

THE APPLICATION OF QFD AND KANO MODEL FOR THE IMPROVEMENT OF PRODUCT DOCUMENT MANAGEMENT

Kristine BROKA , Galina ROBERTSONE ^{*}

*Faculty of Engineering Economics and Management, Riga Technical University,
6 Kalnciema Str., Riga, Latvia*

Received 28 January 2024; accepted 3 April 2024

Abstract. Within competitive markets, emphasizing customer satisfaction is crucial for a company's enduring stability. This satisfaction lays the foundation for loyalty, strengthening the company's financial resilience. Consequently, businesses must pinpoint the key elements contributing to customer satisfaction. While traditionally, Quality Function Deployment and the Kano model are utilised for product development and measurement of customer satisfaction, in this research, an unconventional application of Quality Function Deployment (QFD) and the Kano model for improving product quality document management will be demonstrated by identifying the most critical aspects of service quality from the customers' point of view. The research employs several methods – literature overview, surveys, the Delphi method, action research, the application of Quality Function Deployment, and the Kano model. It has been concluded that although the processing of product quality documentation within one day has been identified as of utmost importance and the customers would appreciate it, at the same time, they would not be disappointed if this requirement is not fulfilled.

Keywords: customer satisfaction, food company, improvement, Kano, QFD.

JEL Classification: L66, L81.

1. Introduction

Understanding customers' experiences is crucial due to its profound implications for the supplier–buyer relationship, especially in the B2B segment. A supplier must be adaptive to customer needs and requests; otherwise, customers will disconnect from using the supplier's services (Gounaris & Almoraish, 2024, p. 9).

The customer – supplier collaborative relationship can be mutually beneficial if the supplier can learn from the customer and provide the customer with better quality and production control. Suppliers can proactively adopt management practices to attain higher customer satisfaction and enhance competitive advantage against their competitors (Ueki, 2016, p. 2233).

A key measure of service quality is delivery lead time, which notably affects the customers' channel choice, demand, and loyalty (Tahirov & Glock, 2022, p. 417). In food supply chains, product documentation is necessary to ensure that adequate and accessible information is available for the next person in the supply chain to know

the correct, suitable, and safe ways of handling the food (Noor Hasnan et al., 2022, p. 10).

In this research, handing over product quality documents to customers is analysed in detail because there was a growing trend of customer complaints about food product quality document management deficiencies, which accounted for 16% of all complaints in the analysed company in 2022. The essence of the complaints was about inadequate or missing information in the product labels and specifications, which is not allowed according to Section 13 of the Latvian Law on the Supervision of the Handling of Food (Saeima, 1998) which stipulates that the information provided in the product labels must not be misleading.

The Kano customer satisfaction model can be optimally combined with Quality Function Deployment (QFD). A prerequisite is to identify customer needs, their hierarchy, and priorities. Kano model is used to establish the importance of individual product features for customer satisfaction, and thus, it creates the optimal

* Corresponding author. E-mail: galina.robertsone@rtu.lv

prerequisite for process-oriented product development activities (Matzler & Hinterhuber, 1998, p. 30).

Rampal et al. (2022, p. 1486) combined the Kano and QFD tools to understand customer perception better. Zhang et al. (2023, p. 3) used Kano surveys as a part of a QFD-based framework to develop a knowledge-based decision support system.

Tague (2005, p.17) indicated that customer satisfaction is the primary goal in QFD. A model of customer satisfaction, developed by Noriaki Kano, is often considered when QFD is applied. Through the application of the Kano model, the influence on customer satisfaction can be identified and reflected in the service quality attributes, and the integration with QFD connects the quality attributes to technical requirements (Lizarelli et al., 2021, p. 12). To manage such challenges as “interpreting the customer’s voice” and “identifying the most important customer demands”, QFD is often combined with the Kano model, which helps to prioritise customer needs, based on how they affect customer satisfaction (Schindler et al., 2023, p. 1000).

The study aims to demonstrate an unconventional application of Quality Function Deployment and the Kano model for improving product quality documentation management by identifying the most critical aspects of service quality from the customers’ point of view.

The previous research shows how the results of the Kano model are used to develop QFD. However, the authors could not identify the research on how the results of the QFD are analysed with the Kano model to improve the company’s internal processes, which also substantiates the relevance of the study.

