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The Comparison of Characteristics Profile of the Traditional Fishing Boats in Lamongan, Probolinggo, and Pasuruan, Indonesia

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Abstract

In this study, we explored the characteristics profile of traditional fishing boats in the three regencies of East Java, Indonesia, namely: Lamongan, Probolinggo, and Pasuruan. We presented the characteristics profiles of traditional fishing boats by using indicators and dimensions of product quality. We found the differences of traditional boats among these three regencies such as the GT size and the hull construction shape. The results showed that the GT size in Lamongan is from 24 to 50 GT sizes on average, whereas in Probolinggo and Pasuruan is below 30 GT ones. The hull shape in Lamongan is uniform with U-shape. Meanwhile, the hull shape in Probolinggo and Pasuruan is varies with U-shape and V-shape. The similarities among these 3 regencies are in the type of fish catching tools, machinery, and equipment. The majority fishermen used trawl automatically for larger than 13 GT sizes and net for below 10 GT sizes. In machinery, inboard system is used by vessels for larger than 13 GT. Meanwhile, the equipment used is standard, such as: lamp, compass, and audio. By studying the characteristics profile in the 3 regencies helps the standardization of traditional fishing boats in Indonesia.

Keywords
Traditional fishing boat, product quality, hull construction, Indonesia

1. Introduction

Most fishermen used traditional boats in East Java, Indonesia. Traditional boats are made from wood. There are some places in East Java that still produce these traditional vessels, such as: Lamongan, Probolinggo, and Pasuruan regencies. Each regency has their own uniqueness in building boats. We aim to compare the uniqueness among these three regencies.

There are several limited studies of traditional boats. Son and Kim (2014) discussed about job assignment in ship hull construction. The results showed that the assignment of hull blocks to design engineer were done efficiently in business process management system. Liu et al. (2018) designed bilge keel for traditional boats in Indonesia. The results show that the installation of bilge keels increased operational efficiency, reduced fuel costs and fuel emissions. Praharsi et al. (2018) studied about product quality characteristic of traditional boats. They provided the lines plan in order to re-build the traditional boat at the same size.

In this study, we aim to compare the characteristics profile of traditional boat products quality among three regencies in East Java, i.e.: Lamongan, Probolinggo, and Pasuruan. For comparison study, we follow the dimensions of products

quality in the theory of quality management, such as: durability, performance, reliability, serviceability, features, and aesthetics (Nasution 2015). Subsequently, we classify some indicators used in measuring product quality dimensions such as: the GT size, the machinery, the boat capacity, the speed, the supplier of traditional boat component, the number of boat crew, the type of fish catching tool, and equipment. In addition, we discuss specifically some uniqueness in each regency, i.e.: the GT size, the type of fish catching tool, and the shape of hull construction.

The rest of the paper is organized as follows. Section 2 presented the research methodology. Section 3 described the results and discussions and finally section 4 discussed the conclusion, limitation of this research study, and the future research.

2. Research Methodology

2.1 Research stages

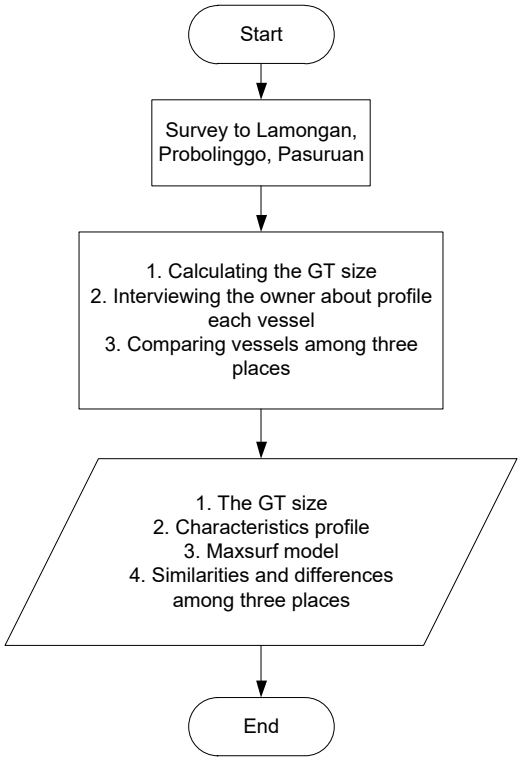


Figure 1. The research stages

We started research by surveying to Lamongan, Probolinggo, and Pasuruan regencies. Subsequently, we measured the length over all, the breath molded, and the height molded in order to obtain the GT size. We also did interview the owner and the team leader of building boat about the vessel's profile. Finally, we compare the GT size and the characteristics profile among these three regencies.

