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Optimization of the *Jaloe Kayoh* seat design using the Quality Function Deployment (QFD) method based on Anthropometric measurements of the Acehnese society

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Abstract

Jaloe Kayoh is a traditional canoe used by Aceh's fishing communities to catch fish in downstream rivers and shallow waters. The current *Jaloe Kayoh* design does not meet ergonomic aspects, especially in the user's seat position component. It is known from the results of distributing the Nordic Body Map (NBM) questionnaire at the initial stage of the study which was distributed to 30 respondents that 9 out of 27 fisherman's body parts were in the "very high" complaint score. This complaint is also supported by data on the user's sitting position by bending the legs to form an angle of 70°, while the ideal sitting position is with the body upright and bending the legs at an angle of 90°-135°. Because this can lead to complaints that have an impact on the risk of long-term injury such as Musculoskeletal Disorders (MSDs) so this study aims to design a seat for *Jaloe Kayoh* users according to anthropometric measurements to avoid the risk of long-term injury. The design of the *Jaloe Kayoh* stand was carried out using the anthropometric approach of Acehnese fishermen and the Quality Function Deployment (QFD) method as a reference for researchers to determine the design according to the wishes of the user. The anthropometric dimensions used in this design are Popliteal Height (PH), Buttock-Popliteal Length (BPL), Hip Breadth (HB), Backrest Height (BH), Elbow Rest Height (ERH), and Shoulder Breadth (SB). Data calculation from anthropometry produces the 5th, 50th and 95th percentile measurements, which will be used in designing the seat position for *Jaloe Kayoh* users. The three percentile values result in a new measure of the design; PH is 39.31 cm; BPL of 48.43 cm; HB is 40.31 cm; BH is 61.37 cm; ERH of 100º; SB is 52.26 cm. So based on the QFD method produced by the house of quality, it produces a design for the *Jaloe Kayoh* seat position that is in accordance with what the user wants.

Keywords:
Jaloe kayoh, Aceh fisherman, anthropometry, ergonomics, quality function deployment method

1 Introduction

Jaloe Kayoh is a traditional Acehnese canoe [1], also known as a paddle boat in Indonesian, used by fishermen as a mode of transportation to catch fish in shallow waters or downstream rivers. *Jaloe Kayoh* is made of wood resistant to cracking and breaking, such as *Bangka*, *Semantok*, *Meranti*, and *Bungo*. The size of the *Jaloe Kayoh* is comparable to that of a canoe or other traditional boat. The length is 4.4 meters, the width is 1.2 meters, and the height is 0.4 meters based on the average size. *Jaloe Kayoh*'s dimensions are designed to carry only 2 to 4 fishermen. Currently, *Jaloe Kayoh*, made of hybrid fiber composites, is widely used for engineering applications, particularly in producing traditional Aceh boat frames and wall structures [2]. This allows *Jaloe Kayoh*'s design to be optimized regarding ergonomic factors that affect the safety, comfort, and health of *Jaloe Kayoh* users. *Jaloe Kayoh* design development using fiber composite materials has been developed in previous studies [3], where *Jaloe Kayoh* using this material has been tested with a minimum load of 539.3 N and a maximum variation of 2157.4 N. The resulting stress value is 3.998e+09 N/mm^2 and the highest reaction force value of 4.952e+03 N. However, the researchers discovered that traditional *Jaloe Kayoh* designer did not pay close attention to the aspects of comfort, safety, and performance efficiency of the seat position. Meanwhile, the abovementioned factors are not a priority for fishermen who use *Jaloe Kayoh*, resulting in injuries and fatigue in several body parts such as the waist, knees, and upper thighs. It is known from the results of the distribution of the Nordic Body Map (NBM) questionnaire that 9 of the 27 fisherman's body parts have a "very high" complaint score. This complaint is also supported by the current sitting design of *Jaloe Kayoh* users which causes the sitting position to bend the legs to form an angle of 70°, while according to [4] the ideal sitting position is with the body upright and bending the legs at an angle of 90°-135°.

Furthermore, the ergonomic aspects of its users should be considered when designing the *Jaloe Kayoh* seat position, which is used for a relatively long period every day. It is known that the duration of the fishermen's activities in using *Jaloe Kayoh* is an average of 3-5 hours/day. As a result, designing an ergonomic *Jaloe Kayoh* seat position necessitates matching the user's anthropometric measurements with the dimensions and design of the *Jaloe Kayoh* itself. At the same time, composite materials are widely used as the primary material in the production of *Jaloe Kayoh* [5]. Product development begins with an examination of market perceptions and opportunities and ends with the production of sales and product delivery to consumers [6]. Then, in order to gather information and understand consumer needs, a direct approach was required, which included direct interviews with consumers and questionnaires [7]. Additionally, boat mount design is a difficult task. The optimization method is excellent for solving design problems [8]. Only one step of the optimization method—the preliminary design—is carried out automatically to produce an ideal result quickly [8][9]. Therefore, choosing constants, parameters, variables, constraints, and objective functions is necessary to model optimization. At the same time, the variable that needs to be minimized or maximized during the optimization process is chosen by the designer, the regulation, and the objective function [9][10]. Microsoft Excel's tool solver has incorporated this optimization technique to address optimization issues [8].