2. Literature review

2.1. Quality function deployment

Quality function deployment was developed by Yoji Akao (Japan) in 1966, and in 1972, it was industrially demonstrated at Mitsubishi Heavy Industries (Costa et al., 2000, p. 306). Traditionally, QFD has been widely used in product development and production decision-making (Eldermann et al., 2017, p. 232). Tague (2005, p.16) mentioned that initially applied to manufacturing, QFD has been used to design services as diverse as police work, healthcare, law, and kindergarten and college curricula.

QFD is a technique that can be utilized to develop a process matrix exhibiting interactions between the system elements. This technique is a four-phase process: 1. understanding customer requirements (product planning), 2. developing a design planning matrix, 3. developing a process planning matrix, and 4. developing an operations planning matrix (Farooq et al., 2016, p. 156). QFD approach allows integrating all parties’ requirements and analysing joint priorities (Eldermann et al., 2017, p. 233).

QFD shortens the design time and reduces the costs of achieving product or service introduction. Eventually,

fewer customer complaints, greater customer satisfaction, increased market share, and higher profits are achieved (Tague, 2005, p. 16). This underscores the effectiveness of the Quality Function Deployment method in discerning and evaluating customer needs, extending its applicability to the service sector.

2.2. Kano model

In 1984, leading Japanese quality management expert Noriaki Kano proposed the Kano model, a well-known service quality assessment approach based on Herzberg’s two-factor theory. The initially introduced model represents a double standard of satisfaction and dissatisfaction in the field of quality management (Jiang et al., 2023, p. 5).

The Kano model of consumer satisfaction, built on the theory of attractive quality, allows evaluation of the importance of specific product features both qualitatively and quantitatively by seizing a more detailed perspective on customers’ reactions, allowing for a richer interpretation of their feedback (Nuojua et al., 2024, p.70).

Although the Kano model was initially employed to enhance product quality development in manufacturing, many researchers later applied it to the service industry. A two-dimensional quality model has been used to explore service quality in banking, laundry services, restaurants, and supermarkets. Moreover, some modifications were proposed to Kano’s two-dimensional quality model for the case of Italian pizza restaurants to explore restaurant service quality and improve indexes (Kuo et al., 2011, p. e210).

Jiang et al. (2023, p.3) noted that the Kano model has traditionally been effective in analysing customers’ service quality demand attributes as a qualitative analytic methodology.

The reviewed literature indicates that Kano’s two-dimensional quality model, initially developed for visualising product attributes, is successfully applied to analyse and improve service quality attributes.

3. Research methodology

The authors have chosen action research as a methodology for the study. One of the authors was employed by the analysed company at the time of the research.

The term “action research” was first coined by the German American psychologist Kurt Lewin after a series of practical experiments in the early 1940s (Adelman, 1993, p. 8). Action research is a collaborative approach aimed at solving a practical problem where the participants are involved in the stages of the research process (Reichwald et al., 2023, p. 226).

The survey and Delphi method were also applied in the research. Fink (2010, p. 152) described a survey as a system for collecting valid information from or about people to describe, compare, or explain their knowledge, attitudes, and behaviour. The system consists of inter-related activities, starting with defining precise survey

objectives, choosing respondents, preparing a reliable and valid survey instrument, testing the survey with respondents, and conducting all activities in an ethical manner. The survey is a suitable method for deductive studies, which can collect large amounts of quantitative data (Saghiri & Wilding, 2021, p. 7).

The Delphi survey is a decision-making method that gathers collective intelligence from decision-makers using iterative anonymous surveys and controlled feedback Yang et al. (2023, p. 1). Schlecht et al. (2021, p. 2) noted that the Delphi method represents a powerful tool for exploring the potential implications of uncertain developments in complex contexts.

The research was carried out in three stages. A literature overview was followed by the analytical part, in which surveys of customers and sales representatives were performed. The information received was used in the expert surveys using the Delphi method. In the practical part, Quality Function Deployment combined with the repeated customer survey and the application of the Kano model was used to assess the significance of customer requirements, the connection to functional requirements, and the impact on customer satisfaction.

The research analyses the internal processes of a food wholesale company, paying the most attention to the problems and solutions in the process of handing over food quality documentation to the customers.

4. Analysis of the company processes

4.1. The characteristics of the company

The analysed company is a food wholesale and storage company with its own warehouse. The company primarily focuses on raw food materials for bakery products (bread mixtures and improvers, yeast, margarine, and others). Assortment includes around 1,500 different food products; all products are divided into ten product groups.

