Quality Improvement Design on Sales Website Using Fuzzy Quality Function Deployment (FQFD) Method

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***Abstract*— PT. XYZ is a company engaged in fashion which manufactures and sells its own products to consumers. The company sells through various online media including its own website and several marketplace media. However, their consumers make more online purchases through the marketplace than the website, which makes it difficult because the company can only use purchases from the website to obtain complete customer data needed to explore customer behavior. This research will be done using the Fuzzy QFD method to improve the quality of online sales service through the website based on the identified weaknesses of the company website that causes consumers to avoid making online purchases through the website. Fuzzy QFD is a QFD method integrated with fuzzy logic which aims to reduce the vagueness or obscurity of subjective judgments to improve calculation accuracy. The results of this research are 5 technical requirement from FQFD 1st iteration and critical part from 2nd iteration which are expected to produce recommendations needed by company to improve the quality of online sales services through its website based on a more objective and accurate data.**

***Keywords*— Fuzzy QFD, Online Sales, Website.**

I. INTRODUCTION

DIGITAL marketing is a communication tool used in marketing products using technology in the form of online marketing, internet marketing, or web marketing (Deekshith & Kinslin, 2016). The use of technology in marketing company products, in addition to selling, is also used to facilitate customer data collection and storage.

Customer data is needed so that companies can continue to provide the latest information to consumers about products produced by the company or about the company itself. This is usually done in order to keep consumers loyal to the products produced by the company or to always maintain the relationship between the company and customers.

One company that has problems in collecting customer data is PT. XYZ. PT. XYZ is a company located in the city of Bandung, which sells various models of bags produced directly by this company with the main target of consumers being teenagers. This problem was found, after an assessment of the website at PT. XYZ with one of the company owners. The results of the study show that many consumers prefer to buy products through marketplaces such as Line, Shopee, Tokopedia, Bukalapak, and others compared to PT. XYZ as shown in Figure 1.

Figure 1 shows the sales revenue made through the website of PT. XYZ is only 10.52% compared to total sales. The income illustrates the small consumer purchases on the website of PT. XYZ, of the sales target desired by the company, which is 60% of sales come from the website of PT. XYZ. Therefore, PT. XYZ began to develop on their sales website, after realizing that customer data in the company's development was needed. Meanwhile, customer data is obtained after consumers make purchases through the website of PT. XYZ

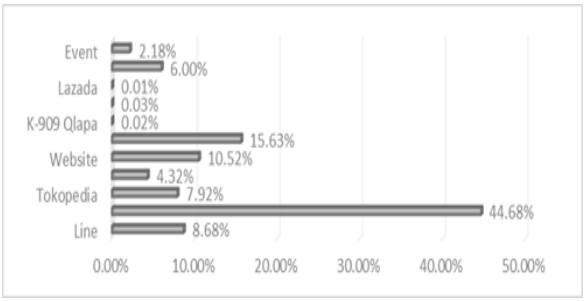


Figure 1. Sales Data for November 2018 - October 2019.

In terms of knowing the least amount of product purchases on the sales website of PT. XYZ, the consumer's view of the PT. XYZ is very necessary. For this reason, a preliminary survey of 9 consumers who had opened the PT. XYZ. This preliminary survey, conducted through in-depth interviews (in-depth interviews) to determine consumer ratings of the website of PT. XYZ. Table 1 shows complaints of preliminary survey results and comparison of PT. XYZ and PT. ABC as a competitor of PT. XYZ, based on existing complaints.

Based on Table 1 it can be seen that complaints from PT. XYZ when accessing the website of PT. XYZ. This is what makes customers tend to buy products not through the website. Therefore, companies need to design a better quality website.