This suitability serves as a guide for determining the ideal position for the *Jaloe Kayoh* seat design, which satisfies ergonomic requirements for effectiveness, health, safety, and human comfort in the workplace [11]. Users of *Jaloe Kayoh* will become more easily exhausted and susceptible to severe injuries as a result of working in a painful position. This anticipated level of comfort while sitting, rowing, or operating the *Jaloe Kayoh* will have a significant impact on the physical well-being and output of the fishermen users. In developing industrial products, users or people are always used as objects [12].

2 Methodology

2.1 Material

The material used in the *Jaloe Kayoh* boat model n, this study, is a material derived from ramies fiber and E-glass formed through a lamination process. The ramie fiber and E-glass are processed by the hand lay-up method combined with polyester resin (yukalac 157) to form a composite product. As for the composite product, Ramie Fiber (RF), an alkalization process was carried out using 5% NaOH for 48 hours, and E-glass or E-glass fibers (GF) which were each arranged in various layers, namely three layers in the form of E-glass–Ramie–E-glass (GF-RF-GF) (Table 1).

Table 1. Mechanical properties of E-glass–Ramie–E-glass (GF-RF-GF) material.

Properties	Dimension	Value
Young's modulus	E	8.195 GPa
Tensile strength	σ	49.320 MPa
Elongation	v	0.607 %
Density	ρ	1.29 g/cm^3

2.2 Design of *Jaloe Kayoh*

In this study, CAD-based software called Solidworks was used to incorporate the already existing *Jaloe Kayoh* design into the design of the seat position. *Jaloe Kayoh* is 4.4 meters long, 1.2 meters wide, and 0.4 meters tall (see Fig. 1).

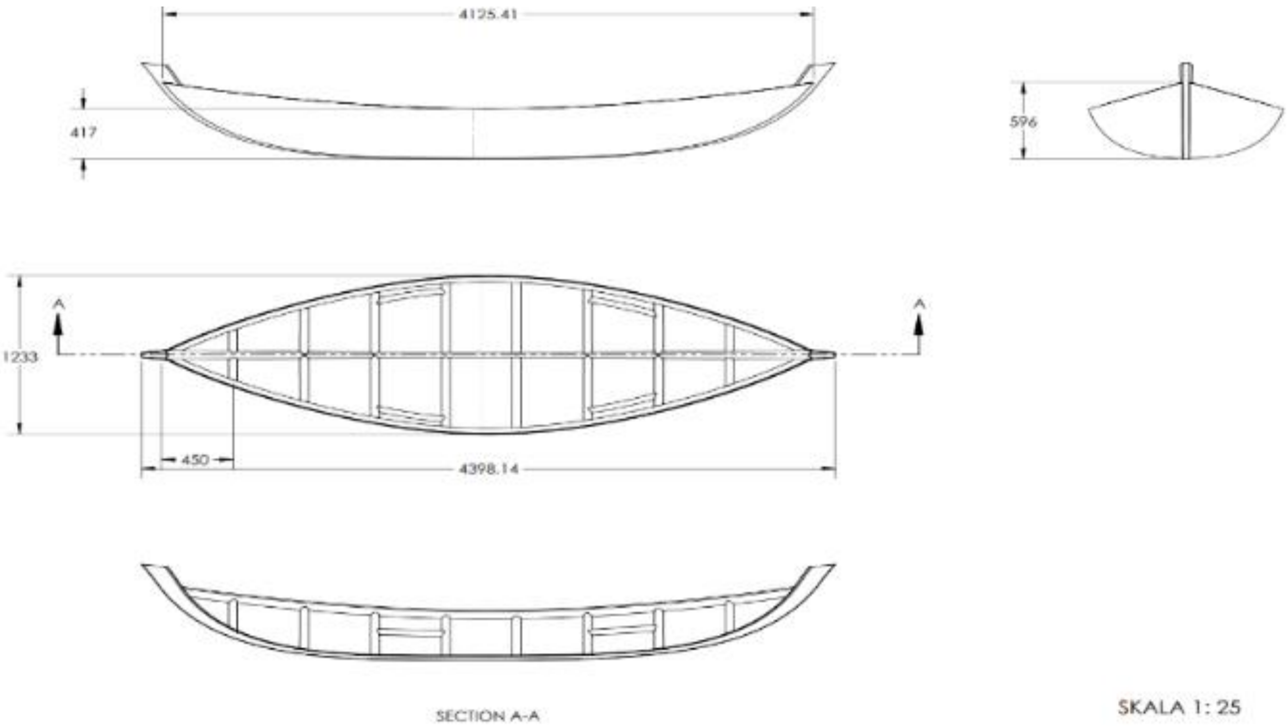


Fig. 1. *Jaloe Kayoh* dimension (m) [5].

