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Product Development of Sneakers Design Based on Consumer Preference Through Integration of Kano Method and Quality Function Deployment

Devi Susiati[1], Lukmandono[2]
[1,2] Magister Teknik Industri, industrial Technology Faculty -InstitutTeknologi Adhi Tama Surabaya
devisusiati45@gmail.com

Abstract—**Ardiles brand shoes are local Indonesian brand shoes that have been around since 1950. Ardiles produces several shoe models, one of which is sneakers. This brand received the top brand award from 2018 to 2021. In analyzing consumer needs, this study uses the Kano method and Quality Function Deployment (QFD). The attributes used to find 25 attributes based on 8 dimensions of product quality. The results of the research using the Kano category method were found that there are 2 attributes in the attractive category, 3 in the indifferent category, 3 in the must be category, and 17 in the one-dimensional category. Furthermore, the results of the QFD method get the top 5 attributes, namely shoes have two functions/models (low cut and high cut) with a value of 20.50%, shoe products have a warranty with a value of 13.87%, safe foot protection with a value of 9, 56%, eco print batik motifs with a value of 9.31%, and non-slip soles with a value of 6.39%. Efforts to improve with HOQ analysis obtained 16 technical requirements attributes with 5 highest priority including upper material type with a contribution value of 18.83%, outsole material type with a contribution value of 18.24%, locking system with a contribution value of 14.58 %, additional features with a contribution value of 13.28%, and the type of locking material with a contribution value of 8.54%.**

***Index Terms*—About; Shoes; Kano; Quality Function Deployment; Attribute.**

I. INTRODUCTION

Competition continues to grow, making domestic producers are required to be more critical, creative, and innovative in seeing demand according to market needs and maintain a positive perception in the minds of consumers. The shoe (footwear) industry is a non-oil and gas industry that is growing rapidly at this time. According to Derajad S Widhyharto, a sociologist at Gadjah Mada University, he argues that the development of modern lifestyles in the millennial era has made the need for shoes not only function as footwear but also plays an important role in fashion to attract social identity [1]. In Indonesia, the number of the footwear industry is 18,687 business units covering 18,091 units including small-scale industries, 441 medium-scale business units, and 155 large-scale business units [2].

Shoe products have a high enough demand in the country. Competition in the local shoe industry is getting tougher with many old brands continuing to innovate, accompanied by the emergence of new brands such as Piero, League, Eagle, Ardiles, Compass, Ventela, Patrobas, Panna, and PijakBumi [3]. This is a problem for Ardiles brand shoes, even though this brand has already received a top brand award. This shoe manufacturer experienced a decline in sales of up to 54.4% in 2021. To overcome the problems faced, this brand must innovate to gain consumer trust and be able to see market opportunities that consumers want. Related to the issue of global warming and environmental pollution. Manufacturers develop sneakers products using natural dyes and have 2 functions or models. In this study, Kano and QFD integration are used to analyze whether the attributes related to environmental friendliness and the model are considered important when juxtaposed with the attributes that support this product. Kano and QFD methods function to categorize attributes and make product improvements following the wishes of consumers or the voice of the customer. This method was chosen because it can solve these problems with optimal results, like severalstudies that have been done before. Previous research designed sports shoes that have 2 functions, namely soccer shoes and futsal shoes

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using the QFD method [4]. Another study developed a product design for women's shoes with jute sack material based on the QFD method [5]. Design the concept of footwear products, namely sandals with Kano and Kansei Engineering [6]. Conducted research on the design of women's ready-to-wear shoes made of kraft paper which has strength and resistance to tearing, by soaking the material in salt water for 5 minutes, the paper becomes elastic, this material can be used as a substitute in shoe making. as the characteristics of the leather material [7].