The company comprises several departments – procurement, sales, logistics, innovation, quality, and finance. The largest departments are sales and logistics, directly corresponding to the company's core business – wholesale and storage.

The main customers of the analysed company are bread and pastry production plants, bakeries, and confectioneries.

4.2. Surveys of customers and sales representatives

In order to study the product quality document management process in more detail, a survey was conducted to clarify the answers to when and in what way it is the best to convey information about changes in product quality documentation to customers, as well as ask the opinion of what, according to the respondents, could be the reasons that prevent timely preparation of quality documentation and handing it over to customers. The survey included two closed-ended multiple-choice

questions and one open question (Table 1). Questions for sales representatives and customers were identical; only their wording was changed.

Table 1. Structure of the customers and sales representatives survey (created by authors)

Survey element	Explanation
Informative note at the beginning of the survey	I inform you that “quality documents” are understood as such documents as, for example, specifications, quality certificates, manufacturer's certificates, testing reports, product labelling, etc.
The first question	For sales representatives – <i>In your opinion, what is the best way to convey information to customers about changes in quality documents?</i>
	For customers – <i>How would you like to receive information from a food wholesale company about changes in quality documents?</i>
Answer options for the first question	(1) Sales representatives send to their customers (2) Quality specialist sends to customers (3) Another option
The second question	For sales representatives – <i>When, in your opinion, would be the best time to convey information to customers about changes in product compositions, specifications, and labels?</i>
	For customers – <i>When would you like to receive information about changes in product compositions, specifications, and labels?</i>
Answer options for the second question	(1) Immediately as information is received from the manufacturer, even though the product with the changed composition/ specification is not yet in the food wholesale warehouse and it is unknown when it will be received (2) As soon as it is known when the new batch of goods with a changed composition will be received at the food wholesale warehouse (3) Simultaneously with the first delivery of products of the changed composition to the customer (4) Another option
The third question (common to both groups of respondents)	What, in your opinion, could be the reasons that hinder the timely preparation of quality documentation and timely delivery to customers? Please mention at least three reasons.

All seven sales department employees of the food wholesale company were surveyed, including the sales manager, key account manager, sales representatives, and customer service specialists.

Customers were selected according to those customer segments in which the largest volume of goods was sold in 2022; respectively, those customers whose sales volume is over 5% of the total volume sold were selected for the survey. According to the percentage distribution

of the volume sold, the number of respondents was calculated, and surveys were sent electronically to 30 customer representatives from quality departments or those responsible for quality issues. Answers were received from 20 respondents (response rate 66.7%).

There is a consensus among sales representatives and customers about the best time and way to hand over quality documentation to customers – 59% of the respondents indicated that they would like information on changes in quality documents to be given as soon as it is known when the new batch with changed composition will be received at the warehouse.

Answering the open question of the survey, the respondents indicated unequivocally that the most essential reason that hinders the timely preparation and delivery of quality documentation to customers is “Not receiving timely and appropriate information from the manufacturer/supplier” (mentioned by 33.9% of the respondents), followed by “Large amount of work” (mentioned by 11.9% of the respondents), “Lack of time” (8.5%), and “Lack of workforce (including vacations, sick leaves)” (8.5%).

The reasons for this are summarized and prepared into nine factors for evaluation in the expert survey.

4.3. Expert surveys and the Delphi method

Those working in food distribution, whose daily duties are related to the circulation of quality documentation at various levels, were invited as experts. The expert team consisted of 8 experts from five different companies from Latvia, Lithuania, Estonia, Finland, and Sweden of the leading bakery and ice cream ingredients supplier in the Nordics and Baltics, whose core activity is food wholesale and storage. Among the experts were three quality specialists, three quality managers, a food technologist/sales consultant, and the head of the quality department of several joint food production companies.

The experts were asked to rank the factors that influence the timely preparation and delivery of quality documentation to customers in the food wholesale industry, which were identified during customers’ and sales representatives’ surveys, where 1 is the most important factor, and 9 is the least important factor. Table 2 represents the results. According to the experts’ opinion, the smallest rankings represent the most important factors.