2.2 The calculation of GT size

Formula to calculate the GT size is as follows (Jami'in et al. 2016):

$$GT = (k_1) \times (V) \qquad (1)$$

where:
$k_1 = 0.2 + 0.02 \times \text{Log}(V)$
$V = (LOA) \times (Bm) \times (Hm) \times (0.5)$

LOA: Length over all
Bm: Breadth molded
Hm: Height molded

The measurement from the rear of the boat to the very front is called the overall length of the vessel. Meanwhile, the measurement of width from the inside is mentioned as breadth molded. Finally, the height measured from the top of the keel to the inside of the deck is called the height molded.

2.3 Characteristics profile of product quality

We used the dimensions of product quality to represent the characteristics profile of each vessel. The length of product usage and the size of Gross Tonnage reflected the durability. The number of driving machine, the engine power, the brand and type of machine, the machine position (inboard/outboard), the diameter of propeller, the speed of boat, the capacity of fuel, and the number accumulator presented the performance. The the boat capacity, the fish capacity, and the ice block capacity described the reliability. The supplier's place of machine, propeller, and wood and also the number of boat crew at the time of each sail discussed the serviceability. The type of fish catch tool, the capacity of net, and the additional equipment such as lamp, multimedia, and GPS explained the features. Finally, the shape of hull construction showed the aesthetics (Praharsi et al. 2018, Nasution 2015)

3. The results and discussions

3.1 The research sample

Table 1. Traditional fishing boats in Lamongan

Vessel name	LoA (m)	Bm (m)	Hm (m)	Volume	Log (V)	K1	GT
Mekar jaya	12.9	6.7	2.3	99.3945	1.997362	0.239947	24
Titipan Illahi	17.55	6.7	2.8	164.619	2.21648	0.24433	40
Qatar	16.5	7.5	3.3	204.1875	2.310029	0.246201	50
Perahu2	15.7	6.4	2.8	140.672	2.148208	0.242964	34
Wirausaha	15.7	6.4	2.8	140.672	2.148208	0.242964	34
Golek untung	11	5.6	1.8	55.44	1.743823	0.234876	13
Semut ireng	16	6	3	144	2.158362	0.243167	35
Permata jingga	14	6	3	126	2.100371	0.242007	31
Karya jaya	9	3.5	2	31.5	1.498311	0.229966	7
Kapal pincuk	8	2.5	1.5	15	1.176091	0.223522	3
Aqilla jaya	10.5	2.8	1.5	22.05	1.343409	0.226868	5

Using the calculation based on Equation 1, we derived the GT sizes in Table 1. In Lamongan, the GT sizes of traditional boats are varies from 3 GT to 50 GT. The GT mode is at 34 GT.

Table 2**.** Traditional fishing boats in Probolinggo and Pasuruan

Vessel name	LoA (m)	Bm (m)	Hm (m)	Volume	log (V)	K1	GT
Mimpi manis	15.5	5.5	2	85.25	1.930694	0.238614	20
Kota baru 2	16.4	5.5	2	90.2	1.955207	0.239104	22
King anugrah	16	5.5	2.5	110	2.041393	0.240828	27
Kapal kecil	7	2.1	0.8	5.88	0.769377	0.215388	1
Km siliwangi	10	2.5	1	12.5	1.09691	0.221938	3
Ridho illahi	11	2.5	1.2	16.5	1.217484	0.22435	4
Joko samudro	12	5	2	60	1.778151	0.235563	14
Berkat Tuhan	7.3	2.1	0.8	6.132	0.787602	0.215752	1

The calculation of GT sizes in Table 2 is similar to ones in Table 1. The GT sizes in Probolinggo and Pasuruan are varies from 1 to 27 GT. The GT mode is at 1 GT.

