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Utilizing QFD model to determine quality characteristics of the products and priority needs of customers in the medical industry products (Case Study: Plasma seat product in mashhad`s Sahateb medical equipment company)

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A B S T R A C T

Quality Function Deployment (QFD) as one of the quality engineering methods; originates from market study and product or service customers identification, where by determining their needs; tries to involve them in all stages of product or service development. This study uses QFD method to apply customers' criteria in production of Coach Plasma in Mashhad`s Sahateb Company. Coach Plasma is used for healthy bloodletting. The proposed study of this paper designed and distributed a questionnaire, which includes identification & determination of customers' needs and investigation of their satisfaction of manufactured products, while looking for technical and engineering characteristics related to their needs. The Coach Plasma costumers are categorized into two groups of local and external customers. Data collection was done based on available documents, experts opinions, structured interview with managers and questionnaire. Customers' needs were studied in QFD teams. Collecting essential information such as needs importance degree and competitive benchmarking of customer`s needs, the weight of each need has been evaluated. In this research, House of Quality was used from first matrix of QFD leading to estimation of engineering & technical characteristics in order to enter to the quality deployment matrix. Take a look at obtained results, we could mention the role of each of these external factors in satisfaction of Sahateb Company customers and technical characteristics of the company in providing these factors and the prioritization of the customer's needs.

1. Introduction

In the present era, organizations focus on the customer and follow up necessary measures to implement customer-orientation culture in all levels of the organization. In customer-oriented approach, customer is the main pivot and existential philosophy of the organizations. Therefore, identifying, segregating and prioritizing consumers, discovering their main expectations and eventually, gaining customer's satisfaction are of major activities of this approach (Mohammadi,

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2003). If an organization or producer or service provider receives a thorough and full knowledge on expectations of its customer, it can meet customer's demands in the best possible form through using its expert and efficient personnel and existing technical know-how. Here, two points should be taken into consideration. Firstly, product features must be fit with various aspects of customer expectations and also product should be designed based on expectations of customer. Secondly, raising consumers' awareness is of paramount importance with regard to some specialized goods or services. Here, there are some mistaken beliefs beyond scientific, engineering and technological principles among customers. If we intend to answer all incorrect beliefs of customers, technical quality of the goods must be sacrificed. In some cases, lack of enough information and accurate consumption pattern and/or favorable condition of consuming goods will cause inefficiency of product and will follow customer's dissatisfaction.

Therefore, relationship between marketing and production departments in any organization seems necessary in order to provide goods, which can meet customer's satisfaction in the best possible form. The important relationship between production and marketing has been known in the late 1960s, i.e., when Japanese used QFD (Quality Function Deployment) to design products with features and taste of customers. They believe that constant changes resulting from the globalization process and innovation in technology, which affects business environment severely, force organizations to create new competitive advantages in order to maintain their situation in the market. Given the above subjects, we are in great need of a scientific tool in order to apply comments and tastes of customers in designing products and services, while surveying their opinion, on one hand and consider requirements and restrictions of producer to meet demands of customer according to the features as expected by customer from product on the other hand. Quality Function Deployment (QFD) is one of these tools and it can be considered as a result of current competitive market which helps producers consider demands, expectations and requirements of customers in its product. Given the application of QFD, it was decided to use this model in a company as producer of medical equipment (Saha Teb Mashhad Company).

2. Research objectives and questions

Applying technique of Quality Function Deployment (QFD) in Saha Teb Mashhad Company and helping managers of this company to present high-quality products according to the customers' demands is the basic objective of this research.

This research seeks to answer the following questions:

1. What are the quality dimensions of the company's product (plasma seat) in view of the company's customers at the present situation?
2. Which one of the quality dimensions is more important for customers of this company? (prioritizing)
3. What are the effective technical features in view of this company to meet quality dimensions obtained by customers of the company's product?
4. What is the weight of each requirements of the management?
5. Due to the limitations of the company, how relationship can be established between expectations of customers and promotion of product quality? (reflection of customers' demands to products design)

3. QFD

3.1.QFD Genesis

In today's world, a product, which is more compatible with customers' demand than other rival products, has the higher quality for its customers as well. But a question is posed here: what product should be produced that can have more compatibility with customers' demands?

How a product can be produced from the beginning, which can meet customer's demand appropriately in order to adopt less and partial engineering changes on it?