II. METHOD

A. Quality Function Deployment

Quality function deployment or QFD is a concept that was first introduced by Yoji Akao and Shigeru Mizuno (Alsaadi et al., 2018). The QFD concept is a methodology developed to translate Voice of Customer (VoC) into technical characteristics used in the design of products or services (Iqbal et al., 2015). Quality function deployment is very important in developing a product/service, because the QFD concept provides steps in understanding the needs and demands of consumers for a product or service which is then translated into the form of technical characteristics that have

Table 1.
Comparison of PT. XYZ with PT. ABC based on complaints

Complaint	PT. XYZ	PT. ABC
Website display	Inefficient use of layouts	Use efficient layouts
Navigation	There are inefficient features, so it requires more clicks for a process	There are efficient features, so they require a smaller number of clicks for a process
Graphic design on the menu display	- There are no barriers between menus and submenus, the distance between the posts in the remote submenu and the search feature cannot be clearly seen -There are navigation features in the form of overlapping icons	- There is a border between the menu and submenus, the distance between the posts in the submenu is sufficient and the search feature can be seen clearly - There is no navigation feature in the form of overlapping icons
Loading time	2 to 3 seconds	0 to 1 second
Product information	Less specific explanation about the product	A more specific description of the product

Table 2.
Nilai Pengali Kategori Kano

Kano Category	Kano Multiplier Value
A (Attractive)	4
O (One Dimensional)	2
M (Must Be)	1

Table 3.
Converting Scale of Relationship between Technical Characteristics and True Customer Need to Triangular Fuzzy Number

Relationship	TFN
Strong relationship	(4,9,9)
Medium relationship	(1,3,5)
Weak relationship	(0,1,2)
No relation	(0,0,1)

benefits in achieving the highest level of customer satisfaction (Asadabadi, 2016). The development of concepts using QFD can not only be done by manufacturers but also in the fields of planning, design, and processes at each stage of the product (Iqbal et al., 2015). From the above statement, it can be seen that QFD is a method that can be used in developing products/services through the translation of consumer needs to product planning, product design until product sales process.

B. Fuzzy Logic

A tool used in analyzing uncertainty into a strong decision is fuzzy logic (Zadeh, 2015). Fuzzy value operation can be done in several ways below (Pandiya, Wahyudin, & Nareswari, 2016).

Addition → N1 + N2 = (a1 + a2, b1 + b2, c1 + c2)
Multiplication → N1 x N2 = (a1 x a2, b1 x b2, c1 x c2)
Division → N1 / N2 = (a1 / a2, b1 / b2, c1 / c2)
Multiplication with non-fuzzy numbers → r x N2 = (ra, rb, rc)
Where : N = Traditional Number
(a,b,c) = Triangular Fuzzy Number from N

In using fuzzy values in the calculation process, there is the term crisp number. Crisp numbers are the final numbers

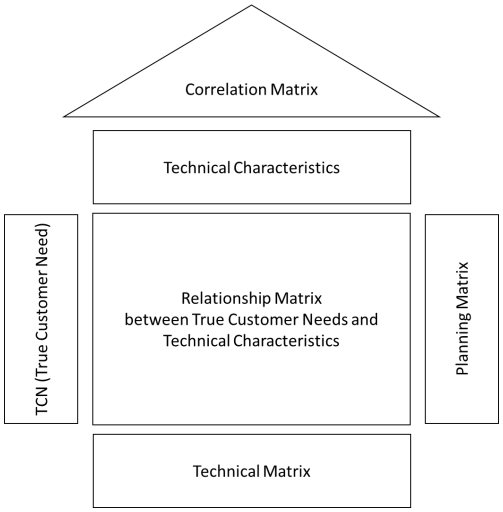


Figure 2. HOQ Matrix.