II. RESEARCH METHOD

The object of this research is the Ardiles brand of sneakers, this shoe manufacturer is located in the city of Surabaya. The research method describes the flow and steps that will be taken to solve the problem, including
the following:

A. Data Collection

The method used in data collection is a survey to identify the criteria for sneakers according to the needs and desires of customers. The research instrument is divided into 2, namely open and closed questionnaires. Open questionnaires were distributed to 30 expert respondents consisting of marketing, distributors, shoe industry activists, and consumers. While the closed questionnaire is divided into the Kano questionnaire, satisfaction level questionnaire, expectations, and interests. Questionnaires were distributed to male respondents with an age range of 15-45 years. The sampling of data in this study is non-probability sampling, which means that not all members of the population have the same probability of being sampled [8].

A validity test is an accuracy between the data collected and the actual data [9]. So that the validity test can show the extent to which the measuring instrument used in the study produces accuracy. So that the validity test can show the extent to which the measuring instrument used in the study produces accuracy. The data is declared valid if the data obtained from the questionnaire can describe consumer desires. The reliability test aims to determine the extent to which the measuring instrument produces relatively consistent quantitative data. Reliability is an index that shows the extent to which a measuring instrument can be trusted and relied on [10]. In processing the validity and reliability using the help of the Statistical Product and Service Solution (SPSS) software. The data is declared valid if the calculated R-value R table. Meanwhile, the data will be declared reliable if it gives a Cronbach Alpha value > 0.7 [11].

B. Kano Method

The application of the Kano method as an analysis of the attributes that have been selected from the distribution of open questionnaires. Furthermore, from each attribute, the number of each category of Kano is calculated and classified. The steps in classifying the Kano model are to determine the attributes of the question based on the Kano evaluation table and provide an assessment using Likert 1-5 [12]. Kano's model categories include Attractive / attractive (A), Must be / hope (M), One dimensional / one absolute dimension (O), Reverse / inverse (R), Questionable / doubtful (Q), and Indifferent / no effect (I). The category and evaluation of Kano are made in tabular form. Each question is asked twice to the respondent, where the question is positive (functional) and negative (dysfunctional). The data obtained are included in the primary data because it is done directly by the researcher. Then determine the Kano category for each attribute using Blauth's Formula. The Kano method selects the number of votes received by consumers so that later the voices of consumers with the best satisfaction will be selected, while those that do not have a satisfaction impact will be eliminated.

C. Quality Function Deployment (QFD) Method

This method is defined as a structured process mechanism to determine customer requirements and translate them into technical requirements [13]. QFD uses a matrix in the form of House of Quality (HOQ), to describe consumer desires and the company's ability to design products according to consumer desires.

The stages of analysis using the QFD method in the HOQ matrix are Customer Requirements analysis, namely, the first step is to collect consumer voices/opinions related to the desires and things that consumers need in buying shoe products. Importance to Customer analysis, namely the attributes of the customer requirements then compiled using a Likert scale. Questionnaires were distributed to Ardiles shoe

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consumers, distributors, marketing, shoe lovers, and shoe industry activists. Customer Satisfaction Performance analysis aims to determine consumer ratings of how good the existing Ardiles shoe products are. Customer Expected Performance analysis aims to determine consumer expectations regarding Ardiles shoe products in the future. Improvement Ratio analysis contains the evaluation of attributes that do not meet the standards. To calculate the level of improvement by dividing the results of product calculations by the level of satisfaction. Sales Point (t provides information about the ability to sell products based on how well each customer's need is met. The sales point rating scale is a value of 1.0 indicating the attributes that are considered to be fulfilled, a value of 1.2 indicating the attributes to be fulfilled, and a value of 1.5 indicating attributes that are met Technical response translates consumer needs into development language This process is an answer to the question how consumer needs can be met Relationship Matrix, at this stage, places consumer wants on the left and technical characteristics on the top of the HOQ Technical correlation is used to determine bottleneck designs and determine the key to communication between designers. From there, the relationship between the two can be evaluated systematically. The technical characteristics attribute can influence both positively (supporting each other) and negatively (contrarying each other).

