

Design Development of Catfish Chips using the Kano Model and Quality Function Deployment (QFD) at the Pelemadu Rempeyek Industrial Center

Muhammad Arif Prasetyo, Chadziqatun Najilatil Mazda, Taufiq Aji and Khusna Dwijayanti

Department of Industrial Engineering
Faculty of Science and Technology
Universitas Islam Negeri Sunan Kalijaga
Indonesia

arifprasetyo19@gmail.com, mazdacha97@gmail.com, taufiq.aji@uin-suka.ac.id and khusna.dwijayanti@uin-suka.ac.id

Abstract

The Pelemadu Rempeyek Industrial Center had a declining demand for peanut chips in 2020 until the research was done. Catfish chips becoming an alternative product to overcome the declining demand for peanut chips, they have high nutritional value and are easy to produce. This research was carried out by questionnaires and focus group discussions (FGD) to improve the design of catfish chips using the Kano model and quality function deployment (QFD). The results of the Kano model analysis show that the consumer requirements of catfish chips are a long time savage, ease of purchase, safe packaging, attractive design, clean packaging, and the variety of flavors offered. The results of Quality Function Deployment (QFD) show the important factors that must be considered in catfish chips to fulfill consumer requirements are the clarity of the oil used which has a contribution value of 17.66%, draining the oil with a spinner machine has a contribution value of 16.02%, the thickness of the catfish meat pieces has a contribution value of 15.22%, and the spices used have a contribution value of 9.37%. Thus, the Rempeyek Industrial Center must consider the type of cooking oil used which has high clarity, drain it after frying, and cut the catfish chips not too thickly. The design development of catfish chips in 100-gram packaging has a production cost of IDR 9.411 or rounded up to IDR 9.500. The consumers' willingness to buy is on average IDR 12.690, so the profit is IDR 3.190 for each package.

Keywords

Kano Model, Quality Function Deployment, Industrial Center

1. Introduction

The Pelemadu Rempeyek Industrial Center located in Imogiri, Bantul, Yogyakarta, is one of the regional centers of the peanut brittle industry which was founded in 1994. The Pelemadu Rempeyek Industrial Center has superior products, namely peanut chips, soybean chips, and sago chips. Tubilah, the owner of Micro, Small, and Medium Enterprises (MSMEs) Pelemadu Rempeyek Industrial Center said that the problem currently was a significant decline in demand for peanut chips since 2020. The prices of peanuts as the raw material of chips fluctuate making the profits uncertain. Indonesia is the largest fish producer country in ASEAN, there are 21.87 million tons in 2021 and 28,43 million tons in 2022 (Ministry of Maritime Affairs and Fisheries 2023). The national fish consumption in 2021 reached 55.37 kg/capita. Maluku is the region with the highest fish consumption, it is 77.49 kg/capita. However, Yogyakarta is the region with the lowest fish consumption, it is 34.82 kg/capita (Ministry of Maritime Affairs and Fisheries 2022).

The Yogyakarta Marine and Fisheries Service stated that the type of freshwater fish that is mostly produced in the Yogyakarta region is catfish, with amount total production of 46.89 tons in 2022. The catfish as raw material becoming an opportunity for MSMEs to innovate and increase their competitiveness. Innovation is needed to develop new product quality (Prayogo and Mazda 2021).

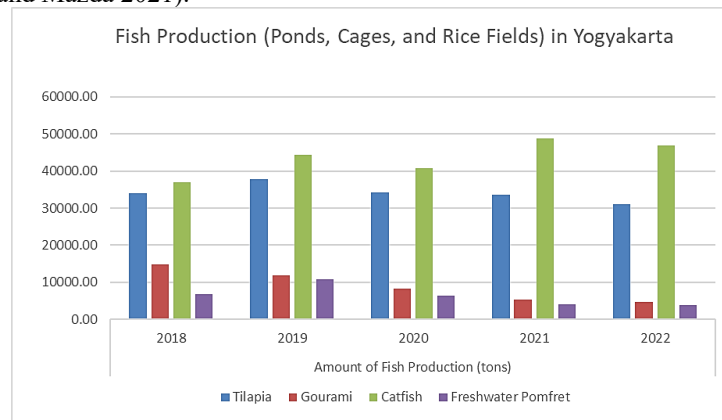


Figure 1. Total production of Catfish in Yogyakarta
Source: Ministry of Maritime Affairs and Fisheries, 2023

Figure 1 above shows that catfish productivity over the last five years has been at the top compared to other types of fish. Quality is necessary for product development (Mazda et. al 2019). Catfish chips are an alternative new product with high quality and nutritional value. The nutritional content of catfish per 100 grams is 17.7% protein, 4.8% fat, 1.2% minerals, 0.3% carbohydrates, and 76% water (Astawan 2008). Because of this, there is are need to research design improvement of catfish chips.