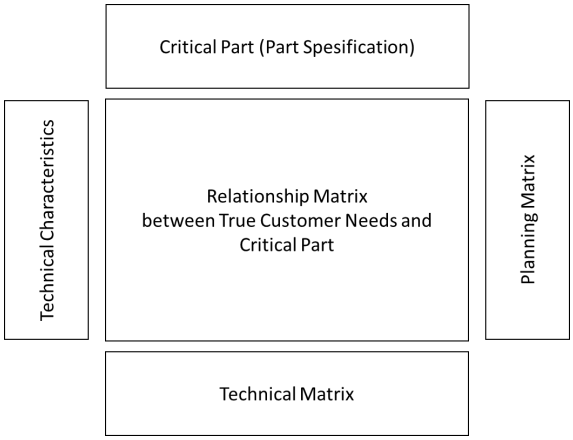


Figure 3. Part Deployment Matrix.

from the results of using fuzzy values in a process, these numbers are obtained after a defuzzification process (Pandiya et al., 2016). The following is a calculation in the defuzzification process.

M (a,b,d) = (a+4b+c)/6
Where, M (a,b,c) = Crisp Number
(a,b,c) = Fuzzy Number

C. Fuzzy Quality Function Deployment

Fuzzy number is then integrated with QFD to reduce inappropriate and vague decision making because it uses subjective values (Mohanraj & Sakthivel, 2014). This integration produces fuzzy QFD, which is a method used in translating a technical product from the needs of consumers in a product and produces a ranking of the value of the product's technical relationship and consumer needs, which are assessed subjectively, for more appropriate decision-solving.

1) Fuzzy Quality Function Deployment Iterasi 1

Fuzzy QFD iteration 1 uses the House of Quality matrix tool. This matrix is divided into six parts namely, the consumer needs matrix (true customer needs), the technical characteristics matrix, planning matrix, the relationship matrix between true customer needs and technical characteristics, the correlation matrix between technical

Table 4.
Scale that Determines Correlation Level between Technical Characteristics

Relationship Symbols	Relationship Symbols
Very positively related	●
Positively related	○
Negatively related	⍟
Very negatively related	✖

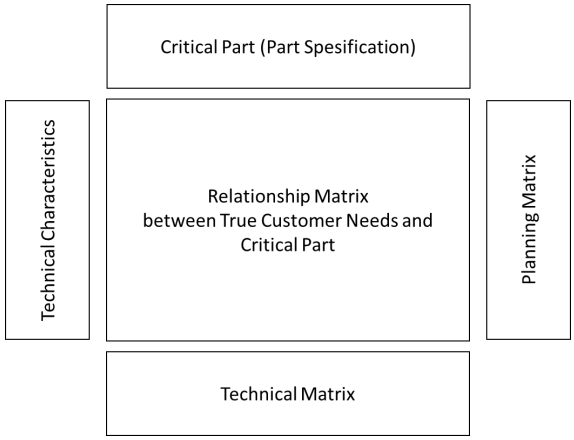


Figure 3. Part Deployment Matrix.

characteristics and the technical matrix. Figure 2 is an illustration of the HOQ matrix.

The planning matrix is filled with the results of multiplying the Fuzzy NKP value with the Kano multiplier value. Kano multiplier values were obtained from the kano category as described in Table 2 (Rahman et al, 2014). The technical matrix contains the value of existing companies, competitors and company targets, units, and the results of fuzzy value processing in the relationship matrix and planning matrix.

The value that is filled in the matrix of the relationship between true customer needs and technical characteristics by the internal parties of the company is first translated into fuzzy values before proceeding with data processing. Data processing results in a ranking of true customer needs. Conversion values are explained in the table below (Nawar, Backar, & El-Dardiry, 2018).

The filling out of the relationship between technical characteristics was also carried out by the internal developer of the PT. XYZ website. The scale used in determining the relationship between technical characteristics is stated in Table 4 (Erdil & Arani, 2018).

2) Concept Development

Concept development is the stage for designing and selecting concepts based on the characteristics that have been obtained in FQFD iteration 1. The results of the development of this concept are then continued to FQFD iteration 2 (Part Deployment). The concept development stage begins with designing the concept and then continues with the concept selection stage after making several considerations of the alternative concepts formed.