Thinking about answering the above questions result in needing a tool, which can help producers in adapting specifications of the product and production operation and its delivery as well as their control operation with the requirements of the customer. This subject is one of the most important concepts in the quality assurance management and also in Total Quality Management (TQM) in general. Japanese engineers responded to this need in 1972 in Mitsubishi Heavy Industry, in Kobe, Japan and devised a systematic method for the expansion of quality and qualitative activities of the product, which is now called QFD, (Bossert, 1991). QFD was created in the late 1960 to develop new products based on total quality control and was introduced in Japan. The term "Quality Deployment" was first used in 1980 in American industries. The car manufacturing industries were of the first group of industries, which resorted to use QFD in the United States of America. However, after a short period, other industries especially service industries reported to use the QFD. In fact, both groups of production and service industries could use the benefit, which has been expected in research literature on implementation of QFD (Cristiana et al., 2000).

The primary innovation of QFD was occurred when a question hit in mind of Akao as follows: "As far as quality in concerned, we pay due attention to some components of the product or process greatly and intend to know whether quality has been observed on them or not? Why these important points of quality, which are called "Quality Assurance Points", should not be considered as the control and inspection points in primary design of our product or process? In this case, we have taken effective steps from the beginning of designing product in line with our priorities." (Franceschini, 2001).

The first book in this case has been written by "Yoji Akao" and "Mizono". These two Japanese scientists embarked on doing this activity when Japan had reached economic-industrial independence newly in the face of America. In those days, statistical quality control had been introduced to Japan and in addition to understanding the importance of design quality, the country was grasped out the deficiency of quality control process chart because of its establishment after goods production. In the beginning of its evolution, QFD was put forward as "Design Points" (Chan & Wu, 2002).

Then, in continuation of its evolution, QFD became prevalent by Kobe Tables, Mitsubishi Heavy Industry Shipbuilding. These tables were not only balancing customer's requirements with the duties that should be performed, but also were specifying relationship between these duties. It should be noted that this issue is the mistake of those who know Mitsubishi as the origin of QFD evolution while the Akao had written an article with the same title two years ago. The name of Quality Deployment was given to them with the evolution of ideas related to QFD and their integrity. Turning customers' demands into the quality indicators was the main aim of QD. In continuation, another concept of value engineering was added to QD and a way was opened in order to know functions of goods. In continuation of evolution trend, business process functions were created and then QFD was established. At any rate, identifying QFD and using it started as of early 1990s in the world and presently, usage of QFD and expansion of its concept is increasing rapidly.

3.2.QFD Process

Generally, QFD includes four continuous matrixes as follows respectively: Product Planning (Quality house), Product Design, Process Planning and Process Control Planning.

Based on the above model, summary of the mentioned stages are as follows

1. 1st Matrix: (Product Planning Matrix), First Matrix translates customer's requirements to the design or engineering requirements.

2. 2nd Matrix: (Part Planning Matrix): The second matrix translates design or engineering requirements to the part or product characteristics.
3. 3rd Matrix (Process Planning Matrix): The third matrix translates specifications of part or product to the construction operation.
4. 4th Matrix (Production/ Operation Planning Matrix): The fourth matrix translates construction operation to the specific operations and controls. (Jo, 2004)

QFD House of Quality is the most important stage, which is considered as basic and strategic stage, because, customers' requirements are identified in this stage and then, necessary planning is carried out in order to design them. The general view of the House of Quality has been shown in Fig. 1 in below:

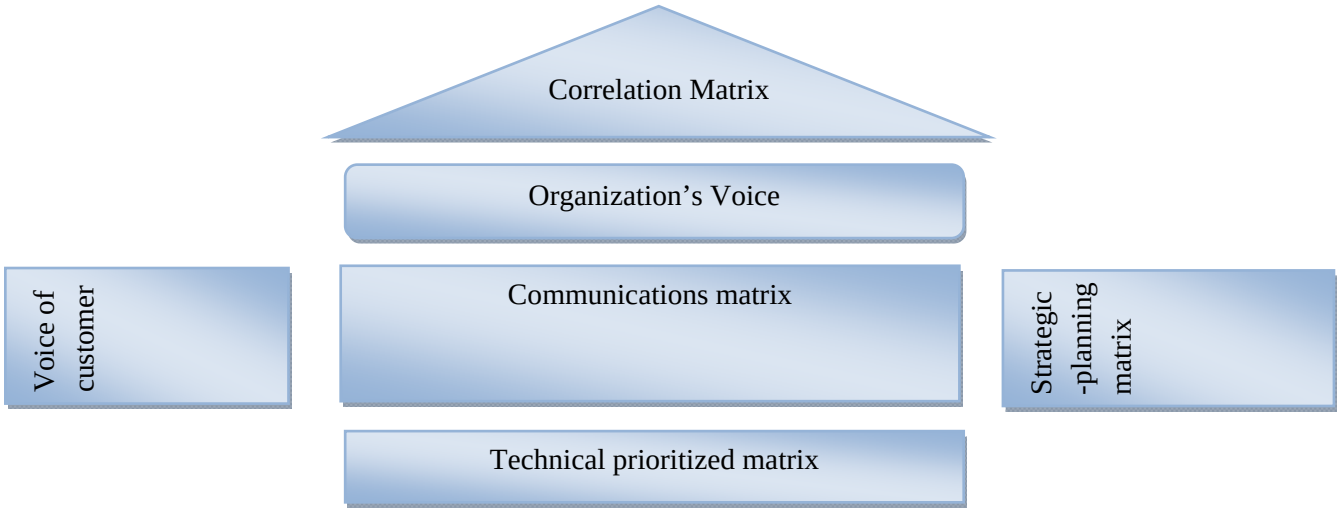


Fig. 1. House of Quality, Source: Gaverz (2001)

The other parts, application and components of the House of Quality is described in the part related to the application process.

4. Background of Research

Most researches on QFD have been carried out in the industry sector but this technique has recently been used in the field of services as well. Here under are some of the researches, which have been carried out in the field of industry through the use of QFD:

Oliaii (1998) used QFD method in quality planning in a heavy machinery production unit. With setting up QFD team in the company and specifying entry and exit channels of information related to it, this researcher collected and classified complaints and proposals of customers through questionnaires on a product entitled "Backhoe Loader".

Then, he formed QFD matrixes for the two parts of the device, which had been identified "critical" and "sensitive" and finally, the product was promoted qualitatively through the use of QFD model and a giant stride was taken in the field of management and quality assurance. Asadi (2001) conducted a research through the use of QFD Model, where customers' demands were classified in two main groups: demands related to the Armelat Company's products and demands related to the implementation of Armelat Company's products and finally, demands related to the implementation of Armelat Company's products were identified more than the demands related to the company's products. Generally, demands related to the implementation of the company's products were concentrated more. The control role of the company's soil was the other results of the research in line with meeting customer's demands.

Ghaseminejad (2003) conducted a research on QFD and stated that possibility of making decision, flexibility or more precision has been provided with making QFD fuzzy and dynamic. He also

explained that there was the possibility of revising, correcting decision and prioritizing new technical characteristics with exerting appropriate feedback (in compatible with changing predicted comments). Nahavandi (2006) proposed a framework combined with deployment of fuzzy quality function and ideal planning was presented for selecting product technical requirements. In this framework, fuzzy network analysis process approach has been used to extract coefficients used in mathematical model. In addition, the presented procedure is able to consider multipurpose nature of the issue. Finally, the ideal model presented in this study includes importance of technical requirements through the use of methodology of fuzzy network analysis process, restriction of budget, extensibility, and required degree of competitiveness as the system restrictions to set those groups of the technical requirements which should be taken into consideration in product design phase.

While using QFD in designing auto parts, FORD Company was named as the first pioneers of this technique in the U.S. in 1986 and this was due to the increased sales of its products. As of 1986, using QFD was developed in industries of the U.S. and Europe gradually as an efficient and effective tool in designing new products (Rezaei, 2001). Pacific Gas & Electric Company, largest investor of the related industry in the United States of America (USA), applied a program for using this technique (QFD) to determine programs and present services for improving customers' satisfaction. The said issue was led to an increase in customer's satisfaction, based on which, the company managed to increase its market share through the use of this technique (Tsesler, 2001).

