

Model of Raw Material Inventory Control for Pinisi Shipbuilding in Bulukumba Regency, Indonesia

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ABSTRACT

The pinisi ship is an extraordinary creation of the son of Bugis-Makassar, South Sulawesi Province. The construction of this pinisi ship as local wisdom was designed and calculated for each component of the raw material carefully and thoroughly. High quality wood raw materials are the main elements in the process of making a pinisi boat to produce a quality pinisi boat. The purpose of this study was to determine the inventory control model for pinisi shipbuilding raw materials in Bontobahari District, Bulukumba Regency. This research was conducted in Bontobahari District, Bulukumba Regency, South Sulawesi Province, Indonesia. Determining the research location was carried out with the consideration that the area is the center of the pinisi shipbuilding industry. Data was collected by conducting in-depth interviews with pinisi boat entrepreneurs and panrita lopi (experts in making pinisi boats), and community leaders. The data obtained were then tabulated and analyzed using descriptive methods. The results of the study show that the entrepreneurs of the pinisi ship make quite a large supply of raw materials in bantilang (warehouses where wood raw materials are stored). The number of raw materials purchased is based on considerations, including (1) the need for a pinisi ship, according to the size of the ship ordered, (2) the price of wood raw materials on the market, and (3) the availability of wood raw materials on the market.

Keywords: Inventory Control, Pinisi ship, Raw materials.

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I. INTRODUCTION

The pinisi ship is a famous traditional ship from the Bugis tribe in South Sulawesi Province. The process of making the Pinisi Ship is quite unique and requires quite a long time, done in the traditional way using human power. In the manufacture of pinisi ships, each component of the raw material is carefully and thoroughly calculated, both in quantity and size. The Lopi Panrita (pinisi boat builders) designed the construction of the pinisi boat without using standard measuring tools, but they were able to produce a pinisi boat that was strong, sturdy, and tough. That is what is amazing for foreigners who come to see the process of making pinisi boats in Bulukumba Regency, South Sulawesi Province (Ramadhani, 2017).

The production process for pinisi ships requires a balance between raw materials, capital, machines, methods, and human resources. Especially for raw materials which are important and main elements, and greatly determine the smooth production and quality of the ships produced. Therefore, every company must have a good planning for raw

material requirements and must be aligned with every related element within the company (Akhmad, 2018).

The selection of raw materials, especially types of wood, should be adjusted to the wishes of consumers and their construction (Ahmad, 2011). Raw material supplies must be controlled and have operational standards (SOP), both in terms of the quantity and quality of raw materials prepared, as well as the time of order so that the availability of raw materials which is right for the smooth production process of pinisi boats. Adequacy of raw material stocks and raw material reserves can also anticipate damage in the production process (Samsir, 2017).

In general, pinisi ship entrepreneurs in Bontobahari District, Bulukumba Regency place orders for raw materials after they already have a ship purchase contract with the buyers. The importance of cooperation agreement contracts is carried out to create certainty and mutual trust, so that mutual need and mutual benefit are built (Arief & Nurdin, 2009).

The problem faced by pinisi ship entrepreneurs today is the increasing difficulty in obtaining raw materials, especially several types of wood which are the main elements, such as iron/ulin wood, teak wood, and bitti wood. This type of wood

is increasingly expensive and difficult to obtain in this area, so that this type of wood has to be imported from outside the Province of South Sulawesi, such as from Southeast Sulawesi and Central Sulawesi, and sometimes even imported from the island of Kalimantan (Akhmad *et al.*, 2022). The challenge faced by pinisi ship entrepreneurs in the future is the limited availability of wood raw materials, the increasing competition in the pinisi ship industry causes the need for wood materials to increase as well (Akhmad *et al.*, 2020).

The scarcity of wood supply is not only felt by pinisi boat manufacturers, but also the wood furniture industry, as experienced by the wood furniture industry in Tirtonirmolo Village, causing business actors to switch to substitute wood raw materials, thus having a negative impact on the amount of production, the number of workers, the price selling products, and increasing business capital. To be able to continue to survive, entrepreneurs make several adjustments by changing product composition and reducing labor (Priyadi, 2014).

To make pinisi boats in South Sulawesi Province, especially in Bulukumba Regency, which is one of the centers for making pinisi boats, high-quality types of wood are sourced from various provinces in the Southern Province and other provinces in Indonesia. Therefore, the research was to find out the model for procuring raw materials for making pinisi boats in Bontobahari District, Bulukumba Regency, South Sulawesi Province.