3) Fuzzy Quality Function Deployment iteration 2

Fuzzy QFD iteration two (part deployment) is data processing with the same steps as Fuzzy QFD iteration 1. Beginning with the determination of the value of column weight percentage, then determining the critical part, the relationship between critical parts with technical characteristics, and ending with a technical matrix. Figure 3 shows the part deployment matrix.

Table 5.
TCN Data, Fuzzy NKP Values and Kano Categories

Code	*True Customer Needs*	NKP (*Fuzzy Number*)			Kano Categories
QC1	The ability of the website to maintain performance and improve the system when an error occurs	6.88	7.87	8.36	O
QC2	Ease of website for users to access	7.22	8.20	8.47	O
QC3	The ability of the website to be used on various communication tools that can access the website	6.82	7.80	8.26	O
QC4	Ease of website to be operated by users without having to spend a large effort	6.97	7.96	8.37	O
QC5	The ability of the website to operate at any time	6.94	7.92	8.34	O
UE1	Ease of website to be understood by users	7.17	8.17	8.50	O
UE2	Website interface looks good and attractive	6.92	7.90	8.30	O
UE3	The ability of a website to provide a user-friendly appearance	6.89	7.87	8.26	O
IQ1	Website availability to display estimated shipping prices for products	7.12	8.11	8.47	O
IQ2	The ability of the website to provide product information and content that is clear and understood by users	7.41	8.39	8.63	O
IQ3	The ability of the website to provide search results according to the user's wishes	7.29	8.27	8.57	O
RS1	The ability of a website to load pages quickly	7.04	8.03	8.42	O
EP1	The sales website can display according to user needs	6.94	7.92	8.38	O

III. RESULT AND DISCUSSION

The first step is to obtain input data obtained based on previous research using the Fuzzy Refined Kano Model. The results obtained are TCN data with fuzzy NKP values and Kano Categories (Rahatesa, 2019).

Table 6.
Technical Characteristics

No	Technical Characteristics	Kode	Direction of Goodness
1	Website maintenance	K1	MTB
2	Use of SEO	K2	LTB
3	Navigation feature	K3	TB
4	Front end	K4	TB
5	Customer service online time	K5	MTB
6	Display total price	K6	MTB
7	Product information display	K7	MTB
8	Display of search results (search column)	K8	MTB
9	Website loading time	K9	LTB
10	Search display options	K10	MTB

Table 7.
Adjusted Importance

TCN Code	NKP (*Fuzzy Number*)			Kano Multiplier Value	*Adjusted Importance* (*Fuzzy Number*)		
QC1	6.88	7.87	8.36	2	13.76	15.74	16.71
QC2	7.22	8.20	8.47	2	14.43	16.40	16.94
QC3	6.82	7.80	8.26	2	13.63	15.60	16.52
QC4	6.97	7.96	8.37	2	13.95	15.91	16.75
QC5	6.94	7.92	8.34	2	13.88	15.84	16.68
UE1	7.17	8.17	8.50	2	14.35	16.33	17.01
UE2	6.92	7.90	8.30	2	13.84	15.81	16.61
UE3	6.89	7.87	8.26	2	13.77	15.74	16.52
IQ1	7.12	8.11	8.47	2	14.24	16.23	16.94
IQ2	7.41	8.39	8.63	2	14.82	16.78	17.25
IQ3	7.29	8.27	8.57	2	14.57	16.54	17.13
RS1	7.04	8.03	8.42	2	14.09	16.05	16.83
EP1	6.94	7.92	8.38	2	13.88	15.84	16.77