Karsak (2002) determined technical requirements of the product process through the use of ideal planning technique and used it in product design phase model with merging these requirements in QFD Model. Then, he embarked on prioritizing requirements according to the technical facilities of the organization. It should be noted that the company managed to add number of its customers through the application of this technique as well as increase its market share by approx. 4.5%. Lee (2008) used QFD Model and merged it with Kano Model to collect requirements of customers. Then, he embarked on prioritizing requirements of customers through the use of fuzzy logic. The result of this study indicates that matrix technique of house of quality and its combination with other models can result in increased rate of customers' satisfaction and also bringing about more profitability for the organizations. Sharma and Ravany (2009) established a relationship between a production company with its customers and rivals through the use of QFD Model. QFD Model helped the company apply appropriate strategies with rivals and meet customers' requirements and demands in the best form possible. With using QFD Model, they managed to prioritize customers' demands and requirements. In the same direction, they could prevent from waste of company's resources according to the degree of importance of these requirements as viewed by the customers. Cristiana and et al. (2010) embarked on studying necessary requirements in order to design wheelchair for the disabled athletes for the competitions like basketball and volleyball, etc. through the use of QFD Model. The results of this study show full satisfaction of customers in this respect.

5. Research Method

5.1.Methodology, Tools for Data Collection and Data Analysis

The present study is of applied type in terms of objectives, because, application of QFD Model is the main objective of this study in order to determine quality specifications of products and also determine priority of customers' requirements in the medical industries. On the other hand, since requirements of customers of a subject (Saha Teb Mashhad Company) are analyzed and since we have not enough information at hand on the industry, customers and specification of their requirements, the present study is of exploratory type in terms of extraction of information related to the determination of specifications of QFD Model in products of medical industries and also is of survey type in terms of data collection method. In addition, this study includes two subjects. Since sample size of the two subjects is few, census method has been applied and the first subject includes customers of plasma seat product in Saha Teb Mashhad Company and the second subject of the study

includes senior managers of Saha Teb Mashhad Company. The data related to the satisfaction degree of customers on the product and also degree of importance of these requirements was collected through relevant questionnaires. Also, much information was collected by the decision-making team i.e. senior managers of the company. The average index was used in order to analyze the data as well. Content validity method is the validity of questionnaire according to the view of experts in Management field and Cronbach's Alpha Coefficient was selected to measure degree of reliability. The degree of satisfaction of customers (existing situation) and degree of importance of requirements (favorable situation) was calculated 0.90 and 0.80 percent respectively which indicates reliability of the questionnaire.

5.2.Process of applying research model

The model of the present study is originated from the adjusted conceptual model which has been used by Cristiana et al. (2010) in order to design wheelchair for the disabled athletes willing to take part in the competitions.

Given the necessary adjustments in the mentioned model, the following steps have been taken into consideration in Saha Teb Company in order to implement the above-said technique:

1st Step: Identifying and Reckoning Customers' Needs

Identifying customers' demands of the company was the main objective of this step. To attain this aim, an open questionnaire form was designed and was submitted to nine organizations (four blood transfusion organizations, two plasma production companies, two foreign companies (German Bioset and French GEM companies) and social security organization), considered as major customers of the company, in order to announce their needs and demands from the plasma seat product as produced by Saha Teb Company. In addition, a questionnaire was submitted to senior managers of the company in order to take advantage of their experiences in this regard. These managers were tasked to list customers' demands according to their experiences. Finally, this step led to the identification of 19 factors affecting customer's satisfaction. Given the theoretical framework and background of the research, these needs and factors were classified within the framework of five-category dimensions of the conceptual model of the research.

2nd Step: Determining Degree of Significance of Demands and Satisfaction Rate of the Demand

Given the factors identified in the first step, a questionnaire was designed and distributed among subject of the study. This questionnaire included 19 questions, which were measuring significance of each demand in view of customers on one hand and satisfaction degree or current performance of the company from 19-category factors on the other hand. The results of this step were mentioned in the House of Quality and in columns indicating degree of importance and satisfaction.

3rd Step: Setting up Decision-Making Team

The decision team is comprised of five people from senior managers of different departments of the company, in which, necessary information such as correlation matrix, relationship matrix, sales points and objective of performance, was collected. In this study, the decision team included the following individuals (Table 1) :

Table 1

Members of the Decision Team

No	1	2	3	4	5
Position	Research and development (R&D) manager	Business Manager	Design Manager	Planning Manager	Financial Manager

4th Step: Completing Column of Numbers of Function Objective and Sales Point

The information related to these two columns in the House of Quality was collected by the Decision Team and through its specific questionnaire and interview with the senior member of the team. The sales point indicates competitive advantage of each component or need to its rival in the community (country).