II. LITERATURE REVIEW

A. Inventory Control

Inventory control is a key factor in the industry, including in this case pinisi shipbuilding, to ensure the smooth production and operations of the company. Inventory control is very helpful in minimizing production costs, can increase production efficiency and maintain product quality, (Pratama & Riyanto, 2022).

The inventory control method with ABC (ABC inventory control method) is an approach to managing and controlling inventory based on the relative importance of each inventory item. This method divides inventory items into three categories based on their relative value or contribution to business activities, (Heizer & Render, 2014, Brown *et al.*, 2005).

These categories are Category A: Items of highest importance. This category includes inventory items that have a high value or the greatest contribution to the company's sales or profits. Typically, about 20% of inventory items will fall into this category, but the percentage can vary depending on the business and industry. This category A needs to be managed more carefully and requires more intensive monitoring. Category B: Items of medium importance. This category includes approximately 30% of inventory items that have a moderate value or contribution to sales or profits of the company. Category B requires moderate control and needs regular attention. Category C: Items with the lowest importance level. This category includes approximately 50% of the inventory items that have the lowest value or contribution to the company's sales or profits. Category C

requires simpler controls and can be managed with a more relaxed approach (Ronen & Pass, 2008; Loader, 2006)

The inventory control method with ABC assumes that not all inventory items have the same contribution or value to business performance. By dividing inventory into these categories, companies can direct their efforts and resources more efficiently and effectively. Items with a high value or contribution will receive greater attention in terms of inventory control, monitoring, and risk management, while items with a lower value or contribution can be managed with a simpler approach.

Inventory control using the ABC method often involves analyzing historical data to determine the relative importance of each inventory item. This method can also be used to optimize inventory levels, reduce the risk of inventory shortages, and improve operational efficiency, (Elwood *at.al.*, 2007; Musthafa. 2017).

B. Economic Order Quantity

The inventory control method with the EOQ (Economic Order Quantity) method is an approach to determine the optimal number of orders that must be made to minimize the total cost of inventory. The EOQ method is based on the assumption that demand for inventory is constant, order costs are fixed, inventory holding costs are constant per unit and there are no delays in supply delivery (Roy, 2005; Mujiastuti, *et al.*, 2018).

The following are the steps in inventory control using the EOQ method: Parameter identification: Annual demand: The total amount of inventory requested for one year. Order costs: Costs associated with processing and issuing orders, such as administration, shipping, and ordering costs. Storage costs: Costs related to inventory storage, such as warehouse rental costs, insurance, and inventory control costs (Musthafa, 2017).

To determine the ideal amount of raw material inventory, so that the supply is not too much and not too little, a method known as the Economic Order Quantity (EOQ) is needed, (Akhmad, 2018; Fadhy, *et al.*, 2018). By using EOQ, it can improve the inventory management process and sufficient inventory stock. Companies that have the ability to maintain inventory standards can prevent running out of goods and maintain the smooth operation of the company (Ibnu, 2021).

Preparation of raw materials, installation of keel, installation of boat walls, installation of frames, manufacture of decks, work on rooms, work on sails, installation of engines and installation of rudders, then launching of the ship is a stage in the process of making a pinisi ship (Akhmad, 2020). Pinisi ships can contribute to the nation and state in three pillars. The cultural pillar, the economic pillar, and the political pillar (Triantoro & Nurcahyo 2016).

The pinisi ship, which is the pride of the Bugis-Makassar tribe, the Indonesian nation, even at the world level, is now facing various problems, especially the rare wood raw materials, ironwood, teak, and bitti wood, which are increasingly expensive and difficult to obtain, so they have to be imported from outside South Sulawesi.

III. RESEARCH METHODS

This research was conducted in Ara Village, Bira Village,

Tanah Beru and Tanah Lemo Villages, Bonto Bahari District, Bulukumba Regency, South Sulawesi Province, Indonesia. The area was chosen because it is the center of the pinisi shipbuilding industry in South Sulawesi Province. Data was collected through in-depth interviews with key informants consisting of pinisi boat entrepreneurs, panrita lopi (experts in making pinisi boats), and community leaders. The data collected includes types of wood raw materials used in the manufacture of pinisi boats, and types of non-wood materials.