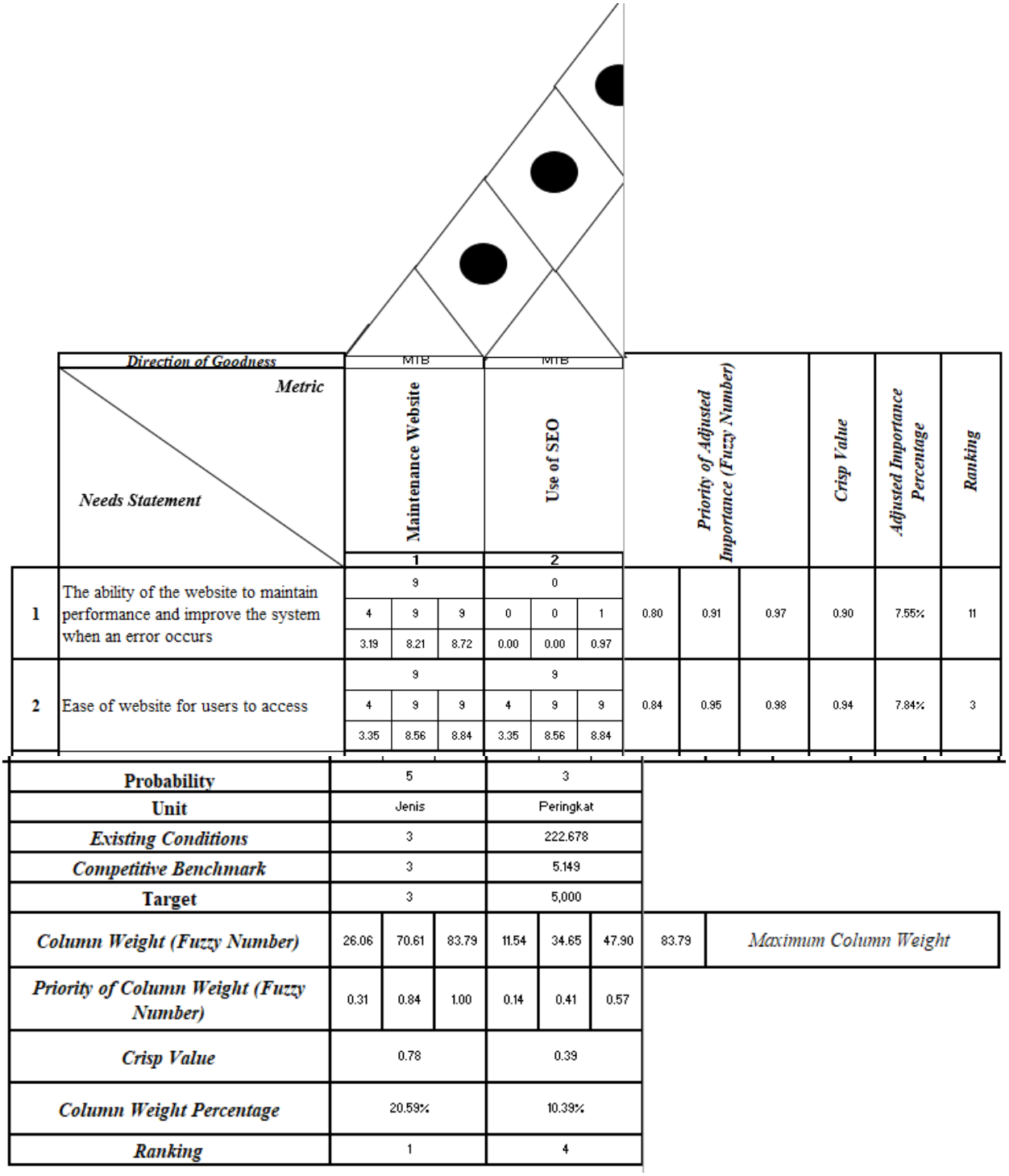
Table 8.
Planning Matrix

TCN Code	*Fuzzy Priority of Adjusted Importace*			*Crisp Value*	*Adjusted Importance Percentage*	*Rank*
QC1	0.80	0.91	0.97	0.90	7.55%	11
QC2	0.84	0.95	0.98	0.94	7.84%	3
QC3	0.79	0.90	0.96	0.89	7.48%	13
QC4	0.81	0.92	0.97	0.91	7.63%	7
QC5	0.80	0.92	0.97	0.91	7.59%	9
UE1	0.83	0.95	0.99	0.93	7.81%	4
UE2	0.80	0.92	0.96	0.91	7.57%	10
UE3	0.80	0.91	0.96	0.90	7.54%	12
IQ1	0.83	0.94	0.98	0.93	7.77%	5
IQ2	0.86	0.97	1.00	0.96	8.02%	1
IQ3	0.84	0.96	0.99	0.95	7.91%	2
RS1	0.82	0.93	0.98	0.92	7.69%	6
EP1	0.80	0.92	0.97	0.91	7.60%	8
		Total			100.00%	

Technical characteristics were obtained from the results of identification on 13 TCN by discussing with internal and external parties the PT. XYZ website developer. TCN is then broken down into 10 technical characteristics as in Table 6.

The planning matrix contains the value of fuzzy priority of adjusted importance, crisp value of fuzzy priority of adjusted importance, adjusted importance percentage and ranking of each technical characteristic based on adjusted importance value. The fuzzy priority value of adjusted importance is obtained from the fuzzy priority importance value. Fuzzy adjusted importance is derived from the multiplication between the NKP fuzzy value and the kano multiplier value of the kano category on each technical characteristic. Table 7 shows the NKP fuzzy value, the kano category in each technical characteristic, the kano multiplier value derived from the kano category and the calculation results for the data needed on this matrix are fuzzy adjusted importance values.

After obtaining the value of fuzzy adjusted importance, then determine the value of fuzzy priority of adjusted importance. Fuzzy priority value of adjusted importance is obtained from the division of each value of fuzzy adjusted importance with the greatest value in the value of fuzzy adjusted importance. While the adjusted importance percentage value comes from the calculation of crisp value on the fuzzy priority of adjusted importance. The crisp value