1.1 Objectives

Seeing the high opportunity for catfish to be made into chips, a deeper analysis of the design of this new product is needed. The method used to analyze the design of catfish chip products is the Kano Model and Quality Function Deployment (QFD). A combination of these two methods is used to identify the attributes of consumer requirements that are priorities to be fulfilled in selling catfish chips to the market. Apart from that, this research can be used as consideration for The Pelemadu Rempeyek Industrial Center who want to improve the design of catfish chips using the Kano model and quality function deployment (QFD).

2. Literature Review

2.1 Kano Model

The KANO model is a service consumer satisfaction index that is needed to determine the level of consumer satisfaction by paying attention to the level of satisfaction with the service. The quality dimension was chosen to measure the comparison between the level of importance of a variable and the reality perceived by consumers. The Kano model is used to obtain data regarding consumer satisfaction with the system's functionality. The Kano does not discuss technical changes to the system. Based on system functionality, an analysis of consumer satisfaction using the Kano model was carried out (Sahfitri and Yulianingsih 2015).

2.1 Quality Function Deployment (QFD)

Quality Function Deployment (QFD) is the translation set of subjective consumer needs priorities into a set of system levels during the conceptual system design process. This method was developed at the Mitsubishi Heavy Industries, Ltd Shipyard in Kobe, Japan, and has come a long way since 1972. The benefits of using the QFD method are increasing consumer satisfaction, improving the quality of a product, increasing product reliability, increasing productivity, increasing company profits, cutting time to market, reducing design costs, and facilitating communication (Farah 2018). The House of Quality is a series of matrices used to translate consumer wants and needs into design characteristics (Ginting 2010).

3. Methods

The collection and processing of data from the object studied was done to get the information (Arikunto, 2006). In this research, the Kano model is used to categorize product and service attributes based on the level of influence on consumer satisfaction (Wijaya 2011). The attributes that have a significant level of influence are then processed using the Quality Function Deployment (QFD) analysis method. The QFD is a systematic method that helps companies understand consumer needs quickly and apply them to the company's goods or services (Wijaya 2011).

4. Data Collection

In this research, the data collection was carried out by questionnaires and focus group discussions (FGD). There are two stages of the questionnaire, the first stage is a questionnaire to identify the voice of consumer attributes while the second questionnaire is used to determine the attributes of consumer requirements that have a significant influence on consumer satisfaction with functional (positive questions) and dysfunctional (negative questions) questionnaire types. The focus group discussions (FGD) were carried out to determine the technical response to consumer requirements by involving competent experts in chips and catfish production.

5. Results and Discussion

5.1 Voice of Consumer Catfish Chips

The Y generation as known as the millennial generation becoming the subject of this research, they are the generation born between 1978-2000 (Putra 2016). The Y generation was selected as research subjects because of the social construction that they are in teenage and more consumptive. So it is easy to introduce catfish chips to the market. The questionnaire was made by the dimensions of food quality. They are color, appearance, portion, shape, temperature, texture, aroma, level of doneness, and taste (Margaretha and Japariato 2012). In this research, only six dimensions of food quality were used. It is taste, appearance, shape, color, texture, and portion. The temperature, aroma, and level of doneness are not used because they are not relevant to the food quality of catfish chips. The recapitulation of the consumer requirements is as following Table 1.

Table 1. The Recapitulation of Consumer Requirements

Categories	Items of consumer requirements
General	Basic ingredients for nutritious snacks
	Long-lasting/long-lasting snacks
	The snack brand has a good reputation
	The shop that sells it has a good reputation
	Snack prices are relatively affordable
	Good food processing process
Color	Recommended by others for consumption
	Light-colored fried results indicate good frying
Appearance	The chips are a natural golden color without any obvious coloring ingredients
	Clean and neat packaging
	The packaging material is thick and has a plastic clip
	Unique and attractive packaging design
Portion	There is a complete product description on the packaging label
	The packaging is transparent so that the contents can be seen directly
Form	Around 30-75 grams for one meal
	Above 100 grams for a shared snack portion
Texture	The size of the chips in the packaging is uniform
	It is flat, small, and thin so it is easy to eat
	The crunchiness of catfish chips when consumed
	Frying chips until dry doesn't leave any cooking oil
Taste	Medium chip hardness level
	The flour layer on the chips is not too thick
	The taste of the chips does not cover the original taste of the catfish meat
	Added variations of flavors other than the original

The general category is an outside attribute of the quality dimension of food that is taken into consideration by consumers when choosing snacks on the market. Meanwhile, the categories of color, appearance, portion, shape, texture, and taste are the six dimensions of food quality that are used as study boundaries in this research.