According to the theoretical framework and conceptual model of the study, top and superior competitive advantage than rival in the community stands at 1.5, average advantage stands at 1.2 while lack of competitive advantage stands at 1. Regarding function objective, it should be noted that objective function indicates ideal of the company in presenting quality services and products to customers, so that restrictions of the company should be taken into consideration. In other words, given the existing restrictions, the organization intends to evaluate presentation of its services and products. In this part, Likert 5-pieces scale was used. Given the abovementioned studies, the relevant questionnaire was designed and was put available to the decision team.

5th Step: Determining Improvement Ratio

Improvement ratio is calculated according to the following formula and enters the House of Quality:

Current performance/objective function = Improvement ratio

6th Step: Calculation of Raw Weight of Each Demand

The raw weight of each need is calculated through the following formula:

Importance degree of needs x improvement ratio x point of sale = raw weight of needs

7th Step: Calculating Relative Weight of Needs

In this step, weight of the figures, obtained from 6th step, is calculated relatively. After calculating raw weight of each need, weight of each need should be defined in normalized form and its relative weight is calculated. For this purpose, total raw weights are first added, then, raw weight of each need is divided into total figure and is multiplied by 100.

8th Step: Identifying Management Requirements / Products Design

As a matter of fact, management requirements are the completion of ceiling of House of Quality. This part is related to the way of meeting requirements and demands of customers. In other words, this part of House of Quality is related to the factors, where the organization may face problems in providing them. These factors were identified through questionnaire and interview, way of meeting customers' demands in the company. Management requirements or voice of organization state that how customers' demands can be presented with the controllable tools of the organization?

9th Step: Completing the Communication Matrix

This matrix, which has placed a large part of data of House of Quality in itself, studies the relationship between customers' needs and demands and management requirements/products design. In this step, the numbers, decided by the decision team, are allocated to the communications matrix. The scale, used in this part, is inspired by the literature of subject, background and conceptual model of the research as follows (Table 2) :

Table 2
Symbols of Communication Matrix

Number	0	1	3	10
Concept	Disaffiliation	Low correlation	Average correlation	High correlation

10th Step: Completing Correlation Matrix

This matrix is the gable roof of House of Quality and shows relationship of existing elements in ceiling of House of Quality (Management Requirements) with each other. Usually, symbols and signs are used in completing this part. These signs and symbols are considered as follows (Table 3) :

Table 3

Symbols of Correlation Matrix

Vacant House		○	◈	☆
Concept	Disaffiliation	Low correlation	Average correlation	High correlation

11th Step: Determining Relative Raw Importance and Weight of Each Management Elements and Requirements

In this step, weight and importance of factors affecting services design and/or voice of organization is calculated. For calculating raw weight of these factors, it is done according to the Table 4:

Table 4

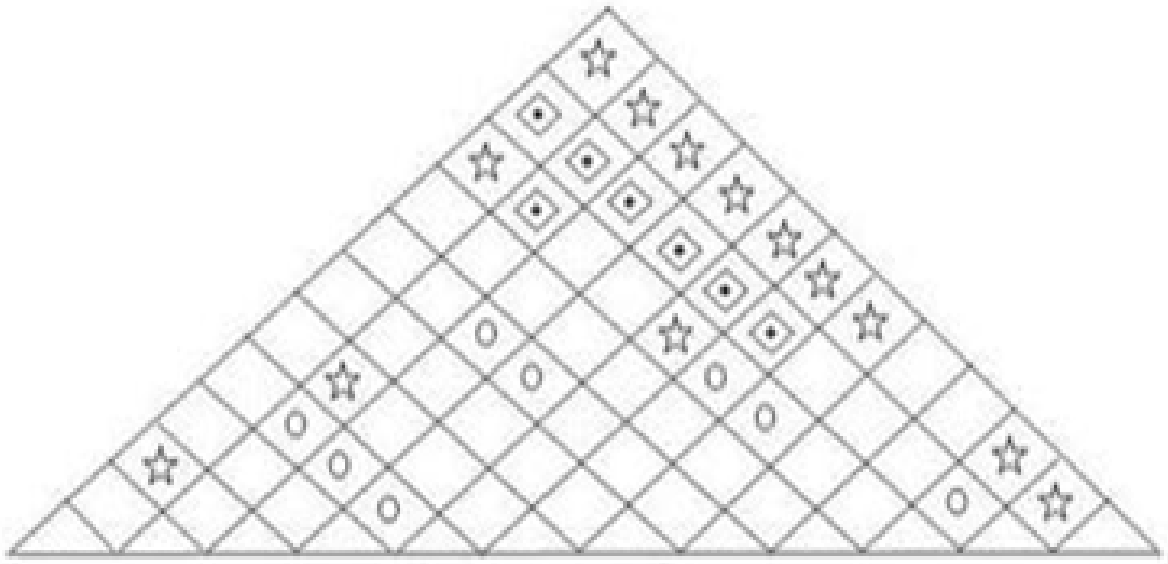
Calculation of Weight of Management Requirements