To determine the degree of agreement between the experts, the calculation of Kendall’s coefficient of concordance was used, which was carried out according to the formula (1):

$$W = \frac{\sum_{i=1}^n \left\{ \sum_{j=1}^m r_{ji} - \frac{1}{2}m(n+1) \right\}^2}{\frac{1}{12}m^2(n^3 - n) - m \sum_j T_j}, \quad (1)$$

where: r_{ji} – assigned rank, j – expert, i – object to be evaluated, T_j is determined by the formula (2):

$$T_j = \frac{1}{12} \sum_{ij} (t_j^3 - t_j), \quad (2)$$

where t_j is the number of rank repetitions (Karpičs & Markovičs, 2007, p. 38).

Kendall’s concordance analysis is used to check for consistency in the rankings given by respondents. Kendall’s coefficient of concordance (W) evaluates agreement among a group of experts on a set of variables, indicating how much the actual rank variation aligns with the maximum possible variation (Nahar et al., 2022, p.3).

The calculation of Kendall’s coefficient of concordance was carried out using Microsoft Excel.

Kendall’s coefficient of concordance shows the degree of consensus among experts. The values of the found coefficient are in the range $0 \leq W \leq 1$. If it is below 0.5, there is a low consensus; if it is equal to or greater than 0.5, there is an acceptable consensus (Karpičs & Markovičs, 2007, p. 38).

After the first round of the experts’ survey, Kendall’s coefficient of concordance was $W = 0.20$. Considering that if $W < 0.5$, the obtained result indicates a low consensus among the experts and mutually very different opinions. After the second round of the experts’ survey, Kendall’s coefficient of concordance was $W = 0.54$; thus, $W \geq 0.5$. Therefore, the obtained result is evaluated as valid, and the experts’ consensus is acceptable.

Table 2. Experts ranking (2nd round) of the factors influencing timely preparation and delivery of quality documentation to customers (created by authors)

No.	Factors	The sum of the ratings
1.	Not receiving timely and appropriate information from the manufacturer/supplier	11
2.	Lack of communication in one of the stages of the supply chain	19
3.	Lack of knowledge and skills of employees, as well as the human factor	36
4.	Lack of resources (time and labour, including vacations, sick leaves)	41
5.	Deficiencies in the document management process	43
6.	A large amount of work	45
7.	The need to develop a translation of the document into the national language	51
8.	A large assortment of raw materials	53
9.	Request for a new product	61

According to the experts, the most impacting factors are “Not receiving timely and appropriate information from the manufacturer/supplier”, “Lack of communication in one of the stages of the supply chain”, “Lack of knowledge and skills of employees, as well as the human factor.” The least significant factor is the “Request for a new product.”

5. The application quality function deployment and Kano model

End of Table 3

5.1. Quality function deployment

Quality function deployment was applied to find out the possibilities of improving the quality documentation management process of the food wholesale company according to customer requirements. In applying the method, the quality documents of the food wholesale company are taken as the “product”, while the “customer” is the customer of the analysed company.

Customer requirements are developed based on the results of customer and expert surveys obtained in the previous research steps. The evaluation of the significance of these requirements within the company, along with the analysis of both the company’s and its competitors’ performance, is derived from feedback given by the company’s CEO, which was collected through a survey.

In the survey, the CEO of the analysed company was asked to provide answers to 4 questions, assessing the importance of the customer’s requirements for the company, rating 9 if the customer’s requirement is very important, 3 if the customer’s requirement is moderately important, 1 if the customer’s requirement is not important for the company. In addition, he was asked to evaluate the performance of the company and its competitors in fulfilling these customer requirements on a scale from 1 to 5, as well as the performance of competitors in fulfilling functional requirements.

The relationships between customer requirements, functional requirements, and the direction for the improvement can be seen in Table 3.

Table 3. The relationships between customer requirements and functional requirements (created by authors)

Direction of Improvement	▼	◇	▲	▲	▲
Functional Requirements					
Customer Requirements					
	An opportunity for the quality specialist to set priorities independently	Recruitment of additional employees	Professional training of employees	Traceability	Clearly defined communication channels, participants, minimum content, and volume of information
1	2	3	4	5	6
(A) Receive information about changes in quality documentation from the quality specialist	●	●	●	○	○

1	2	3	4	5	6
(B) Receive information about changes in product compositions, specifications, and markings within one working day after it becomes known on which date the batch of goods with a changed composition will be received in the company’s warehouse	●	○	●	●	●
(C) To process the received information and pass it on within one working day	●	●	○	▽	●
(D) Ensure that the information provided corresponds to the requested	▽	●	●	▽	●