The data analysis technique in this study uses qualitative analysis by adopting the model (Miles & Huberman, 1984; Moleong; 2010.), suggesting that the activities in qualitative data analysis are carried out interactively and continuously until complete, so that the data is saturated. Data analysis techniques in research include three activities, namely:

1) Data Reduction, Data reduction is summarizing, choosing the main things, focusing on important things, looking for themes and patterns. Thus, the data that has been reduced will provide a clearer picture and make it easier for researchers to carry out further data collection and look for it if necessary. This process lasts as long as the research is carried out, from the beginning to the end of the study.

2) Data Presentation is a collection of structured information that gives the possibility to draw conclusions and the next action. The form of presentation includes narrative text, matrix, graph, and network (network), and charts.

3) Drawing Verification Conclusions (Conclusion Drawing Verification) Actions taken after the end of data collection are drawing conclusions with verification based on all things contained in the reduction and presentation of data.

IV. RESEARCH RESULT

Material inventory control is a management process that involves monitoring and managing material inventory in an organization. The purpose of material inventory control is to ensure the availability of the right materials at the right time, optimize the use of inventory, and avoid excess or shortage of inventory that can have a negative impact on the company's operations.

In the pinisi shipbuilding industry in Bontobahari District, Bulukumba Regency, the types of materials used can be divided into two groups, namely wood and non-wood materials. Therefore, the focus of the study in this study is the control of raw materials, especially wood used in the pinisi ship industry in Bulukumba Regency.

A. Figure Types of Raw Materials Used

Wood Raw Materials Wood is the main component in the process of making pinisi boats and at the same time determines the quality of the pinisi boats that are produced. The results of the interviews with the Pinisi and Panrita Lopi boat entrepreneurs said that selecting high-quality wood was the main prerequisite if they wanted to produce a ship that was strong, tough, and sturdy in navigating the oceans.

Types of wood commonly used in the manufacture of pinisi boats in Bontobahari District, Bulukumba Regency include (1) Ulin wood (iron wood), (2) bitti wood, (3) teak wood, (4) mahogany wood, (5) kandole wood or punaga wood, (6) pude wood. (7) white teak. The seven types of wood are described.

1) Ulin wood/iron wood (*Eusideroxylon zwageri*)

Ironwood or commonly called ironwood is one of the well-known and strongest types of wood in its habitat in the forest. The ironwood tree is a type of forest plant that can reach 50 m in height and up to 120 cm in diameter. Ironwood tree trunks grow straight and up to 4 meters in diameter. The outer skin is reddish brown to dark brown, 2-9 cm thick. The results of interviews with pinisi boat entrepreneurs found that this type of wood, in the last 10 years, could only be obtained from Southeast Sulawesi Province.

Panrita Lopi said that the strength and sturdiness of a ship is largely determined by how much ironwood is used in shipbuilding. The higher the percentage of ironwood used in the shipbuilding process, the higher the quality of the ship. However, the higher the percentage of ironwood used, the higher the price of the ship.

Therefore, the amount of ironwood used greatly determines the quality of the ship made, the more expensive, the higher the quality of the ship, because it uses a lot of ironwood. The use of ironwood for the construction of cruise ships, generally uses ironwood for more than 50 percent of the total use of wood in shipbuilding, while for fishing vessels and types of freight/cargo vessels, the use of ironwood is generally below 40 percent.

2) Bitti wood

Bitti wood can be found in several places such as in Bulukumba, South Sulawesi Province, bitti trees are planted as community forests. The spread of this plant in South Sulawesi is in Kab. Bantaeng, Enrekang, Bone, Bulukumba, Sidrap and Selayar (Akhmad *et al.*, 2022).

The results of interviews with ship entrepreneurs and Panrita Lopi said that the raw material for bitti wood is widely used as ship hulls and floor boards for pinisi boats in Bulukumba Regency. In the process of making a pinisi boat. Bitti wood is a very important type of wood that serves as deck boards and ivory. Bitti wood is important because it is used to make deck boards and ivory.

The results of interviews with pinisi boat entrepreneurs and lopi panrita, it was found that the use of bitti wood in the manufacture of pinisi boats can reach 10 to 15 percent for cruise ships, while for cargo ships and fishing boats it can reach 25 percent.

3) Teak wood

Teak is a high quality wood and is produced from trees that are more than 80 years old. Teak trees can grow for hundreds of years, in Indonesia. Teak trees are classified as high quality wood, strong and durable for making furniture. Teak trees can grow in a really dry climate, but not too long.