2.3 Data collection

Data is collected scientifically in the form of primary and secondary data. The preliminary data set included *Jaloe Kayoh* size dimension data that had been redesigned by previous researchers, as well as product images. All of the data was collected in the field through direct observation using instruments such as questionnaires and anthropometric measuring instruments, and it was supplemented with data from literature studies. The number of data and research respondents was determined using a sampling technique known as non-probability sampling, also known as purposive sampling [13], which is thought to represent the population logically. The specified number of respondents or samples is 30, consisting of fishermen from the Ulee Lheue and Alue Naga in Banda Aceh City.

2.3.1 Anthropometry

Anthropometric data were collected on 30 Acehnese fishermen via questionnaire distribution by measuring the fishermen who used *Jaloe Kayoh*. This study measured six body dimensions of sitting position [14] [15]: Popliteal Height (PH), Buttock-Popliteal Length (BPL), Hip Breadth (HB), Backrest Height (BH), Elbow Rest Height (ERH), and Shoulder Breadth (SB). Following the measurement of the six body dimensions, the anthropometric data is processed using Microsoft Excel software. The following is the data processing procedure [16]:

1. Data uniformity test.

The data uniformity test is carried out to see the variants of the data that have been collected and then reduce the variance of the data so that it complies with the applicable provisions. If there is extreme data, the researcher can replace or discard the data. Data processing is done with the Microsoft Excel [11].

a. Calculating the average.

The mean is a typical value that represents the middle property of a set of data values (Eq. 1), where $\bar{X}$ is Average (*mean*), X_t is Anthropometric data, and N is Number of data.

$$\bar{X} = \frac{\sum X_t}{N} \quad (1)$$

b. Deviation standart

Deviation is a measure of spread that is often used to determine the upper and lower control limits (Eq. 2), where is σ = Standard deviation, $\bar{X}$ is Average (mean), Xi is Anthropometric data, and N is Number of data.

$$\sigma = \sqrt{\frac{\sum (Xi - \bar{X})^2}{N-1}} \quad (2)$$

c. Upper Control Limit (UCL) (Eq. 3) and Lower Control Limit (LCL)(Eq. 4).

$$UCL = \bar{X} + Z\sigma \quad (3)$$

$$LCL = \bar{X} - Z\sigma \quad (4)$$

If the data is outside the control limits then the data is eliminated where the uniformity of the data can be known with the x control chart.

2. Data sufficiency test.

Furthermore, a data sufficiency test was carried out to see whether the data used represented the research population. All data is considered sufficient if N' < N (Eq. 5). This sufficiency test was also carried out using the assistance of the Microsoft Excel, where *N'* is Total of theoretical data, *N* is Total of observational data, *Z* is Confidence level, σ is standard deviation, α is Degree of accuracy, and X_i is Number of data.

$$N' = \left[\frac{Z/\sigma\sqrt{N\sum Xi^2 - (\sum Xi)^2}}{\sum Xi}\right]^2 \quad (5)$$

3. Percentile calculation.

Percentile is the value obtained by dividing a number of observations into one hundred equal parts. Table 2 is a percentile calculation for each user's anthropometric dimensions.

Table 2. Percentile calculation.

Percentile	Calculation
1.0 st	$\bar{x} \times 2.325\ \sigma_x$
2.5 th	$\bar{x} \times 1.950\ \sigma_x$
5.0 th	$\bar{x} \times 1.645\ \sigma_x$
10 th	$\bar{x} \times 1.280\ \sigma_x$
50 th	$\bar{x}$
90 th	$\bar{x} \times 1.280\ \sigma_x$
95 th	$\bar{x} \times 1.645\ \sigma_x$
97.5 th	$\bar{x} \times 1.950\ \sigma_x$
99 th	$\bar{x} \times 2.325\ \sigma_x$

2.3.2 Quality Function Deployment (QFD)

Some stages of Quality Function Deployment are [17]:

1. Attribute identification.

These attributes are identified in two ways: directly by researchers based on quality values in the product or through direct interview techniques (Table 3).