III. RESULT AND DICUSSION

- *Identification of Attributes of Consumer Neeeds*

Identification of consumer needs and desires is done by distributing open questionnaires in Focus Group Discussions (FGD). In the FGD, it is hoped that this questionnaire will consist of 12 questions about 18 attributes regarding shoe products. The attributes obtained are divided into 8 dimensions of product quality, namely in terms of performance, features, reliability, conformance, durability, aesthetics, and perceived quality. An open questionnaire was distributed to 30 expert respondents consisting of marketing, distributors, shoe industry activists (BPIPI), and shoe lovers or consumers of Ardiles shoes offline during the FGD event. The open questionnaire is the first step to obtain information about several attributes related to shoe product development.

In determining the sample of research attributes, the Bernoulli method of calculating the minimum sample size is used to test the adequacy of the data from taking the questionnaire [14].

$$N \geq \frac{(Z\ /2)\ ^2.p.q}{e^2} \quad (1)$$

where:
N= Minimum number of samples
Z = Normal distribution value
= Confidence level (95%)
p = Proportion of the number of questionnaires considered correct
q = Proportion of the number of questionnaires answered incorrectly
e = Error tolerance

Of the 30 respondents who answered the first stage of the questionnaire, the results showed that 3 questionnaires were not filled out correctly (wrongly) and were not filled in as a whole, so there were 27 questionnaires that were considered correct to obtain attribute information that would be used at the closed questionnaire stage. So to determine the minimum number of samples is as follows:

$$N = \frac{(Z\ ,0\ /2)\ ^2.(2\ /3\ ).(3/3\ )}{0,0\ ^2} \quad (2)$$

= 138,2976 ≈ 138responden

The mode of the recapitulation of the open questionnaire for each question attribute will be an attribute of the statement on the closed questionnaire. Respondents in the closed questionnaire wire 138 according to the minimum sample size which was divided into 120 consumers (consumers of Ardiles shoes men aged 15-45 years), shoe lovers/collectors, and 18 experts/experts (marketing, distributors, Footwear Industry Development Center (BPIPI)/shoe industry activists). The proportion of determining the number of respondents is more to consumers because in order to determine the level of success in meeting consumer desires are high. The attributes in the closed questionnaire are 25 based on 8 dimensions of product quality, which can be seen in table 1.

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Table 1
Attributes of the Closed Questionnaire

Dimension	No	Attribute
Performance	1	Safe foot protection
	2	Shoes have two functions/models (low cut and high cut)
	3	Shoes are stable when used
Feature	4	The comfort of shoes when used
	5	Easy assembly of upper with an outsole
	6	Light shoe weight
	7	Flexible shoes
	8	Eco-friendly material
	9	Soft insole
Reliability	10	Strong outsole adhesion
	11	Strong shoe material
	12	When wearing shoes, feet don't get scratched
	13	The sole of the shoe is not slippery

Table 1
Continued Attribute Closed Questionnaire

Dimension	No	Attribute
Conformance	14	The suitability of the shape of the shoe with the foot
	15	The front/back of the shoe is reinforced
Durability	16	Durability shoes
Aesthetics	17	Fashionable shoe design
	18	Neutral shoe color
	19	Ecoprint batik motif
	20	Wearing accessories
Serviceability	21	Easy shoe care
	22	Shoe products have a warranty
	23	Ease of getting shoes
Perceived Quality	24	Affordable prices
	25	Brand

