curd	Production person in charge
							Total count	Max. 100 000 unt/ml	plates count	Laboratorist	To contact producer	C. Quality Responsible
Filtration	△		△		⊙		Holes in the filtration screen	Absent	Visual	Production worker	To repair holes	Mechanic
Temperature of cooling of the raw milk	⊙	○	⊙				Temperature of cooling	Maximum 4 °C	Thermometer	Production worker	To verify the system of cold	Mechanic
Pasteurization	⊙	○	⊙				Pasteurization temperature	Minimum 75 °C	Thermometer	Machine Operator	To regulate pasteurization	Production person in charge
							Pasteurization time	15 sec.	Retention tube	Machine Operator	To regulate pasteurizator	Production person in charge
Packing	△		○		⊙	⊙	Packing temperature	Maximum of 4 °C	Thermometer	Production worker	To regulate pasteurizator	Mechanic
Placement of the dates						⊙	Position of the dates	Space of the label	Visual	Production worker	To regulate packer	Production person in charge
Storage	⊙		⊙				Storage temperature	Maximum 7 °C	Thermometer	Production worker	To regulate camera	Mechanic

⊙Strong correlation ○Medium correlation △Weak correlation

The PTP illustrates the productive process from the time in which the raw material begins to be worked up to end product elaboration. The referring specifications to the services and the packages were transmitted to company responsible sectors through the 5W1H tool, looking for a decision, for each specification to be worked on, about who would be the responsible professional or sector, when the action should happen, where it would take place, why and in which way such action would be done.

5. Conclusions

The company defined as a goal to be better or at least equal to the competitor. The demanded quality item, "easy to identify the production and expiration dates", was considered of high degree of importance by the costumers. The demanded quality items were considered very important by costumers, and the fact that the company was accomplishing satisfactorily job and the competitors were not, weren't considered arguments of sales. The item "to be more nutritious" could be considered a strong argument of sales, because the product in study is has added vitamins A and D, while the competitors' product doesn't.

It could be verified that the QFD method allows companies, independently of their size, to plan the quality and to obtain benefits from their products. Company's top management needs to be aware that the costs to guarantee the product quality are usually soon recovered, since there will be waste reduction and refused products, reduced defect numbers and losses, and increase in the sales.

6. References

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