Table 3. Voice of Customer

Attribute	Voice of Customer
Functional	Lightweight
	Space-saving
	Load-bearing
	Easy to clean
Safety	No sharp edges
	No corners
Life cycle	Durable
	Attractive product design
Ergonomics (convenience)	Sitting height dimension
	Backrest dimension
	Stand dimension
	Tilt backrest
	Seat tilt
	Backrest shape
	Stand shape

This study determined the attributes directly through literature studies and direct product observation. In the research questionnaire distributed to 30 respondents, 15 Voice of Customer (VoC) attributes were given a choice; after an assessment of the importance of the 15 initial attributes, the researcher selected the attributes that were deemed unimportant by the respondents. Attributes that have a weight below 50% are considered unimportant so they are removed from the study.

2. Importance level measurement.

The measurement of the level of importance was carried out by distributing research questionnaires to 30 respondents using a Likert scale of 1-5 (Table 4). The VoC attribute presented is the result of the researcher's initial selection of a VoC attribute with a weighting level of importance greater than 50%.

Table 4. Recapitulation of importance level questionnaire results.

Voice of Customer	Assessment					
	1	2	3	4	5	Total
Lightweight	0	1	1	12	16	30
Space-saving	0	1	2	13	14	30
Load-Bearing	1	3	4	8	14	30
Easy to clean	0	1	1	13	15	30
No sharp edges	0	0	0	4	26	30
No corners	1	2	2	8	17	30
Durable	1	0	2	8	19	30
Attractive Product Design	1	6	10	8	5	30
Sitting Height Dimension	0	0	0	21	9	30
Backrest Dimension	0	0	0	9	21	30
Stand Dimension	0	0	1	13	16	30
Tilt Backrest	0	0	1	5	24	30
Seat tilt	0	0	1	10	19	30
Backrest Shape	1	1	2	21	5	30
Stand Shape	0	0	3	23	4	30

Note: 1 is very unimportant, 2 is not important, 3 is quite important, 4 is important, and 5 is very important

3. Satisfaction level measurement.

The level of user satisfaction was assessed using research questionnaires. This level of satisfaction will be used to inform the next stage.

3 Results and Discussion

3.1 Processing of Anthropometric data

Anthropometric data of *Jaloe Kayoh* users taken on six parts of the user's body include Popliteal Height (PH), Buttock-Popliteal Length (BPL), Hip Breadth (HB), Backrest Height (BH), elbow rest height (ERH), and Shoulder Breadth (SB). Table 5 is a recapitulation of anthropometric data that has been collected from 30 respondents.

Anthropometric data processing includes data uniformity test, data adequacy test and percentile calculation. From the results of data processing, a graph of uniformity test data is obtained for the data on the dimensions of the popliteal height body (PH) which is shown in the graph in

Fig. 2 shows that the PH body dimension data is within the control limits, indicating that the data is uniform. The highest PH is 43 cm, and the lowest is 39 cm, with 46.721 cm as the upper control limit and 37.145 cm as the lower control limit. Upper and Lower Control Limits (UCL and LCL) are calculated with a 98% confidence level (k = 3).

Fig. 3 is shows of the uniformity test data on the Buttock-Popliteal Length (BPL) body dimension data. It shows that the BPL body dimension data is within the control limits, indicating that the data is uniform. The third data has the highest BPL dimension of 50 cm, and the second data has the lowest dimension of 45 cm.

Fig. 4 is a graph of uniformity test data on body dimension data of Backrest Height (BH). The BH body dimension data is within the control limits, indicating that the data is uniform. The third and tenth data have the largest BH dimensions of 62 cm, while the eighth data has the most diminutive dimensions 57 cm.

Table 5. Recapitulation of respondents' anthropometric data.

Respondents	Anthropometric dimension (cm)					
	PH	BPL	HB	BH	ERD	SB
1	44	50	37	60	18	50
2	39	45	36	58	22	49
3	45	52	38	62	20	53
4	42	48	40	59	17	51
5	44	50	39	59	15	54
6	41	47	40	58	18	50
7	44	51	37	60	19	52
8	42	48	39	57	17	51
9	42	49	38	59	18	53
10	43	50	40	62	16	54
11	40	46	37	60	20	50
12	41	48	39	60	19	52
13	42	50	39	61	18	51
14	40	47	38	59	18	55
15	41	47	38	58	17	51
16	43	50	37	59	18	50
17	44	51	39	60	19	52
18	41	47	40	57	20	54
19	40	47	37	60	16	53
20	39	45	37	59	17	50
21	40	46	38	58	16	52
22	41	48	39	61	18	51
23	43	49	39	60	19	49
24	43	50	40	59	20	51
25	44	51	40	58	20	50
26	42	48	37	60	18	50
27	41	47	39	59	17	53
28	42	48	38	59	18	51
29	43	49	38	60	19	54
30	42	49	39	59	16	50