5.2 Kano Model

In this analysis, the Kano data was obtained using the Kano questionnaire. It is a closed questionnaire with a comparison scale of functional and dysfunctional questions. In addition, the identification of the importance level of attributes was carried out by 60 respondents from the Y generation. The Kano categories of consumer requirements attributes are as following Table 2.

Table 2. Items of Consumer Requirements Based on the Kano Model and Level of Importance

Number	Attributes	Categories	Level of Importance
1	Catfish chip products last a long time	<i>Attractive</i>	4,22
2	Ease of purchasing catfish chip products	<i>Attractive</i>	3,15
3	Safety of catfish chip packaging	<i>Attractive</i>	4,15
4	Unique and attractive packaging design	<i>Attractive</i>	3,60
5	A variety of flavors is offered	<i>Attractive</i>	3,40
6	Nutritional content of catfish chips	<i>One Dimensional</i>	3,95
7	Natural light-colored fried chips	<i>One Dimensional</i>	3,80
8	Packaging cleanliness	<i>One Dimensional</i>	4,30
9	Complete information on the packaging label	<i>One Dimensional</i>	3,67
10	Level of crunchiness of catfish chips	<i>One Dimensional</i>	4,08
11	Level of hardness of catfish chips	<i>One Dimensional</i>	3,43
12	Catfish chips do not contain residual frying oil	<i>One Dimensional</i>	4,33
13	Catfish chips taste	<i>One Dimensional</i>	4,13

In the Kano model, the consumer requirements attributes in the indifferent category were eliminated because they are attributes that are not looked at and have no impact on consumer satisfaction. This attribute was eliminated so that the product development process was more focused on attractive attributes that have a significant influence on consumer satisfaction.

5.3 Validity and Reliability Test

The data obtained from the questionnaire were tested for validity and reliability using SPSS software. In this research, the decision criteria for validity tests are by comparing of R value with the R table with a significance of 0.05 in a 2-sided test (Priyatno 2010). For the R table with a total of 60 respondents (N=60), the R table is 0.254. If the calculated R-value is more than the R-table, then the item is considered valid. Meanwhile, if the calculated R-value is less than R-table, then the item is considered invalid. The results of the validity test are shown in the following Table 3.

Table 3. Validity Test of the Level of Importance of Consumer Requirements Attributes

No	Attributes	R-Value	R Table	Decision
1	Expired durable catfish chips	0,047	0,254	<i>Invalid</i>
2	Ease of purchasing	0,418	0,254	<i>Valid</i>
3	Safe packaging	0,439	0,254	<i>Valid</i>
4	Attractive packaging	0,557	0,254	<i>Valid</i>
5	A variety of flavors is offered	0,500	0,254	<i>Valid</i>
6	Nutritional content of catfish in chips	0,283	0,254	<i>Valid</i>
7	Natural light-colored chips	0,382	0,254	<i>Valid</i>
8	Clean packaging	0,472	0,254	<i>Valid</i>
9	Complete information on the packaging label	0,444	0,254	<i>Valid</i>
10	Crispy chips	0,368	0,254	<i>Valid</i>
11	Soft chips	0,493	0,254	<i>Valid</i>
12	Free from residual frying oil	0,327	0,254	<i>Valid</i>
13	The taste of catfish meat is strong	0,490	0,254	<i>Valid</i>

From Table 3, attribute number one has an R-value less than the R table ($0.047 < 0.254$), so attribute number one was declared invalid. It can be caused the attribute number one is a necessity for snacks to be able to last a long time, so this attribute is not used in this research.

The reliability test used in this research is the Cronbach alpha indicator. The results of the reliability test using SPSS software had a Cronbach alpha value of 0.612. This value is more than 0.60, so the reliability of the category is high (Guilford 1956).

5.4 Characteristics of Catfish Chips

The technical characteristics of catfish chip products were formulated based on the results of the FGD with experts in related fields, as follows in Table 4.