No.	Product Features	Remote Control	Relative Weight	Raw Weight
1	Price	10	5.8	58
2	Ease of product use	10	4.45	44.5
3	Weight	0	5.03	0
4	Color	0	4.25	0
5	Size	3	5.42	16.26
6	Transport capability	1	5.22	5.22
7	Appropriate height	3	6.87	20.61
8	Convenient fulcrum for the arm	0	5.61	0
9	Convenient fulcrum for the back	3	6.87	20.61
10	Sustainability	10	3.48	34.8
11	Proper packaging	1	4.64	4.64
12	Product guide	3	4.84	14.52
13	After-sales services	3	5.90	17.7
14	Proper mattress	0	7.55	0
15	Ability to remain constant (brakes)	1	3.87	3.87
16	Quality of parts used in product (wheels, jack, remote control, etc.)	10	5.13	51.3
17	Corporate reputation	1	6.14	6.14
18	Product being exported	3	4.35	13.05
19	Proper conduct of sales staff with customers	0	6.38	0
Total				311.22

Accordingly, after completion of steps and different parts of the model, House of Quality is interpreted according to the Fig. 2.

5.3.Discussion and interpretation of house of quality

Now, after completion of House of Quality, it can be analyzed and the research questions can be answered as well. Now, according to the research questions mentioned in the introduction, we embark on answering them. Regarding first question of the research, i.e. identification of quality dimensions, it should be said that according to the opinion poll carried out from customers and managers of Saha Teb Company, 19 factors were identified which were very effective in satisfaction of customers of the company. Also, in Table 5, each of the dimensions of the quality along with degree of its importance was stated in order to obtain rank of each of dimensions and also answer second question of this research.



Needs and Demands	remote control	Adjustable pad	power cable	Headrest pad	chair mats	start bolt pad	basic roll of paper	wheel pedal lock	price	humble and etiquette of sales personnel	manual book	after-sales services	current performance	degree of importance	objective function	point of sales	Improvement ratio	raw weight	Relative weight
Price	10	10	10	10	10	10	10	10	3	0	0	10	4	4	4	1.5	1	6	5.8
easiness of product use	10	10	10	3	3	10	10	10	1	0	10	10	4.3	4.4	4.1	1.2	0.9	4.6	4.45
weight	0	1	1	1	3	1	3	3	0	0	0	0	3.7	4.1	4.1	1.4	1	5.2	5.03
color	0	0	0	1	3	1	3	3	1	0	0	0	4.2	4.2	3	1.5	0.7	4.4	4.25
size	3	3	3	1	3	1	1	3	10	0	0	0	4	4.1	4	1.4	1	5.6	5.42
transport capability	1	1	1	3	3	3	3	10	1	0	1	3	3.8	3.7	4	1.3	1.1	5.4	5.22
appropriate height	3	1	1	1	1	3	0	0	0	0	1	3	4.3	4.4	5	1.5	1.1	7.1	6.87
convenient fulcrum for the arm	0	10	3	3	1	10	0	0	1	0	1	3	4.6	4.4	4	1.4	0.9	5.8	5.61
convenient fulcrum for the back	3	1	0	3	3	1	1	0	1	0	0	3	4.7	4.4	4.6	1.5	1	7.1	6.87
sustainability	10	10	1	3	10	3	10	10	10	0	3	10	4.3	4.3	2.6	1.4	0.6	3.6	3.48
appropriate packaging	1	3	3	3	10	3	10	10	10	0	0	0	3.7	2.7	2.6	1.3	1	4.8	4.64
owning product manual book	3	3	1	3	1	3	3	3	3	0	10	1	3.5	3.8	4	1.3	1.1	5	4.84
after-sales services	3	3	1	3	3	3	3	3	3	10	0	10	3.7	3.4	3.6	1.5	1.1	6.1	5.90
proper mattress	0	0	0	1	10	1	0	0	10	0	0	3	4.7	3.8	4	1.5	1.1	7.8	7.55
ability to fix brakes	1	0	0	0	0	0	1	10	3	0	3	3	4.2	4.3	3.6	1.2	0.8	4	3.87
quality of the used parts in product (jack, etc.)	10	10	3	10	10	10	10	10	10	0	3	3	4.2	3.8	3.3	1.4	0.9	5.3	5.13
reputation of the company	1	3	3	3	3	3	3	3	10	10	3	10	3.6	4	3.3	1.5	0.8	4.3	6.14
expertness of the product	3	3	3	3	3	3	3	3	3	1	10	3	3.6	3.5	3	1.4	0.9	4.5	4.35
good conduct of sales staff with customers	0	0	0	0	0	0	0	0	0	10	0	3	4.4	4	4	1.5	1	6.6	6.38
raw weight and significance of management requirements	311.22	362.56	227.7	292.92	426.2	363.34	358.35	433.69	424.28	188.55	209.96	418.09							
relative weight and importance	8.39	9.78	6.14	7.90	11.5	9.80	9.67	11.70	11.44	5.08	5.66	11.28							