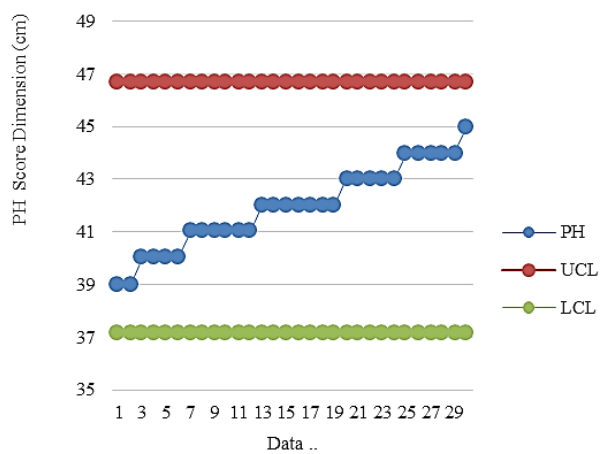


Fig. 2. Popliteal High data uniformity test

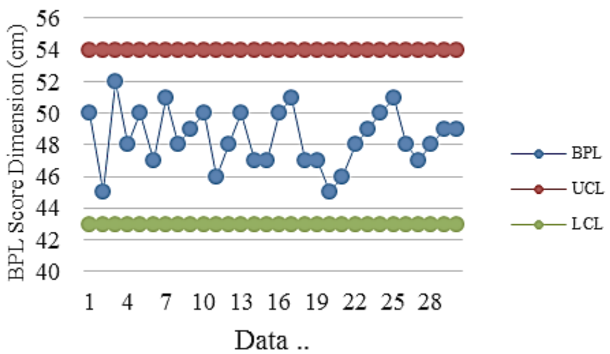


Fig. 3. Buttock-Popliteal Length (BPL) data uniformity test.

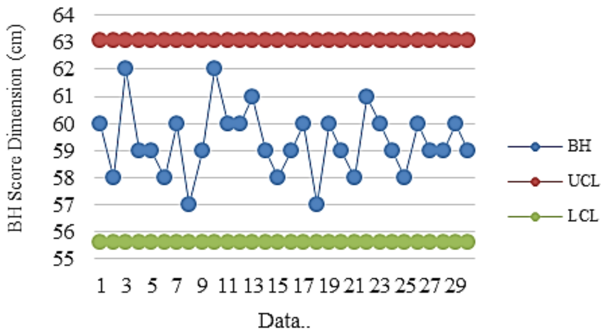


Fig. 4. Backrest Height data uniformity test.

Fig. 5 depicts uniformity test data on Hip Breadth (HB) body dimension data. According to the Fig. 5, the HB body dimension data is within the control limits, indicating that the data is uniform. The largest HB dimension is 40 cm, while the smallest is 36 cm.

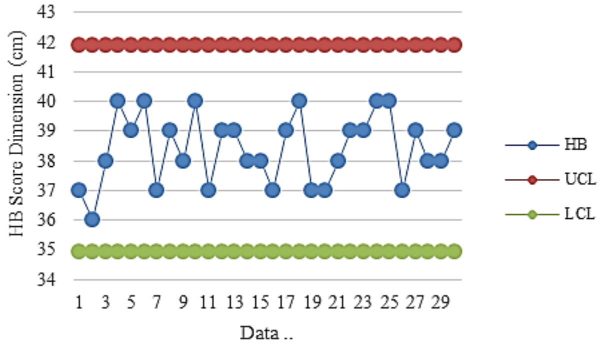


Fig. 5. Hip Breadt data uniformity test.

Fig. 6 depicts uniformity test data on body dimension data of Elbow Rest Height (ERH). It shows the ERH body dimension data is within the control limits, which means the data is uniform. The highest dimension is the second data which is 22 cm and the lowest is the fifth data which is 15 cm.

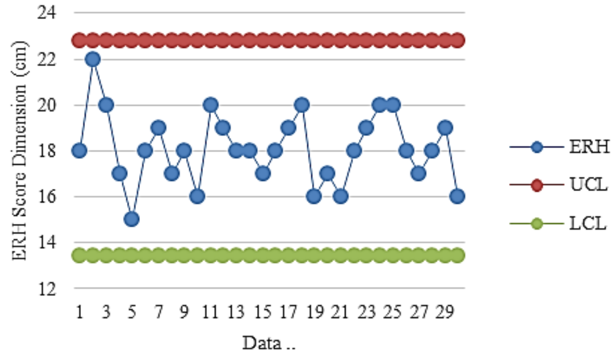


Fig. 6. Elbow Rest Height data uniformity test.

Fig. 7 is a graph of uniformity test data on body dimension data of Shoulder Breadth (SB). The SB body dimension data can be seen in the Fig. 7 to be uniform and within the control limits. The 15th data point, 55 cm, has the highest dimension, and the lowest is 49 cm.