Table 4. Characteristics of Catfish Chips

Number	Technical Characteristics	Development
1	Number of marketing relations	<i>More the Better</i>
2	Active on social media	<i>Target is Best</i>
3	Plastic packaging thickness	<i>More the Better</i>
4	Zipper	<i>Target is Best</i>
5	Comparison of chips and packaging	<i>More the Better</i>
6	Flavor ingredients measurements	<i>Target is Best</i>
7	Clarity of frying oil	<i>More the Better</i>
8	Draining with spinner	<i>Target is Best</i>
9	Label length	<i>More the Better</i>
10	Label width	<i>More the Better</i>
11	Catfish age	<i>Target is Best</i>
12	Thickness of catfish meat pieces	<i>Target is Best</i>
13	Dough water temperature	<i>Target is Best</i>
14	Spices	<i>Target is Best</i>

The attributes of consumer desires or the voice of the customer are translated into the technical language of product development or the voice of the developer. Technical characteristics are a technical definition of the attributes of consumer desires related to the product design process for catfish chips.

5.5 House of Quality (HOQ) of Catfish Chips

The house of quality (HOQ) is a matrix used in the quality function deployment (QFD) method to describe the attributes of consumer requirements into technical characteristics. The following table was the house of quality (HOQ) of catfish chip products (Table 5).