	Direction of Goodness		MTB			MTB							
	Metric / Needs Statement		Maintenance Website			Use of SEO			Priority of Adjusted Importance (Fuzzy Number)			Crisp Value	Adjusted Importance Percentage	Ranking
			1			2								
1	The ability of the website to maintain performance and improve the system when an error occurs		9			0								
			4	9	9	0	0	1	0.80	0.91	0.97	0.90	7.55%	11
			3.19	8.21	8.72	0.00	0.00	0.97						
2	Ease of website for users to access		9			9								
			4	9	9	4	9	9	0.84	0.95	0.98	0.94	7.84%	3
			3.35	8.56	8.84	3.35	8.56	8.84						
	Probability		5			3								
	Unit		Jenis			Peringkat								
	Existing Conditions		3			222.678								
	Competitive Benchmark		3			5.149								
	Target		3			5,000								
	Column Weight (Fuzzy Number)		26.06	70.61	83.79	11.54	34.65	47.90	83.79	*Maximum Column Weight*				
	Priority of Column Weight (Fuzzy Number)		0.31	0.84	1.00	0.14	0.41	0.57						
	Crisp Value		0.78			0.39								
	Column Weight Percentage		20.59%			10.39%								
	Ranking		1			4								

Figure 4. FQFD Iterasi 1.

of the fuzzy priority of adjusted importance is divided by the total of the crisp value of the fuzzy priority of adjusted importance. Then, the value is multiplied by 100% to get the percentage value used to determine the rank for each true customer needs. The results of the calculation of the value of fuzzy priority of adjusted importance, crisp value of fuzzy priority of adjusted importance and adjusted importance percentage used to determine the ranking of each technical characteristic can be seen in Table 8.

Furthermore, an analysis using the HoQ matrix can be seen in Figure 4 and, with the results of the identification of ten technical characteristics and five priorities for improvement of technical characteristics based on targets that the company has not yet met. The priority technical characteristics are the use of SEO, navigation features, front end, display of search results (search column), and website loading time.