3.2 The characteristics profile of traditional fishing boats

Based on Table 3 and Table 4, we have described the traditional boat according to the durability, performance, reliability, service ability and features dimensions. In durability dimension, the length of use of Golek Untung vessel in Lamongan is 19 years and King Anugerah in Probolinggo is 15 years. Normally, the maximum ideal period of vessel is 20 years. In the performance, all vessels have speed vary in ranges from 5 to 9 knot/miles/hour which the full capacity condition will be faster than empty one. The vessels will use inboard machine for larger than 13 GT sizes and outboard machine for less than 10 GT sizes. In reliability, the load capacities are vary directly proportional to the GT size.

In service ability, the supplier of machine, propeller and wood are from Lamongan, Tuban, Semarang, Probolinggo, Pasuruan regencies and Surabaya city which are nearby from the shipyard. However, Titipan Illahi vessel has a wood supplier from Kalimantan island. In feature dimension for catching fish, fisherman uses trawl automatically in vessel for larger than 13 GT Sizes and net manually in vessel for less than 10 GT sizes. The equipment is similar in each vessel such as: TV, CD player, lamp, sound system, compass, and averter. In aesthetics, the hull construction followed by Maxsurf model and its profile are summarized in Table 5 and 6.

Table 3**.** The characteristics profile of traditional fishing boats in Lamongan

Indicator	Golek Untung	Titipan Illahi	Permata Jingga
The length of use	Since 1999	Since 2017	Since 2003
Size (loa x Bm x Hm)	11 x 5,6 x 1,8	17,55 x 6,7 x 2,8	14 x 6 x 3
GT Size	13 GT	40 GT	30 GT
Boat capacity / load	10 ton	35 ton	11 ton
The number of machine	4	5	4
Brand and Type	Mitsubishi (2) , & Yanmar (2)	Fusso silinder 6 & 4	Mitsubishi 120 pk (3) & Yanmar 30 pk (1)
Inboard or Outboard Machine	Inboard	Inboard	Inboard
Diameter Propeller	30 cm	24 x 34 cm	30 x 35 cm
The Speed (Full capacity & Empty)	7 miles/hour	7 miles / hour	6 miles/hour
The capacity of fuel	9 Drum	25 Drum	10 drum
Accu	4 accu @150 A	3 accu @130 V	1 accu (240 A)
The capacity of ice block	310 blocks	600 blocks	370 blocks
The machine supplier	Lamongan	Surabaya	Surabaya, Semarang
The propeller supplier	Surabaya	Surabaya, Tuban	Lamongan
The wood supplier	Tuban (Jati wood), Lamongan (Mahoni wood)	Kalimantan	Tuban
The number of boat crew	11	17	16
The type of catch tool	Trawl	Trawl	Trawl
The fish catch size (average)	8 ton	20 ton	100 kg
Equipment	Tv, CD Player, Lamp	Averter / Sprint Travo	TV, CD Player, Sound

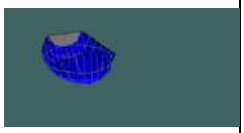
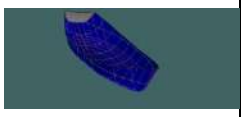
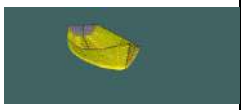
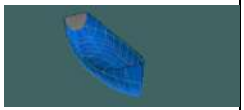
Table 4. The characteristics profile of traditional fishing boats in Probolinggo and Pasuruan

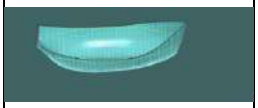
Indicator	King Anugerah	Kota Baru 2	Kapal kecil
The length of use	Since 2003	Since 2012	Since 2012
Size (loa x Bm x Hm)	16 x 5.5 x 2.5	16.4 x 5.5 x 2	7 x 2.1 x 0.8
GT Size	27 GT	22 GT	1 GT
Boat capacity / load	15 ton	15 ton	600 kg
The number of machine	2	2	1
Brand and Type	Mitsubishi D16	Hyundai 90 pk	Kubota
Inboard or Outboard Machine	inboard	inboard	outboard
Diameter Propeller	32 x 32	30 x 32	20 x 20
The Speed (Full capacity & Empty)	7-9 miles/hour	7-8 miles / hour	5 miles/hours
The capacity of fuel	5 drum	4 drum	30 liters
Accu	4 accu @120 A	2 accu @100 A	-
The capacity of ice block	400 blocks	350 blocks	-
The machine supplier	Surabaya	Surabaya	Probolinggo
The propeller supplier	Surabaya	Surabaya	Pasuruan
The wood supplier	Probolinggo (Jati woods)	Ngopak (Jati woods)	Pasuruan (Jati woods)
The number of boat crew	11	8	1
The type of catch tool	Trawl	Trawl	nett (Jaring)
The fish catch size (average)	5-11 ton	1 ton	10 kg crab & 100 kg fish
Equipment	Lamp, CD player, compass	Lamp, compass	Lamp