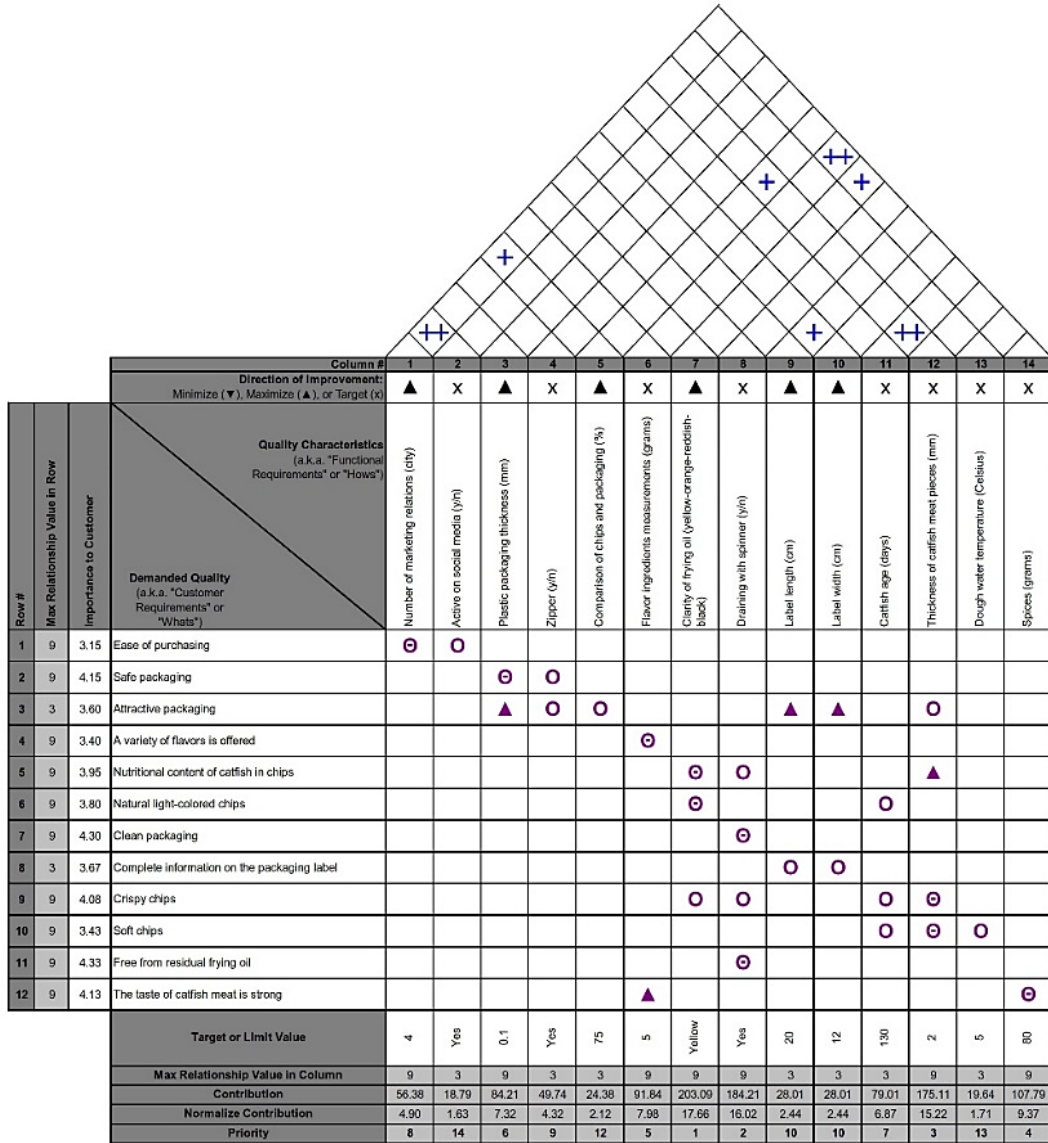


Figure 2. House of Quality (HOQ) of Catfish Chips

Based on the House of Quality (HOQ), the technical characteristics that most influence consumer requirements can be identified (Figure 2), so that the direction of catfish chip design can be more focused. Product design priorities are determined by calculating the contribution value for each technical characteristic. The contribution value is obtained from the total multiplication between the value of the type of relationship between technical characteristics and consumer requirements and the normalized raw weight value for each technical characteristic. Four technical characteristics contribute a total of 58.27% of fulfilling consumer desires which can be used as a top priority in product design. These four characteristics include the clarity of the cooking oil used which contributes 17.66%, the slicing of chips using a spinner machine contributes 16.02%, the thickness of the catfish meat slices contributes 15.22%, and finally, the spices used has a contribution value of 9.37%. Thus, the Pelemadu Rempyek Industrial Center producers must consider the type of cooking oil used which has high clarity, and drain it after frying, as well as cutting the catfish not too thickly and the taste of catfish chips.

5.6 Design Development of Catfish Chips

From analysis of the Kano model and quality function deployment (QFD), the design development of Catfish chips was made as shown in the following Figure 3:



Figure 3. The catfish chips

The picture above shows the catfish chips in a 100-gram package. The catfish chips are a highly nutritious snack because they are made from fresh catfish. The nutritional content of catfish per 100 grams is 17.7% protein, 4.8% fat, 1.2% minerals, 0.3% carbohydrates, and 76% water (Astawan 2008). In this research, we made several samples of catfish chip products by model Kano and quality function deployment (QFD). The ingredients, seasonings, and estimated costs involved in making catfish chips are as follows.

Table 5. The Production Cost of Catfish Chip

Number	Items	Volume	Price (IDR)	Total (IDR)
1	Catfish	5 kg	20.000	100.000
2	Flour	1 kg	13.000	13.000
3	Cooking oil	½ liter	7.000	7.000
4	Seasonings (garlic, coriander, candlenuts, salt, lime leaves)	80 grams	3.000	3.000
5	Operational fee	-	20.000	20.000
6	Packaging	17 pcs	1.000	17.000
Summary Cost				160.000

The estimated production costs are calculated for every 5 kg of fresh catfish. For every processing 5 kg of catfish, it can produce around 1.7 kg of chips. The equivalent of 17 packages per 100-gram packs of catfish chips. So, it can be seen that the cost of production for each 1 pcs of catfish chips is IDR 9.411 or rounded up to IDR 9.500.

According to the results of 40 respondents, it can be seen that consumers' willingness to buy catfish chips products in 100-gram packaging is on average IDR 12.690. With the basic production price of catfish chips per 100-gram package of IDR 9.500, the Peleladu Rempeyek Industrial Center has made a profit of IDR 3.190 for each package. In practice, determining product selling prices can be adjusted to the environment and target market. For example, through the digitalpreneur which uses the internet as a medium for offering and buying and selling products. By marketing online, the product can increase the price sales and reach more consumers so the profit could increase too (Mazda et al 2023).

6. Conclusion

The Kano model can be used as a tool for identifying consumer requirement attributes that fall into the attractive category, namely attributes that have a significant impact on consumer satisfaction. The attributes that consumers require that are included in the attractive category of catfish chips are last a long time, ease of purchasing the product, packaging safety, unique and attractive packaging design, and the variety of flavors offered. The technical characteristics that can be used as a priority in design with a contribution of 58.27% to fulfilling consumer desires

include the clarity of the cooking oil used, the use of a spinner draining machine, the thickness of the catfish meat pieces, and the spices used. Thus, the Rempeyek Industrial Center producers must consider the type of cooking oil used which has high clarity, and drain it after frying, as well as cutting the catfish not too thickly and the taste of catfish chips.