Fig. 2. Matrix of House of Quality

In response to this question on: “What are the effective technical features in view of the company to meet quality dimensions gained by customers of the company’s product? It should be noted that according to the information collected by the Decision Team, these features include 12 cases as shown in Table 7. On the other hand, relative weight of each of the requirements has been mentioned and also has been specified based on rank of each of these requirements.

Table 5

Dimensions of Quality and Ranking It

No.	Needs and Demands	Degree of Importance	Rank
1	Convenient fulcrum for the back	4.7	1
2	Appropriate mat	4.7	1
3	Convenient fulcrum for the arm	4.6	2
4	Good conduct of sales personnel with customers	4.4	3
5	Degree of easiness of the product use	4.3	4
6	Appropriate height	4.3	4
7	Sustainability	4.3	4
8	Color	4.2	5
9	Ability to fix the brakes	4.2	5
10	Quality of the parts used in product (wheels, jack, remote control, etc.)	4.2	5
11	Price	4.0	6
12	Size	4.0	6
13	Transport capability	3.8	7
14	Weight	3.7	8
15	Appropriate packaging	3.7	8
16	After-sales services	3.7	8
17	Reputation of the company	3.6	9
18	Expertness of the product	3.6	9
19	Owning product manual book	3.5	10

The results obtained of the mentioned able indicate that wheel pedal lock with 11.70 percent weight, seat mattress with 11.50 percent, price with 11.44 percent and after-sales services with 11.28 percent have the highest impact in presenting product as desired by customers.

Table 6

Reflection of Customers' Demands to the Products Design

	Remote control	Adjustable pad	Power cable	Using headrest	Seat mattress	Star bolt pad	Paper roll base	Wheel lock pedal	Price	Good conduct of sales	Manual book	After-sales
Price	10	10	10	10	10	10	10	10	3	0	0	10
Easiness degree of product use	10	10	10	3	3	10	10	10	1	0	10	10
Weight	0	1	1	1	3	1	3	3	0	0	0	0
Color	0	0	0	1	3	1	3	3	1	0	0	0
Size	3	3	3	1	3	1	1	3	10	0	0	0
Transport capability	1	1	1	3	3	3	3	10	1	0	1	3
Appropriate height	3	1	1	1	1	3	0	0	0	0	1	3
Convenient fulcrum for the arm	0	10	3	3	1	10	0	0	1	0	1	3
Convenient fulcrum for the back	3	1	0	3	3	1	1	0	1	0	0	3
Sustainability	10	10	1	3	10	3	10	10	10	0	3	10
Appropriate packaging	1	3	3	3	10	3	10	10	10	0	0	0
Owning product manual book	3	3	1	3	1	3	3	3	3	0	10	1
After-sales services	3	3	1	3	3	3	3	3	3	10	0	10
Appropriate mattress	0	0	0	1	10	1	0	0	10	0	0	3
Ability to fix the brakes	1	0	0	0	0	0	1	10	3	0	3	3
Quality of parts used in product (wheel, jack, remote control, etc.)	10	10	3	10	10	10	10	10	10	0	3	3
Reputation of the company	1	3	3	3	3	3	3	3	10	10	3	10
Product being exported	3	3	3	3	3	3	3	3	3	1	10	3
Good conduct of sales personnel with customers	0	0	0	0	0	0	0	0	0	10	0	3

Finally, the last question of this research is as follows: Given the restrictions of the company, how relationship can be established between customers' expectations and promotion of product quality? Reflection of customers' demands to the products' design is posed and its response can be extracted from the communications matrix table.