The notations used to reflect the interrelationship between customer requirements and functional requirements are evaluated with the following values and visual markers – “Significant interrelationship” – 9 or ●, “Minor interrelationship” – 3 or ○ and “Insignificant interrelationship” – 1 or ▽. Also, the direction of improvement is determined considering the company’s strategic development priorities, where “We want to increase” – ▲, “We want to reduce” – ▼ and “We want not to change” – ◇. The main conclusions of the application of the method are as follows: As a result of the application of the quality function expansion method, it was concluded that customer requirements (A) and (B) – from whom and when to receive changes in the product quality documentation are relatively well met, competition is not pronounced, no significant improvements are required to achieve the goal. Investments are required to improve customer and business-critical (C) and (D) requirements and outperform the competition. To improve the performance of the parameter – “Clearly defined communication channels, participants, minimum content and volume of information” (relative importance 27%), so that there is no need to increase the parameter – “Recruitment of additional employees” (relative importance 24%), which the company would not want to change. The greatest attention should be paid to the performance of requirement (C) because, currently, the company is relatively weak in fulfilling this parameter, which is essential for the client. Accordingly, the requirement (C) is advanced for further investigation using Kano’s model.

5.2. Repeated customer survey and Kano model

For the repeated customer survey, the same customers ($n = 30$) as before were selected. The survey was anonymous. Answers were received from 31 respondents,

which may be explained by the fact that in some companies, there is a common e-mail for the quality department, which several employees monitor.

The customers were asked about the most critical customer requirement identified by the QFD method. According to the Kano model, customers were given two choices. These choices were – functional (Provided) and dysfunctional (Not provided), representing the availability of a particular feature in the process (Rampal et al., 2022, p. 1482).

The survey consists of two questions (Table 4) to determine the respondents’ attitude if the specific statement is fulfilled (Provided) or not fulfilled (Not provided).

Table 4. Structure of the Kano survey (created by authors)

Survey element	Explanation
Statement	“The food wholesale company processes and forwards my request for product quality documentation* within one working day.”
Clarification of the statement	* Processing and forwarding documents within one working day means that when receiving a request from the customer, it is forwarded within one working day. When receiving a response from the manufacturer/supplier, the information is transferred to the customer within one working day.
The first question	Please rate how you would feel if the statement above WERE FULFILLED.
The second question	Please rate how you would feel if the statement above WERE NOT FULFILLED.
Answer options	(1) “I would like that” (2) “I expect that” (3) “I have a neutral attitude” (4) “I can handle that” (5) “I would not like that”

The answers obtained were analysed and summarized with the help of the evaluation scheme given in Table 5.

Explanation of notations used in Table 5:

(1), (2), (3), (4), (5) answer options as described in Table 4.

M – Must-Be Attributes,

A – Attractive Features,

O – One-Dimensional Features,

I – Indifferent Features,

R – Reverse Features

Q – Questionable Features (Rampal et al., 2022, p. 1482).

To further analyse the attributes based on Kano’s model, two formulas are proposed to calculate the coefficients for increasing customer satisfaction (3) and the coefficients for decreasing customer dissatisfaction (4):

$$\frac{(A + O)}{(A + O + M + I)}, \tag{3}$$

$$\frac{(O + M)}{(A + O + M + I)}^{-1}, \tag{4}$$

where: A – Attractive attributes, O – One-dimensional attributes, M – Must-be attributes, I – Indifferent attributes (Shen et al., 2021, p. 4).

Table 5. Evaluation scheme for Kano analysis (created by authors)

Statement	The attitude if the statement would not be fulfilled					
	(1)	(2)	(3)	(4)	(5)	
The attitude of the statement would be fulfilled	(1)	Q	A	A	A	O
	(2)	R	I	I	I	M
	(3)	R	I	I	I	M
	(4)	R	I	I	I	M
	(5)	R	R	R	R	Q

The results of the repeated survey (Table 6) indicate that the highest number of responses (35%) is for the category *Attractive attributes*, which can be described as an exciting quality that customers would be happy about but do not expect as a matter of course. Next comes *Indifferent attributes* with 23%, which shows customers are not worried about this parameter. On the other hand, 19% expect such quality, and 16% take it for granted. The attitude of two respondents, or 6% of all respondents in this matter, is not clear; when examining the survey data, it can be observed that both of these respondents answered “I would like it” to both questions, which indicates a possible careless error when answering the survey questions.