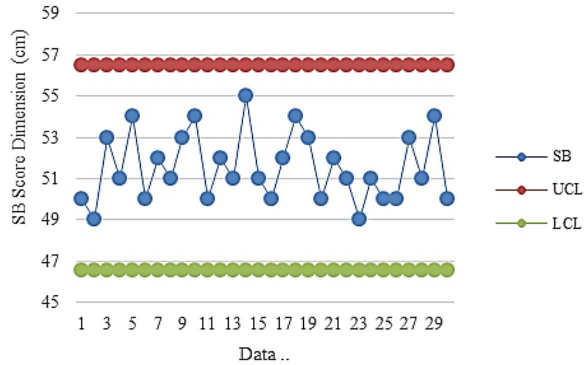


Fig. 7. Shoulder Breadth data uniformity test.

3.2 Test of data sufficiency

The data adequacy test is carried out with the calculation Eq. 5. The amount of data is considered sufficient if the value of N > N' or, in other words, the amount of theoretical data is greater than the actual observation data. Table 6 is the results of the adequacy of data for all body dimensions measured.

Table 6. Data sufficiency recapitulation.

Body dimension	N	N'	Remarks
PH	30	5,041	sufficient
BPL	30	4,981	sufficient
HB	30	3,190	sufficient
BH	30	1,523	sufficient
ERH	30	25,897	sufficient
SB	30	3,591	sufficient

Due to the value of N being greater than N', it was determined from the calculation results that the total amount of user anthropometric data was deemed sufficient for representing the study's population. Therefore, all the data that had been collected was declared to do so.

3.3 Percentile calculation

The percentiles used in this study were P-5, P-50, and P-95. Table 7 is a recapitulation of the selected percentile values for the six user body dimensions. Based on the results of the 6th percentile table, the researcher can determine the size of the new dimensions for the design of the *Jaloe Kayoh* seat position that will be designed.

Table 7. Percentile recapitulation of body size data.

Body dimension	P-5 (cm)	P-50 (cm)	P-95 (cm)
PH	39.31	41.93	44.56
BPL	45.42	48.43	51.45
HB	36.49	38.40	40.31
BH	57.29	59.33	61.37
ERH	15.53	18.10	20.67
SB	48.81	51.53	54.26

The selection of dimensions from the above percentile values is designed with a combination that considers the smallest, average and largest sizes. Where the 5th percentile is used to determine the smallest extreme size of the respondents, the 50th percentile is used to determine the average size of the respondents, while the 95th percentile is used to determine the largest extreme size. Table 8 is a new measure designed by researchers based on the selected percentile.

Table 8. Calculation of new dimensions of *Jaloe Kayoh*'s seat design.

Body dimension	Seat dimension	Chosen percentile (cm)	New size (cm)
PH	Popliteal height	P-5	39.31
BPL	Buttock-popliteal length	P-50	48.43
HB	Hip breadth	P-95	40.31
BH	Backrest height	P-95	61.37
ERH	Elbow rest height	-	100º
SB	Shoulder breadth	P-95	54.26

The updated sizes for the *Jaloe Kayoh* mount are shown in Table 7. Because it took into account human posture, this size is a measure in accordance with the user's anthropometry. It is thought to lower the risk of MSD injuries to fishermen using *Jaloe Kayoh*.

3.4 HoQ making

QFD input data was gathered through the distribution of questionnaires to 30 fishermen. The questionnaire asked respondents to rate their level of satisfaction with and importance of the pre-existing *Jaloe Kayoh* seat design product (Table 9 and Table 10).

Table 9. Recapitulation of interest level questionnaire results.

Attribute	VoC	Evaluation				
		1	2	3	4	5
Functional	Light	0	1	1	12	16
	Save space	0	1	2	13	14
	Able to withstand loads	1	3	4	8	14
	Easy to clean	0	1	1	13	15
Security	No sharp edges	0	0	0	4	26
	No corner	1	2	2	8	17
Life cycle	Durable	1	0	2	8	19
	Attractive product design	1	6	10	8	5
Ergonomics (comfort)	Sitting height dimensions	0	0	0	21	9
	Backrest dimensions	0	0	0	9	21
	Seat dimensions	0	0	1	13	16
	Backrest tilt	0	0	1	5	24
	Backrest tilt	0	0	1	10	19
	Backrest shape	1	1	2	21	5
	Shape of the stand	0	0	3	23	4

Table 10. Recapitulation of user satisfaction levels.