6. Conclusion

Existence of management requirements is the main proposal of this study which Saha Teb Company should meet the criteria in order to attain the factors affecting satisfaction of customers. These factors have been mentioned in Table 7. On the other hand, given the communications matrix Table 6, which shows reflection of customer's demands to the product design, correspondence can be extracted between each of the management requirements and factors affecting customers' satisfaction.

Table 7
Rating Voice of Organization

Management Requirements (Voice of Organization)	Weight	Rating
Wheel lock pedal	11.70	1
Seat mattress	11.50	2
Price	11.44	3
After-sales services	11.28	4
Star-shaped bolt pad	9.80	5
Adjustable pad	9.78	6
Paper roll base	9.67	7
Remote control	8.39	8
Using headrest pad	7.90	9
Power cable	6.14	10
Manual book	5.66	11
Good conduct and etiquette of sales personnel	5.08	12

For example, the company should enjoy technical features like user's manual to meet customer demand which is the easiness of the product use. Alternatively, it should enjoy technical features corresponding with this demand to meet customer's requirement, which is the convenient fulcrum for the arm, based on which, these features include adjustable pad and star-shaped bolt pad in this study. On the other hand, as it is mentioned in Fig. 2 (degree of customer's satisfaction on the current performance of the company), the company could not have strong response to some of the demands posed by customers. For instance, the company has shown lackluster and weak performance in terms of packing product. In addition, we know that each packaging instigates vision of every customer at the first glance. Although good packaging cannot give an accurate vision to customer, it can instigate their feelings and can establish good relationship with customers as well. Existence of creativity is considered as one of the main indicators of packaging. In addition, we are aware of this fact that each packaging should observe requirements of existing standards for each specific product. In this respect, the following points can be taken into consideration to improve performance of this company in the field of packaging plasma seat product:

- Identifying better provider in the related field so that suitable provider should use the highest quality material to provide wooden pallets for packaging product. (Packaging products of Saha Teb Company is carried out by contractor. Since plasma product is rather heavy, it is necessary to use wooden pallets instead of carton.)
- Since the dimensions of this product are large and needs relatively great volume, it seems that packaging product should be carried out appropriately in order to set small space for each box and also forward more products in long distances. Under such circumstances, transport cost will be saved remarkably.

On the other hand, the company needs to improve and promote quality of products on some of the components. This component includes after-sales services. Regarding after-sales services, some actions can be considered. Since customers of the company are scattered in the whole country and since the company has not sales agencies in all provinces of the country, it seems that existence of a sales agency in residence of customer, who uses product of the company, is necessary. On the other hand, using software packages related to the after-sales services for integrating information and systematizing these activities is more economical in order to reduce cost in after-sales services' sector and track all the products sold by the manufacturing company.

The following activities are done in line with improving after-sales services:

- Introducing substitute unit to the customer by the representative company in order to send the defective device to the company if required,
- The personnel of after-sales services unit should enjoy all necessary capabilities and merits to carry out after-sales services (physical ability, enough experience and skill, relevant education, appropriate training, etc.)
- The company should provide necessary facilities for transporting the product which is returned to the company for repair and maintenance services.
- Regarding two foreign companies, which are regarded as main customers of Saha Teb Company, it should be noted that these companies are interested in changing the defective part than repairing it. So,

the company should consider a place to store required accessories and equipment in order to meet their demands.

With regard to the requirements of management or voice of the organization, which is considered as a type of management, investment volume can be decided. As it is observed in Table 8, wheel lock pedal with 11.70 percent weight stood at the first rank and accounted for the highest impact in designing plasma seat product. Therefore, better brand can be used to improve it, because, this part is purchased from the other organization. Regarding application of mattress in plasma seat, better brand can also be used. Moreover, color of the mattress can be taken into consideration, because, using bright color shows observation of proper sanitation.

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