Positively, no answers were received that respondents would not be satisfied if the analysed food wholesale company would process and forward their request for product quality documentation within one working day”, so it is essential for customers to receive the requested quality documentation in time.

Table 6. The results of the repeated customer survey according to the Kano model (created by authors)

Category	Notation	Number of responses	%
Attractive attributes	A	11	35
Must-be attributes	M	5	16
One-dimensional attributes	O	6	19
Indifferent attributes	I	7	23
Questionable attributes	Q	2	6
Reverse attributes	R	0	0
Total:		31	100%

According to formulas (3) and (4), the calculated and obtained coefficient results are:

- Customer satisfaction increase coefficient = 0.586
- Customer dissatisfaction reduction coefficient = - 0.379.

With the majority of responses (35%) falling under the *Attractive attributes* category, customers will be happy if the analysed food wholesale company processes and forwards customer requests for product quality documentation within one business day but will not be upset if it does not happen. This correlation is also confirmed by the customer dissatisfaction reduction coefficient - 0.379, which indicates that there will be a relatively small impact on the level of customer satisfaction if the requirement is not fulfilled.

Based on the research results, the proposed improvement action is to include similar questions in the next annual customer satisfaction survey that could be analysed using the Kano model. The correlation between customer responses and the customer sector they represent (industrial and multinational factories or small bakeries and pastry shops) could also be analysed, allowing the choice of more appropriate strategies to increase customer satisfaction.

6. Results and discussion

The customer satisfaction improvement coefficient is usually a positive value, and the closer this value is to one, the easier it is to improve the degree of customer satisfaction. The coefficient of reduction of customer dissatisfaction is usually a negative value, and the closer to minus one this value is, the easier it is to reduce customer satisfaction (Yu & Ye, 2021, p. 179), or in other words – the closer to minus one, the more significant the impact of non-fulfilment of requirements on the level of customer satisfaction (Mkpojiogu & Hashim, 2016, p. 8).

Accordingly, considering that the obtained coefficient of increasing customer satisfaction is 0.586, there should be no difficulties in increasing the degree of customer satisfaction. On the other hand, the obtained customer dissatisfaction reduction coefficient is - 0.379, which indicates that there will be a relatively small impact on the level of customer satisfaction if the requirement is not fulfilled.

The study of Rampal et al. (2022, p. 1486) points out that combining the Kano model and QFD allows one to understand customer perception better. This study also uses the same methods – the Kano model and QFD – but in reverse order, obtaining indications for the desired solution. In the same way, the methods were also applied by Schindler et al. (2023, p. 1001), where the Kano model was then integrated into the QFD process to reach a deeper understanding of requirements and yield maximal customer satisfaction.

Service quality is characterized as a gap between consumers' expectations of the service and their perception of the service provided by the organisation. One of the

factors influencing the quality of services implies that it is important to only promise the customer what can be delivered (Dale et al., 2016, pp. 123–124). Accordingly, approving customer requests within one business day of receiving them would be desirable, but this is not mandatory in the studied case.

7. Conclusions

The analysis of customers' requirements using QFD demonstrated that attention should be paid to the performance of requirements to process the received product information and pass it on to the customers within one working day because, currently, the company is relatively weak in fulfilling this parameter, and this parameter is essential for the client.

The analysis of customers' preferences and attribute importance using the Kano model indicates that customers will be happy if the food wholesale company processes and forwards their request for product quality documentation within one working day. This aligns with previous research stating that delivery lead time is one of the key service quality determinants (Tahirov & Glock, 2022, p. 417). However, the customers would not be upset if this requirement is not fulfilled. This finding asks for more profound research. Considering that the survey was anonymous, it is impossible to make a more in-depth analysis of the underlying reasons for these results at this stage, but it opens an opportunity for further studies.

The paper's authors recommend that future customer satisfaction surveys include questions that can be analysed using the Kano model. The survey results can then be analysed, and the correlation between customer responses and the customer-represented sector (industrial production and multinational factories or small bakeries) can be evaluated, allowing the choice and the development of more appropriate strategies for increasing customer satisfaction.

The main theoretical implication of this study is the unconventional use and combination of the QFD and the Kano model.