Probability is determined based on the likelihood of the company meeting the targets of the established technical characteristics. The possibility is indicated by the numbers one to five. With the statement the greater the probability value, the greater the possibility to meet the target technical

Table 9.
Technical Characteristics Ranking

Code	*Probability*	*Fuzzy Column Weight*	*Fuzzy Priority of Column Weight*	*Crisp Value*	*Column Weight Percentage*	*Rank*
		26.06	0.31			
K1	5	70.61	0.84	0.78	20.59%	1
		83.79	1.00			
		11.54	0.14			
K2	3	34.65	0.41	0.39	10.39%	4
		47.90	0.57			
		13.78	0.16			
K3	3	43.53	0.52	0.50	13.28%	3
		65.20	0.78			
		21.95	0.26			
K4	3	61.24	0.73	0.68	17.88%	2
		73.92	0.88			
		0.83	0.01			
K5	5	7.45	0.09	0.10	2.73%	10
		21.46	0.26			
		4.99	0.06			
K6	5	17.91	0.21	0.22	5.72%	8
		32.33	0.39			
		6.69	0.08			
K7	5	20.81	0.25	0.25	6.67%	7
		37.20	0.44			
		3.28	0.04			
K8	3	15.90	0.19	0.20	5.25%	9
		33.19	0.40			
		9.70	0.12			
K9	2	28.55	0.34	0.34	8.84%	5
		44.62	0.53			
K10	4	9.07	0.11	0.33	8.64%	6

Table 10.
HOQ Matrix (Technical Matrix)

No	Technical Characteristics	Unit	Eksisting	Target
1	*Website maintenance*	Type	3	3
2	Use of SEO	Ranking	222.678	5
3	Navigation feature	Element	12	18
4	*Front end*	Element	7	8
5	Customer service online time	Hour	24	24
6	Display total price	Element	4	4
7	Product information display	Information	7	7
8	Display of search results (search column)	Element	0	2
9	*Website loading time*	Second	2	1
10	Search display options	Element	2	2

Table 11.
Reference and Alternative Concepts

Technical Characteristics	Existing Concept	Benchmarking Concept	Development and Innovation Concept
Use of SEO	Do not use articles, meta description, and meta keywords	Using articles, meta description and meta keywords	Optimizing the use of articles, meta description and meta keywords
Navigation feature	Do not use the dropdown menu	Use the dropdown menu	Optimizes the use of dropdown menus
Front end	Inefficient use of layouts for the feature placement	Use efficient layouts and use bright colors	Optimizes the use of layouts and soft color combinations
Display of search results (search column)	Search is only able to search according to the correct writing and only displays articles	Search is only able to search according to the correct writing and provide recommendations	Add search autocorrect to provide product recommendations and articles and optimize the use of search recommendations
Website loading time	Website loading time is 2 seconds but there is an animated image	Website loading time for 1 second by reducing image animation	The use of image optimization system to reduce website loading time and slightly reduce image animation

characteristics, and vice versa. Column weight percentage is obtained in several stages, starting from determining the value of fuzzy column weight by adding up the value of the multiplication weight between the relationship matrix value and the value of the fuzzy adjusted importance percentage in the same technical characteristic. Then proceed to divide each of these results with the largest value obtained in the value of fuzzy column weight to get the value of fuzzy priority of column weight. Next, the calculation of crisp value is performed using the crisp value formula. From this crisp value, a percentage is searched by multiplying the quotient value with the total crisp value by 100% to get the column weight percentage value. Column weight percentage calculation is performed to determine the priority of technical characteristics. The greater the weight generated, the characteristics will be prioritized.