Table 2
Validity Test Results

Attribute	R-Value					R Table	Re
	Functional	Dysfunctional	Satisfaction	Expected	Importance		
1	0,627**	0,755**	0,735**	0,760**	0,763**	0,166	V
2	0,420**	0,679**	0,707**	0,828**	0,713**	0,166	V
3	0,711**	0,883**	0,803**	0,851**	0,782**	0,166	V
4	0,684**	0,877**	0,737**	0,833**	0,787**	0,166	V
5	0,663**	0,831**	0,737**	0,828**	0,769**	0,166	V
6	0,602**	0,818**	0,766**	0,798**	0,773**	0,166	V
7	0,644**	0,846**	0,774**	0,853**	0,805**	0,166	V
8	0,549**	0,838**	0,807**	0,832**	0,816**	0,166	V
9	0,670**	0,909**	0,784**	0,851**	0,787**	0,166	V
10	0,720**	0,916**	0,854**	0,872**	0,826**	0,166	V
11	0,561**	0,922**	0,827**	0,882**	0,789**	0,166	V
12	0,743**	0,912**	0,767**	0,822**	0,847**	0,166	V
13	0,721**	0,855**	0,782**	0,857**	0,803**	0,166	V
14	0,689**	0,908**	0,764**	0,834**	0,826**	0,166	V
15	0,642**	0,857**	0,746**	0,746**	0,777**	0,166	V
16	0,686**	0,898**	0,786**	0,844**	0,873**	0,166	V
17	0,704**	0,842**	0,803**	0,836**	0,789**	0,166	V
18	0,679**	0,775**	0,679**	0,738**	0,723**	0,166	V

Table 2
Continued Validity Test Results

Attribute	R-Value					R Table	Re
	Functional	Dysfunctional	Satisfaction	Expected	Importance		
19	0,435**	0,576**	0,595**	0,677**	0,621**	0,166	V
20	0,335**	0,403**	0,405**	0,598**	0,548**	0,166	V
21	0,721**	0,891**	0,799**	0,854**	0,807**	0,166	V
22	0,647**	0,839**	0,695**	0,829**	0,801**	0,166	V
23	0,759**	0,879**	0,790**	0,817**	0,788**	0,166	V
24	0,512**	0,888**	0,735**	0,803**	0,775**	0,166	V
25	0,328**	0,637**	0,599**	0,571**	0,651**	0,166	V

Validity and reliability tests in this study were carried out using SPSS Ver.26 software. If the test results obtained from the calculated r-value> from the r table value and the results of each indicator/attribute have an asterisk (*), then the attribute is declared valid. For N = 138 and r table with a significant level of 5% is 0.166. This study uses the Pearson Correlation Coefficient validity test, with a two-tailed test (two-way) on 138 respondents with the results as described in table 2.

Based on the results of the calculation of the validity test in table 2, it can be concluded that of the 25 attributes in the functional, dysfunctional, satisfaction, hope, and interest question questionnaires, valid results are obtained.

Reliability tests were carried out on attribute questions that were declared valid. Reliable testing using SPSS Ver.26 software obtained Cronbach Alpha values > 0.7 on the functional, dysfunctional, satisfaction, expectations, and interests questionnaires stated reliable in table 3.

Table 3
Reliability Test Results

Questionnaire	Cronbach's Alpha	Coefficient Standard	Results
Fungsional	0,922	0,7	Reliabel
Disfungsional	0,978	0,7	Reliabel
Kepuasan	0,963	0,7	Reliabel
Harapan	0,975	0,7	Reliabel
Kepentingan	0,969	0,7	Reliabel

- *Kano Classification*

Kano's method categorizes the attributes of functional and dysfunctional questions which are classified based on the Kano model evaluation table. In this study, the Kano method grouping and categorizing using the help of Blauth's Formula [15]. The results of the Kano method tabulation category are 1). 3 attributes are included in the must be the category, which means that the Ardiles brand shoe developer must meet these attributes to obtain consumer satisfaction, if these attributes are not fulfilled, consumers will even lose confidence in the brand, 2). 17 attributes are included in the one-dimensional category, meaning that if major improvements are made to these attributes, greater consumer satisfaction will be achieved, on the other hand, if the attributes have low quality, consumers will feel dissatisfied, 3). 2 attributes are included in the attractive category, namely, these attributes are considered attractive by consumers of Ardiles shoes, so that if these attributes can be met, it will make consumer satisfaction increase quite high, and 4). 3

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attributes are included in the indifferent category, namely, this attribute does not have any impact or change on consumer satisfaction so the product quality attribute will be removed for data processing to the next stage. After being categorized, the next step is to calculate the customer satisfaction coefficient (CSC) using if better than (IBT) and if worse than (IWT). If the IBT value is closer to a value of 1, it will increasingly affect consumer satisfaction, on the contrary, if the IWT value is close to a value of -1 then the influence on consumer dissatisfaction is getting stronger [6]. The results of processing the Kano method are in table 4.