The study's limitation is that it only applies QFD and KANO models in a single case in one company. Future research could investigate further the same combination and sequence of these two methods' applications.

Funding

The research received no funding.

Contribution

The authors confirm the contribution to the paper as follows: conception and design of the work: K.B; G.R; acquisition of data: K.B; analysis and interpretation of data: K.B; drafting the article: K.B; revising the article: G.R. All authors reviewed the results and approved the final version of the manuscript.

Disclosure statement

The authors declare that they have no competing financial, professional, or personal interests related to the research described in this paper.

References

- Adelman, C. (1993). Kurt Lewin and the origins of action research. *Educational Action Research*, 1(1), 7–24. <https://doi.org/10.1080/0965079930010102>
- Costa, A. I. A., Dekker, M., & Jongen, W. M. F. (2000). Quality function deployment in the food industry: A review. *Trends in Food Science & Technology*, 11(9–10), 306–314. [https://doi.org/10.1016/S0924-2244\(01\)00002-4](https://doi.org/10.1016/S0924-2244(01)00002-4)
- Dale, B. G., Bamford, D. R., & Van der Wiele, T. (2016). *Managing quality 6e: An essential guide and resource gateway*. Wiley. <https://doi.org/10.1002/9781119302735>
- Eldermann, M., Siirde, A., & Gusca, J. (2017). QFD framework for selection of industry development scenarios. *Energy Procedia*, 128, 230–233. <https://doi.org/10.1016/j.egypro.2017.09.060>
- Farooq, M. A., Nóvoa, H., Araújo, A., & Tavares, S. M. O. (2016). An innovative approach for planning and execution of pre-experimental runs for design of experiments. *European Research on Management and Business Economics*, 22(3), 155–161. <https://doi.org/10.1016/j.iedee.2014.12.003>
- Fink, A. (2010). Survey research methods. In P. Peterson, E. Baker, & B. McGaw (Eds.), *International encyclopedia of education* (pp. 152–160). Elsevier. <https://doi.org/10.1016/B978-0-08-044894-7.00296-7>
- Gounaris, S., & Almorais, A. (2024). A dynamic, relational approach to B2B customer experience: A customer-centric perspective from a longitudinal investigation. *Journal of Business Research*, 177, Article 114606. <https://doi.org/10.1016/j.jbusres.2024.114606>
- Jiang, X., Zhang, J., Yang, C., & Wan, R. (2023). Evaluating the service quality of insular and coastal recreational fisheries by integration of the SERVQUAL-fuzzy Kano model and importance-performance analysis. *Ocean & Coastal Management*, 243, Article 106753. <https://doi.org/10.1016/j.ocecoaman.2023.106753>
- Karpičs, I., & Markovičs, Z. (2007). *Gala darbu novērtējuma izskaitlošanas variants augstskolas mācību procesā* [Calculation variant of the evaluation of final works in the educational process of the university]. *Computer Control Technologies*, 32, 34–43. <https://ortus.rtu.lv/science/lv/publications/8799>
- Kuo, R.-J., Wu, Y.-H., Hsu, T.-S., & Chen, L.-K. (2011). Improving outpatient services for elderly patients in Taiwan: A qualitative study. *Archives of Gerontology and Geriatrics*, 53(2), e209–e217. <https://doi.org/10.1016/j.archger.2010.09.013>
- Lizarelli, F. L., Osiro, L., Ganga, G. M. D., Mendes, G. H. S., & Paz, G. R. (2021). Integration of SERVQUAL, Analytical Kano, and QFD using fuzzy approaches to support improvement decisions in an entrepreneurial education service. *Applied Soft Computing*, 112, Article 107786. <https://doi.org/10.1016/j.asoc.2021.107786>
- Matzler, K., & Hinterhuber, H. H. (1998). How to make product development projects more successful by integrating Kano's model of customer satisfaction into quality function deployment. *Technovation*, 18(1), 25–38. [https://doi.org/10.1016/S0166-4972\(97\)00072-2](https://doi.org/10.1016/S0166-4972(97)00072-2)
- Mkpojiogu, E. O. C., & Hashim, N. L. (2016). Understanding the relationship between Kano model's customer satisfaction scores and self-stated requirements importance. *Springer-Plus*, 5(1). <https://doi.org/10.1186/s40064-016-1860-y>