3.3 The profil pictures of traditional fishing boats in Lamongan, Probolinggo, and Pasuruan

Table 5. Hull construction of traditional fishing boat in Lamongan

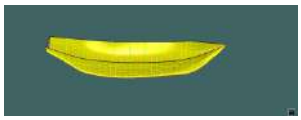
Vessel name	Picture	Maxsurf model	Profile
Mekar jaya			Length (L) : 13 M Breadth (B) : 6,7 M Height (H) : 2,3 M Draft (T) : 1,8 M Vol. Displ. : 86,77 M^3

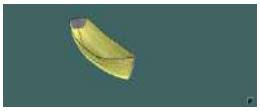
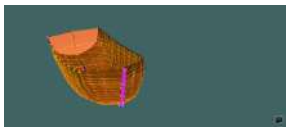
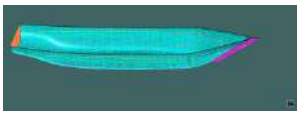
Vessel name	Picture	Maxsurf model	Profile
Titipan Illahi			Length (L) : 17,55 M Breadth (B) : 6,7 M Height (H) : 2,8 M Draft (T) : 2 M Vol. Displ. : 104,9 M^3
Qatar			Length (L) : 16,5 M Breadth (B) : 6 M Height (H) : 2 M Draft (T) : 1,8 M Vol. Displ. : 125,2 M^3
Perahu2	 		Length (L) : 15,7 M Breadth (B) : 6,4 M Height (H) : 2,8 M Draft (T) : 1,8 M Vol. Displ. : 93,74 M^3
Wirausaha			Length (L) : 15,7 M Breadth (B) : 6,4 M Height (H) : 2,8 M Draft (T) : 1,8 M Vol. Displ. : 93,74 M^3
Golek untung			Length (L) : 11 M Breadth (B) : 3 M Height (H) : 1,5 M Draft (T) : 1,2 M

Vessel name	Picture	Maxsurf model	Profile
			Vol. Displ. : 22,37 M^3
Semut ireng			Length (L) : 16 M Breadth (B) : 6 M Height (H) : 3 M Draft (T) : 1,3 M Vol. Displ. : 54,72 M^3
Permata jingga	 		Length (L) : 14 M Breadth (B) : 6 M Height (H) : 2 M Draft (T) : 1,8 M Vol. Displ. : 84,26 M^3
Karya jaya			Length (L) : 9 M Breadth (B) : 3,5 M Height (H) : 2 M Draft (T) : 1,5 M Vol. Displ. : 23,56 M^3
Kapal pincuk	 		Length (L) : 8 M Breadth (B) : 2,5 M Height (H) : 1,5 M Draft (T) : 1 M Vol. Displ. : 10,23 M^3

Vessel name	Picture	Maxsurf model	Profile
Aqilla jaya			Length (L) : 10,5 M Breadth (B) : 2,8 M Height (H) : 1,5 M Draft (T) : 1,2 M Vol. Displ. : 15,61 M^3

Table 6. Hull construction of traditional fishing boat in Probolinggo and Pasuruan

Vessel name	Picture	Maxsurf model	Profile
Mimpi manis			Length (L) : 15,5 M Breadth (B) : 5,5 M Height (H) : 2 M Draft (T) : 1,8 M Vol. Displ. : 66,28 M^3
Kota baru 2	 		Length (L) : 16,4 M Breadth (B) : 5,5 M Height (H) : 3 M Draft (T) : 1,8 M Vol. Displ. : 69,84 M^3
King anugrah			Length (L) : 16 M Breadth (B) : 5,5 M Height (H) : 2,5 M Draft (T) : 2 M Vol. Displ. : 77,26 M^3