Table 4
Kano Method Results

Attribute	M	O	A	I	R	Q	Total	Category	IBT	I
1	20	88	7	8	1	14	138	*One dimensional*	0,77	-(
2	20	34	35	33	6	10	138	*Attractive*	0,57	-(
3	25	78	9	14	10	2	138	*One dimensional*	0,69	-(
4	54	51	11	13	1	8	138	*Must be*	0,48	-(
5	54	51	11	13	1	8	138	*Indifferent*	0,48	-(
6	35	34	18	40	1	10	138	*Must be*	0,41	-(
7	28	58	16	22	3	11	138	*One dimensional*	0,60	-(
8	19	69	14	23	7	6	138	*One dimensional*	0,66	-(

Table 4
Continued Kano Method Results

Attribute	M	O	A	I	R	Q	Total	Category	IBT	I
9	22	74	21	12	1	8	138	*One dimensional*	0,74	-(
10	21	78	14	16	1	8	138	*One dimensional*	0,71	-(
11	58	51	8	12	1	8	138	*Must be*	0,46	-(
12	23	87	5	10	3	10	138	*One dimensional*	0,74	-(
13	23	72	12	19	2	10	138	*One dimensional*	0,67	-(
14	24	71	12	20	3	8	138	*One dimensional*	0,65	-(
15	33	47	12	35	3	8	138	*One dimensional*	0,46	-(
16	24	77	15	12	3	7	138	*One dimensional*	0,72	-(
17	19	59	23	27	1	9	138	*One dimensional*	0,64	-(
18	28	49	26	23	3	9	138	*One dimensional*	0,60	-(
19	19	15	48	37	11	8	138	*Attractive*	0,53	-(
20	20	7	11	56	33	11	138	*Indifferent*	0,19	-(
21	26	62	14	26	1	9	138	*One dimensional*	0,59	-(
22	16	52	24	34	3	9	138	*One dimensional*	0,60	-(
23	22	65	18	20	4	9	138	*One dimensional*	0,66	-(
24	11	77	17	23	1	9	138	*One dimensional*	0,73	-(
25	18	29	22	55	6	8	138	*Indifferent*	0,41	-(

- *Quality Function Deployment (QFD)*

The results of Kano processing obtained 22 selected attributes. Next, look for gaps, namely the difference between perceived satisfaction and the expectations desired by customers. If the gap obtained is negative (-), this indicates a problem faced by the product developer manufacturer so that corrective action is needed. The value of the gap is obtained from the results of the average value of the level of satisfaction minus the level of expectation. The results of the gap value will be multiplied by the level of customer interest so that the satisfaction score is obtained, then the value of the satisfaction score will be multiplied by the weight of the Kano category (attractive = 4, one dimensional = 2, and must be = 1) then the value of adjusting importance to be obtained will be obtained. customer and absolute value so that it becomes the absolute value adjust importance to the customer. Here are the results of the calculations [15].

Technical requirements are needed to improve the quality and innovation of Ardiles shoe products. Technical requirements are obtained from the results of discussions with related parties and are expected to answer the needs or desires of consumers for Ardiles shoe products. Furthermore, it will be known what technical steps are taken by the manufacturer in developing shoe product designs. For the results of the technical requirements obtained 16 attributes. The relationship matrix is stating the relationship between customer requirements and technical requirements. Relationships at this stage are grouped with a strong rating given a number 9, a medium number 3, and a weak number 1.