Attribute	Q	Evaluation				
		1	2	3	4	5
Functional	F1	1	4	23	2	0
	F2	4	5	5	8	8
	F3	1	2	6	8	13
	F4	2	7	13	7	1
Security	S1	1	12	6	4	7
	S2	5	10	8	1	6
Life cycle	LC1	2	3	6	14	5
	LC2	9	11	4	3	3
Ergonomics (comfort)	E1	6	15	5	3	1
	E2	24	6	0	0	0
	E3	10	12	4	2	2
	E4	27	3	0	0	0
	E5	9	14	4	2	1
	E6	27	3	0	0	0
	E7	11	10	3	4	2

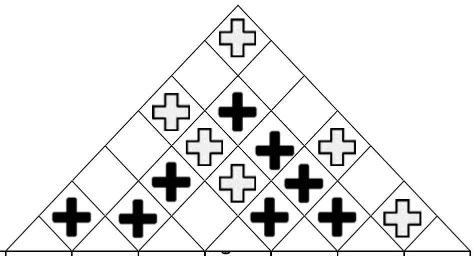
Note: 1 is very not important, 2 is not important, 3 is fairly important, 4 is Important, and 5 is very important

Following data processing, the House of Quality (HoQ) is created, which is the final stage of the QFD method. Fig. 8 depicts the QFD method's output, namely the HoQ. Through VoC, HOQ demonstrates what users want from *Jaloe Kayoh* mount products (Table 11).

According to the correlation matrix above, technical responses have various relationships that include weak, strong, and some technical responses that have no relationship. Furthermore, it is determined that the technical response as the user's wishes. To determine the level of importance or priority in the design, the correlation between technical response and VoC is calculated. This facilitates the creation of new designs by researchers.

Table 11. Recapitulation of contributions and normalized contributions.

Technical Responses	C	NC	Rank
Using natural jute fiber composite material	1.678	0.0565	6
Safe product design	7.385	0.2485	2
The top of the product has a water-proof foam	1.742	0.0586	5
Product dimensions according to the user's anthropometry	6.752	0.2272	3
Has a backrest	4.221	0.1420	4
Product design according to ergonomic principles	7.719	0.2597	1
Use neutral colors	0.224	0.0075	7



Technical Respon / VOC		Using natural jute fiber composite material	Safe product design	The top of the product has a water-proof foam	Product dimensions according to th user's anthropometry	Has a backrest	Product design According to ergonomic principles	Use neutral colors	IL	SL	Goal	SP	IR	RW	NRW	P
Functional	Lightweight	●	▽	○			○		4,43	2,87	5	1,5	1,13	11,60	0,06	8
	Space-saving	▽	○	▽	●	▽	●		4,33	3,37	5	1,5	1,15	9,65	0,05	10
	Load-Bearing	●	●	○	▽	▽	○		4,03	4,00	4	1,5	0,99	6,05	0,03	14
	Easy to clean	○		●			▽		4,40	2,93	5	1,2	1,14	9,00	0,05	13
Safety	No sharp edges	▽	●	○	○		●		4,87	3,13	5	1,5	1,03	11,65	0,06	7
	No corners	▽	●	○	○		●		4,27	2,80	4	1,5	0,94	9,14	0,05	11
Life cycle	Durable	●	○	○	▽		○		4,47	3,57	5	1,5	1,12	9,39	0,05	12
	Attractive Product Design			●	○	●	○	●	3,33	2,37	3	1,2	0,90	5,07	0,03	15
Ergonomics (convenience)	Sitting Height Dimension		●	▽	●	▽	●		4,30	2,27	5	1,5	1,16	14,23	0,07	6
	Backrest Dimension		●		●	●	●		4,70	1,33	5	1,5	1,06	26,44	0,13	2
	Stand Dimension		●		●	○	●		4,50	2,23	5	1,5	1,11	15,11	0,08	5
	Tilt Backrest		●	▽	●	●	●		4,77	1,27	5	1,5	1,05	28,22	0,14	1
	Seat tilt		●		●	▽	●		4,60	2,13	5	1,5	1,09	16,17	0,08	3
	Backrest Shape	▽	●		●	●	●		3,93	1,30	3	1,5	0,76	13,62	0,07	4
	Stand Shape	▽	●	○	●	○	●		4,03	2,23	4	1,5	0,99	10,84	0,06	9
C		1,756	7,299	1,808	6,634	3,997	7,651	0,233	Ket:							
NC		0,060	0,248	0,062	0,226	0,136	0,260	0,008								
Prioritas		6	2	5	3	4	1	7								

IL : Interest Level
SL : Satisfaction Level
SP : Sales Point
IR : Improvement Ratio
RW : Raw Weight
NRW : Normalized Weight

P: Priority

Fig. 8. House of Quality (HoQ)

The *Jaloe Kayoh* seat position was designed using Autocad and Solidworks software, taking into account the results of the anthropometric percentile calculation and the QFD method calculation. The *Jaloe Kayoh* holder is designed to make users feel comfortable and to reduce the risk of long-term injuries such as MSDs that can occur as a result of an incorrect sitting position while using *Jaloe Kayoh*. The following is the outcome of the researchers' design of the *Jaloe Kayoh* seat position based on selected anthropometry (Fig. 9 and Fig. 10).