Vessel name	Picture	Maxsurf model	Profile
Kapal kecil			Length (L) : 7 M Breadth (B) : 2,1 M Height (H) : 0,8 M Draft (T) : 0,5 M Vol. Displ. : 9,05 M^3
Km siliwangi			Length (L) : 15 M Breadth (B) : 3 M Height (H) : 2 M Draft (T) : 1,8 M Vol. Displ. : 30,31 M^3
Ridho illahi			Length (L) : 16 M Breadth (B) : 3 M Height (H) : 2 M Draft (T) : 1,8 M Vol. Displ. : 33,34 M^3
Joko samudro			Length (L) : 12 M Breadth (B) : 5 M Height (H) : 2 M Draft (T) : 1,2 M Vol. Displ. : 34,84 M^3
Berkat Tuhan			Length (L) : 7,3 M Breadth (B) : 2,1 M Height (H) : 0,8 M Draft (T) : 0,6 M Vol. Displ. : 9,53 M^3

The hull construction in Lamongan is different from the one in Probolinggo and Pasuruan. The majority of traditional boats in Lamongan have U-shape hull construction, while in Probolinggo and Pasuruan have U-shape and V-shape ones.

3.4 The Similarities and differences of traditional boats in Lamongan, Probolinggo, and Pasuruan

The similarities of traditional boats among Lamongan, Probolinggo, and Pasuruan are in the machinery, fish catching tools, and equipment. In machinery, inboard system will be used for larger than 13 GT sizes. The driving machine brand used are varies such as Mitsubishi, Yanmar, Fusso, Hyundai, and Kubota. The vessel average speed is 7 miles per hour. Fish catching tools used is trawl automatically for larger than 13 GT sizes. Otherwise, they will use net for less than 10 GT sizes. Overall, the equipment used is lamp, compass, TV and its sound system.

The differences of traditional boats among Lamongan, Probolinggo, and Pasuruan are in the hull construction and the GT sizes. The majority of hull construction in Lamongan has U-shape. Meanwhile, the majority of hull constructions in Probolinggo and Pasuruan have U and V-shapes. The majority of GT sizes in Lamongan is varies from 24 to 50 GT sizes, meanwhile the majority ones in Probolinggo and Pasuruan is below 30 GT sizes.

4. Conclusion and future research

We have presented the characteristics profile of traditional boats in Lamongan, Probolinggo, and Pasuruan by using indicators of product quality. The results show that the GT sizes in Lamongan is larger than Probolinggo and Pasuruan. The hull shape in Lamongan is uniform with U-shape. Meanwhile, the hull shape in Probolinggo and Pasuruan is varies with U-shape and V-shape. The majority type of fish catching tools in Lamongan is using trawl automatically, whereas the majority ones in Probolinggo and Pasuruan are using trawl and net. The same characteristics for fish catching tools among these 3 regencies are trawl used when the GT size is larger than 13 GT and net used when the GT size is lower than 10 GT. By studying the characteristics profile of traditional boats in 3 regencies helps the standardization of traditional boats in Indonesia. The future research could be carried by simulating and creating prototype of standardized traditional vessel according to those three regencies for the optimization of propulsion system. Another future research is supply chain management for standardized traditional fishing vessels.

5. Acknowledgements

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7. Biographies

Yugowati Praharsi is an Assistant Professor at Shipbuilding Institute of Polytechnic Surabaya, East Java, Indonesia. She earned B.Sc. in Mathematics from Satya Wacana Christian University, Indonesia; M.Sc in Electronic Engineering

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Prof. Hui-Ming Wee is a distinguished Professor in the Department of Industrial and Systems Engineering, former Associate Dean and Chaplain at Chung Yuan Christian University (CYCU) in Taiwan. He has received his B.S. degree (honors) from Strathclyde University (UK), M.Eng. from Asian Institute of Technology (AIT), and Ph.D from Cleveland State University, Ohio (USA). He has received an Excellent Research Award from the Taiwan Ministry of Science and Technology, Excellent Life Researcher Award, the Medal for Distinguished Industrial Engineer Award, and Life Distinguished Professor Award. He has published more than 400 papers in refereed journals, international conferences, and book chapters. His papers were cited over 4709 (7778) times in Scopus (Google Scholar) with h-index: 40 (47). He has co-edited seven books and holds two patents; was keynote speaker in a number of International conferences, senior member for Asian Council of Science Editors (ACSE), Board of Directors for International Engineering and Technology Institute (IETI) and Editor/editorial Board member for a number of International Journals. His research interests are in the field of production/inventory control, optimization, logistics, renewable energy, technological singularity, and supply chain risk management.