Table 12.
Decision Matrix

Selection Criteria	Existing Concept	Benchmarking concept	Concept of Development and Innovation
Effectiveness	0	+	+
Efficiency	0	0	+
Appropriateness	0	+	+
Ease to be realized	0	-	+
Estimated cost requirements	0	0	0
Amount (+)	0	2	5
Amount (0)	5	2	0
Amount (-)	0	1	1
Total	0	1	4
Ranking	3	2	1
Next?	No	No	Yes

Table 13.
Critical Part

Technical Characteristics	*Critical Part*	Code	*Direction of Goodness*
Use of SEO	SEO article	C1	MTB
	Meta description	C2	MTB
	Meta keywords	C3	MTB
Navigation feature	Number of clicks on the product selection process	C4	LTB
	Number of clicks on the payment process	C5	LTB
	Number of clicks in the account creation process	C6	LTB
	Number of sticky menu icons	C7	LTB
Front end	The number of layouts on the home menu	C8	TB
	The number of layouts in the product selection display	C9	TB
	The number of layouts in the account creation view	C10	TB
	Number of sticky menu icons	C7	LTB
Display of search results (search column)	Search recommendation	C11	MTB
	Search autocorrect	C12	MTB
Website loading time	Animated image	C13	TB
	Picture on the home menu	C14	LTB

The five priority technical characteristics are then used as a reference in making alternative concepts. This priority setting is based on several technical characteristics that have not reached the target yet.

There are 3 types of concepts formed including the existing concept, the concept of benchmarking and the concept of development and innovation as illustrated in Table 11.

These concepts are determined by discussing with the PT. XYZ website development team, external website developer and some reference sources such as books, articles, journals and competitor's website concepts. The next step, give value to the concepts that have been determined based on discussions with internal parties on the PT. XYZ website developer. The decision matrix can be seen in Table 12.

Table 14.
FQFD Iteration 2 (Technical Matrix)

No	Technical Characteristics	Unit	Eksisting	Target
1	SEO article	Article	0	6
2	Meta description	Element	0	6
3	Meta keywords	Element	0	12
4	Number of clicks on product selection	Click	2	1
5	Number of clicks on payment	Click	3	3
6	Number of clicks on account creation	Click	1	1
7	Number of sticky menu icons	Element	4	1
8	The number of layouts on the home display	Layout	7	8
9	The number of layouts on the product display	Layout	4	4
10	Number of layouts on payment	Layout	3	3
11	Search recommendation	Element	0	7
12	Search autocorrect	Element	0	2
13	Animated image	Element	20	11
14	The number of pictures on the home menu	Element	20	20

Based on table 12, it can be seen that the chosen concept is the concept of development and innovation to be developed further because it has the highest ranking compared to other concepts. The selected concept is then identified to produce critical parts in the Iteration 2 FQFD which can be seen in Figure 5.

The planning matrix contains column weight percentage values for each technical characteristic that has not yet reached the company's target. This value is obtained based on the results of data processing in Fuzzy QFD iteration one (HOQ). The results of the data in the HOQ will be used as a reference in determining the value of the relationship between technical characteristics and critical parts contained in the iteration QFD matrix relationship (part deployment).

Critical parts are obtained through brainstorming with the PT. XYZ website developer and external website developer. Next, the coding of critical parts is carried out, and the direction of goodness or improvement to be achieved by the company is determined. The determination of direction of goodness is also done by discussing with the PT. XYZ website developer and the external website developer.

Critical part priorities are based on targets that have not been met. Table 14 shows the critical parts used in the prep Critical parts that are prioritized are SEO articles, meta description, meta keywords, number of clicks on product selection, number of sticky menu icons, number of layouts on the home display, search recommendations, search autocorrect, and animated images.aration of recommendations.

IV. CONCLUSION

In this study, it can be concluded that five priority technical characteristics were produced from thirteen technical

characteristics. Then, after processing using fuzzy QFD second iterations based on the chosen concept in concept development, nine priority critical parts were obtained from fourteen critical parts. The quality development of the PT. XYZ website is done by giving final recommendations in order to achieve the specified targets based on the result of data processing.

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