3.5 Design of *Jaloe Kayoh* seat product

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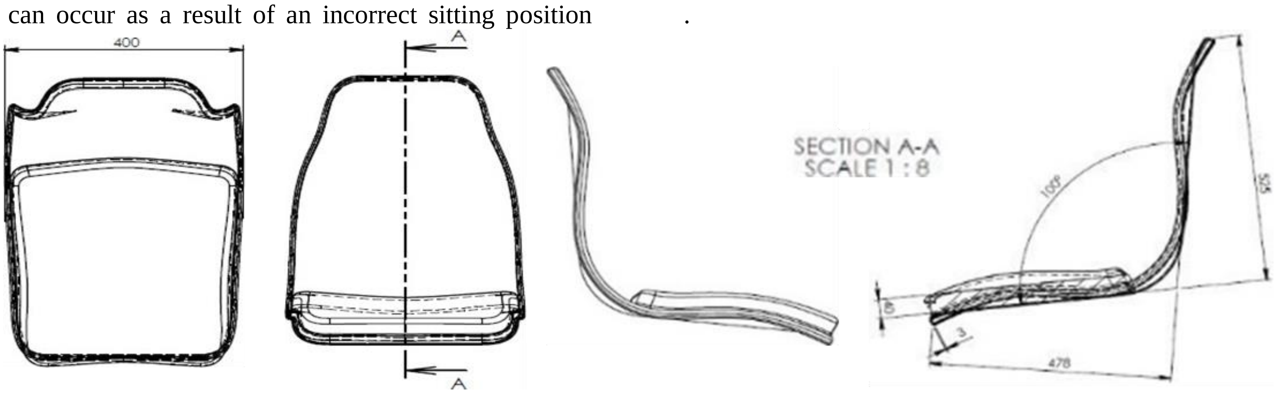

Fig. 9. *Jaloe Kayoh* seat design.

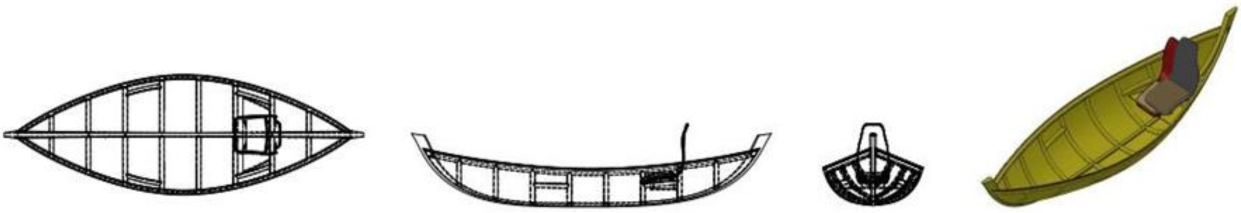

Fig. 10. Final design of the seat on *Jaloe Kayoh*.

3.6 Product comparison analysis

The design of the Jaloe Kayoh seat made by the researcher differs significantly from the existing seat. The comparison can be seen in the Table 12.

Table 12. Product comparison analysis.

Variable	Existing products	New design
Material	Using wood	Making use of ramie fibers Utilizing foam for the seat
Design	Flat shape without following the user's body contour	Has a backrest Water-proof foam (Polyurethane) covered seat cushion Depending on body type The seat's shape is more appealing.
Ergonomic	It does not match the user's anthropometric dimensions	User anthropometry indicates
	Risk of long-term injury	Reduce the risk of long-term injury
Aesthetic	Monotonous without any variation in shape or color	More attractive shape with color
Safety	The seat section has sharp corners and edges	No sharp corners and edges
	The surface of the seat is slippery, so there is a risk of slipping	Water-proof foam (Polyurethane) has been used to cover the seat surface to prevent slipping while seated.

4 Conclusion

This study was conducted to find the best design for the *Jaloe Kayoh* stand, commonly used by Acehnese fishermen. Based on anthropometric calculations, a new size was obtained on the *Jaloe Kayoh* user; the new size was obtained from the selected percentile combination (P-5; P-50; P-95). The new dimensions of the *Jaloe Kayoh* seat are as follows: Popliteal Height (PH) of 39.31 cm; Buttock-Popliteal Length (BPL) of 48.43 cm; Hip Breadth (HB) of 40.32 cm; Backrest Height (BH) of 31.38 cm; Elbow Rest Height (ERH) of 100^{o}; Shoulder Breadth (SB) is 54.25 cm. At the same time, the results of calculations using the QFD method are obtained where the material aspect uses natural *jute* fiber natural composites. In order to reduce the possibility of injury, the product design is made safe. The seat has a backrest, the dimensions are adjusted to the anthropometric measurements of the user, the top of the seat is covered by the water-proof foam (Polyurethane) to provide comfort for the users, and the color scheme is neutral with shades of black or white. The overall new design of the seat is also adjusted to ergonomic principles.

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