The design development of catfish chips given the cost of production for each 1 pcs of catfish chips is IDR 9.411 or rounded up to IDR 9.500. The consumers' willingness to buy catfish chip products in 100-gram packaging is on average IDR 12.690, the producer has made a profit of IDR 3.190 for each package. In practice, determining product selling prices can be adjusted to the environment and target market. In practice, determining product selling prices can be adjusted to the environment and target market. For example, through the digital preneur which uses the internet as a medium for offering and buying and selling products. By marketing online, the product can increase the price sales and reach more consumers so the profit could increase too

References

- Arikunto, S., *Prosedur Penelitian Suatu Pendekatan Praktik*, Jakarta, PT Rineka Cipta, 2006.
- Astawan, M., *Sehat dengan Hidangan Hewani*, Jakarta, Penebar Swadaya, 2008.
- Farah, A. N., *Perancangan Perbaikan Sistem Layanan Publik dengan Integrasi Metode Servqual, Kano, dan QFD (Studi Kasus : Kantor Kecamatan Ceper)*, Yogyakarta, Universitas Islam Indonesia, 2018.
- Ginting, R., *Perancangan Produk*, Yogyakarta, Graha Ilmu, 2010.
- Guildford, J. P., *Fundamental Statistic In Psychology and Education*, New York, Mc Grow-Hill Book Company, 1956
- Margaretha, F. S. and Japariato, E., Analisa Pengaruh Food Quality dan Brand Image Terhadap Keputusan Pembelian Roti Kecil Toko Roti Ganep's di Kota Solo, *Jurnal Manajemen Pemasaran*, Vol. 1, No. 1, pp. 1-6, 2012.
- Mazda, C. N., Kurniawati, D. A., and Musthofa, M. W., Optimasi Keuntungan Digital preneur Hampers Minuman Menggunakan Aplikasi CPLEX., In *Proceedings of the National Conference on Electrical Engineering, Informatics, Industrial Technology, and Creative Media*, Vol. 3, No. 1, pp. 215-220, 2023.
- Mazda, C. N., Makhtum, M., and Apriyanto, I. Pengendalian Kualitas Industri Kreatif Budaya di Era Industri 4.0 sebagai Pendukung Ekonomi Pertahanan Negara (Studi Kasus: CV Kayu Manis Yogyakarta). *IENACO (Industrial Engineering National Conference)*, 7, 2019.
- Ministry of Maritime Affairs and Fisheries, *Laporan Tahunan Perikanan*, Jakarta, Ministry of Maritime Affairs and Fisheries, 2023.
- Prayogo, A., and Mazda, C. N., Inovasi Teknologi Plecing Kaleng Sebagai Pemulihan Ekonomi Pasca Gempa Lombok, *Jurnal Informatika Teknologi dan Sains (Jinteks)*, Vol. 3, No., pp. 376-383, 2021.
- Priyatno, D., *Teknik Mudah dan Cepat Melakukan Analisis Data Penelitian dengan SPSS*, Yogyakarta, Gava Media, 2010.
- Putra, Y. S., *Teori Perbedaan Generasi*. Yogyakarta, Graha Ilmu, 2016.
- Sahfitri, V., and Yulianingsih, E., Kualitas Layanan Sistem Informasi Akademik Menggunakan Metode Kano. *Jurnal Ilmiah Matrik*, 151-162, 2015.
- Wijaya, T., *Manajemen Kualitas Jasa: Desain Servqual, QFD, dan Kano Disertai Contoh Aplikasi dalam Kasus Penelitian*, Jakarta, PT Indeks, 2011.

Biographies

Muhammad Arif Prasetyo is a student at the Industrial Engineering Department, Faculty of Science and Technology, State Islamic University Sunan Kalijaga, Yogyakarta. He is interested in design projects, entrepreneurship, and digital technology.

Chadziqatun Najlatil Mazda is a student at the Industrial Engineering Department, Faculty of Science and Technology, State Islamic University Sunan Kalijaga, Yogyakarta. She is interested in industrial engineering, the defense industry, and national defense and security.

Taufiq Aji is a lecturer at the Industrial Engineering Department, Faculty of Science and Technology, State Islamic University Sunan Kalijaga, Yogyakarta. He is expertise in product development, decision analysis, and entrepreneurship.

Khusna Dwijayanti is a lecturer at the Industrial Engineering Department, Faculty of Science and Technology, State Islamic University Sunan Kalijaga, Yogyakarta. She has expertise in industrial engineering, facility layout planning, production systems, automatic process planning, and Computer-aided process planning (CAPP).