Then analyzed by the QFD method, which is a way to improve the quality of goods according to consumer desires by connecting technical requirements so as to form a house of quality (HOQ) [15]. The HOQ in this study is described in Figure 1.

Based on the explanation of the HOQ, it was found that improvement efforts need to be prioritized at the level of importance by the Ardiles brand shoe product developer. The attribute generated from the top based on customer requirements is the shoe attribute has two functions/models (low cut and high cut)" with a value of 20.50%. Meanwhile, the attribute that has the lowest normalized raw weight value is attributed 13, namely "The suitability of the shape of the shoe with the foot" with a value of -4.53%. The technical requirement attribute that has the highest level of importance is the upper material type with a contribution value of 18.83%. As for the attribute having the lowest value of normalized raw weight is the shape of the foot with a value of -2.72%.

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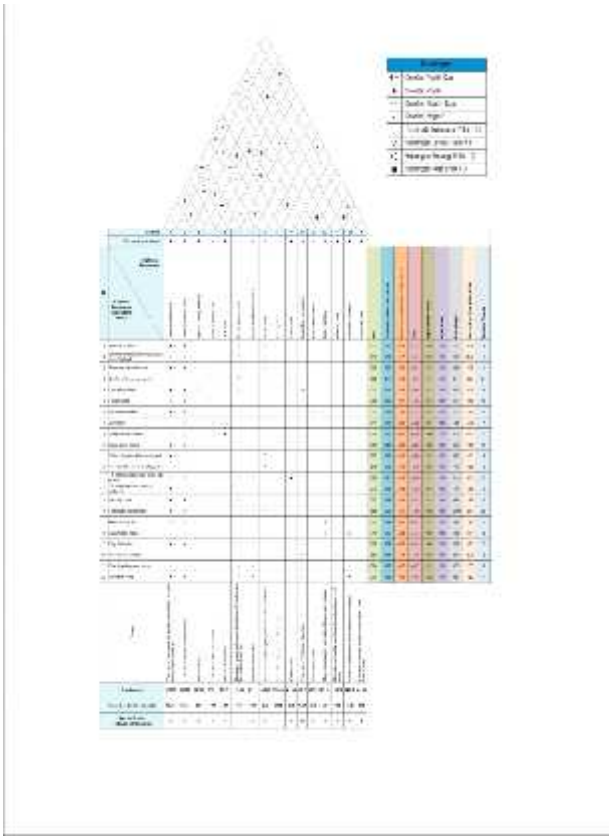

Figure 1: House of Quality (HOQ)

IV. CONCLUSION

Based on the results of the analysis that has been carried out through the integration of Kano and QFD in analyzing the attributes of product design development, it can be concluded:

1. Attribute Analysis with Kano Model

Data processing using the Kano model, obtained 3 attributes in the must-be category, 17 attributes in the one-dimensional category, 2 in the attractive category, and 3 in the indifferent category. In the Kano method, attributes that are included in the indifferent category can be removed or eliminated because these attributes have no effect on the level of consumer satisfaction.

2. Attribute Analysis with QFD Method

The results of data processing with the QFD method obtained the top 3 attributes that need to be prioritized by the developer seen from the normalized raw weight value (%). These attributes are shoes have two functions/models (low cut and high cut) with a value of 20.50%, shoe products have a warranty value of 13.87% and safe foot protectors with a value of 9.56%. After that, improvement efforts were prioritized by the Ardiles shoe design developer in improving the quality of their products based on technical requirements. The technical requirements obtained are 16 attributes. In this study, the 3 highest technical requirements were obtained, including the type of upper material with a contribution value of 18.83%, namely the use of canvas eco-friendly material with eco print and synthetic leather, the type of outsole material with a contribution value of 18.24%, namely the use of phylon rubber material, and a locking system with a contribution value of 14.58%, namely the use of locking system with sewing.

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