- Nahar, A., Mila, F. A., Culas, R. J., Amin, M. R. (2022). Assessing the factors and constraints for value chain development of dairy food products in Bangladesh. *Heliyon*, 8(10), Article e10787. <https://doi.org/10.1016/j.heliyon.2022.e10787>
- Noor Hasnan, N. Z., Basha, R. K., Amin, N. A. M., Ramli, S. H. M. & Aziz, N. A. (2022). Analysis of the most frequent nonconformance aspects related to good manufacturing practices (GMP) among small and medium enterprises (SMEs) in the food industry and their main factors. *Food Control*, 141, Article 109205. <https://doi.org/10.1016/j.foodcont.2022.109205>
- Nuoju, S., Pahl, S., & Thompson, R. C. (2024). Plastic alternatives and substitutes in the packaging sector – A UK consumer perspective. *Sustainable Production and Consumption*, 46, 68–81. <https://doi.org/10.1016/j.spc.2024.02.019>
- Rampal, A., Mehra, A., Singh, R., Yadav, A., Nath, K., & Chauhan, A. S. (2022). Kano and QFD analyses for autonomous electric car: Design for enhancing customer contentment. *Materials Today: Proceedings*, 62, 1481–1488. <https://doi.org/10.1016/j.matpr.2022.02.154>
- Reichwald, S., Treece, R., & DeStefano, D. (2023). Action research. In T. J. Buser & S. Gibson (Eds.), *Reimagining research* (pp. 225–242). Routledge. <https://doi.org/10.4324/9781003196273-11>
- Saeima. (1998). *Pārtikas aprites uzraudzības likums* [Law on the Supervision of the Handling of Food] (1998, February 19). Latvijas Vēstnesis. <https://likumi.lv/ta/id/47184-partikas-aprites-uzraudzibas-likums>
- Saghiri, S., & Wilding, R. (2021). On the effectiveness of supplier development programs: The role of supply-side moderators. *Technovation*, 103, Article 102234. <https://doi.org/10.1016/j.technovation.2021.102234>
- Schindler, P. A., Póczy, A., Riester, M., & Sihn, W. (2023). An approach to define requirements for sustainable biobased stretch wrap: A practical methodology for the packaging industry. *Procedia CIRP*, 118, 998–1003. <https://doi.org/10.1016/j.procir.2023.06.171>
- Schlecht, L., Schneider, S., & Buchwald, A. (2021). The prospective value creation potential of blockchain in business models: A Delphi study. *Technological Forecasting and Social Change*, 166, Article 120601. <https://doi.org/10.1016/j.techfore.2021.120601>
- Shen, Y., Kokkranikal, J., Christensen, C. P., & Morrison, A. M. (2021). Perceived importance of and satisfaction with marina attributes in sailing tourism experiences: A kano model approach. *Journal of Outdoor Recreation and Tourism*, 35, Article 100402. <https://doi.org/10.1016/j.jort.2021.100402>
- Tague, N. R. (2005). *The quality toolbox* (2nd ed.). ASQ Quality Press.
- Tahirov, N. & Glock, C. H. (2022). Manufacturer encroachment and channel conflicts: A systematic review of the literature. *European Journal of Operational Research*, 302(2), 403–426. <https://doi.org/10.1016/j.ejor.2021.12.006>
- Ueki, Y. (2016). Customer pressure, customer–manufacturer–supplier relationships, and quality control performance.

Journal of Business Research, 69(6), 2233–2238.

<https://doi.org/10.1016/j.jbusres.2015.12.035>

Yang, X., Xu, Z., & Xu, J. (2023). Large-scale group Delphi method with heterogeneous decision information and dynamic weights. *Expert Systems with Applications*, 213, Article 118782. <https://doi.org/10.1016/j.eswa.2022.118782>

Yu, Z., & Ye, J. (2021). Research on the function design of 5G intelligent network connected cars based on Kano model. In H. Krömker (Ed.), *Lecture notes in computer science: Vol. 12791. HCI in mobility, transport, and automotive systems. HCII 2021* (pp. 170–183). Springer.

https://doi.org/10.1007/978-3-030-78358-7_11

Zhang, Y., Chen Y., & Li, X. (2023). Integrated framework of knowledge-based decision support system for user-centered residential design. *Expert Systems with Applications*, 216, Article 119412. <https://doi.org/10.1016/j.eswa.2022.119412>