The results of interviews with pinisi boat entrepreneurs and panrita lopi, said that the manufacture of pinisi boats in Tanah Lemo sub-district, Tanah Beru sub-district, Ara village and Bira village, Bontobahari sub-district, Bulukumba district, teak wood is generally obtained from local teak in the sense that it is obtained from Bulukumba Regency, Sulawesi Province South, and as obtained from Southeast Sulawesi Province. It was also obtained that the composition of the use of finished wood in the manufacture of cruise ships can reach 45 percent of the total use of wood, because cruise ship buyers generally want the interior of the ship, especially the rooms and everything made of teak wood. Meanwhile for cargo

ships and fishermen, the use of teak wood is relatively small, only around 10 to 15 percent.

4) White Teak Wood (*Gmelina arborea* Roxb)

This white teak tree can reach 45 m in height with a branch-free length of 15-20 m. Stem shape round and straight. The leaves are round and slightly hairy. The shape of the leaves is ovate (ovatus), the widest part is under the middle of the leaf blade with a yellowish green leaf color. In the manufacture of pinisi boats in Bontobahari District, Bulukumba Regency, in the last 10 years the use of white teak wood has continued to increase, due to its much cheaper price compared to yellow teak wood. Because of that white teak wood is widely used to make room walls, especially for cargo ships and fishing boats. The results of interviews with pinisi boat entrepreneurs and *panrita lopi*, said that the manufacture of pinisi boats in the Tanah Lemo sub-district and Ara village, Bontobahari sub-district, Bulukumba Regency, teak wood was generally obtained from local white teak wood from South Sulawesi Province.

5) Mahogany

Mahogany wood has a characteristic pink and dark red color indicating that it is more than 25 years old. This wood is white, the wood grain is straight. The wood is easier to cut into the desired shape. Mahogany wood material has never lost its popularity in matters of supply of building raw materials, including in the manufacture of pinisi boats. Wood is needed for support, construction, and furniture material. This material is also compatible with a variety of building styles. In the manufacture of pinisi boats, in Bontobahari District, Bulukumba Regency, mahogany wood is generally used for floorboards and rooms and beams, for use on cargo ships and fishing vessels.

6) Kandole wood (*Diploknema oligomera*)

Economically, kandole is known as a commercial timber plant. Muslich and Rulliaty (2016) state that kandole wood is classified as durable class I. In the manufacture of pinisi boats in Tanah Lemo sub-district, Tana Beru, Ara village and Bira village, Bontobahari sub-district, Bulukumba district. Kandole wood is widely used to make ship walls as a substitute for ironwood or ironwood, especially for cargo ships and fishing vessels. Due to the extraordinary strength of this wood, this wood is considered to be able to replace ironwood as ship walls. Besides being used as a substitute for iron wood, kandole wood is also used as ship pegs. Even its position as a peg material in the manufacture of pinisi ships is almost irreplaceable. The results of interviews with pinisi boat entrepreneurs and *panrita lopi*, said that the manufacture of pinisi boats in Bontobahari District, Bulukumba Regency, kandole wood was obtained from the Provinces of South Sulawesi and Southeast Sulawesi Provinces

7) Pule wood

The pule tree has the scientific name *Alstonia scholaris*. The pule tree has very hard wood, so it is widely used for industrial needs. The Pude tree is a type of tree used for reforestation, because of its shady leaves and towering trees.

The results of interviews with pinisi boat entrepreneurs and *panrita lopi*, said that the making of pinisi boats in pule wood was generally obtained from Bulukumba Regency and Sinjai

Regency, Pude wood was generally used as curved beams for pinisi boat bones.

B. Non-wood (non-wood) materials

In making pinisi boats, apart from wood, which is the main material for making pinisi boats in Bonto Bahari District, Bulukumba Regency, other materials are also used, such as: 1. Steel plate 2. Bark which is commonly called *barut* (local term) as an adhesive on the seams shipboard wall. 3. Bolts and nuts 4. Glue, 5. Putty 6. Paper abrasive, 7. Base paint and color, 8. Sail cloth 9. Rope 10. Anchor rope 11. Tima, commonly used as ship ballast 12. Radio and Navigation Equipment 13. Steel Pipes 14. Pumping Machines 15. Ship Anchors 16. Ship Engines 17. Generator Engines 18. Electrical equipment for ships, ranging from electrical cables, sockets/fittings, balloon lights and so on such as the use of electricity in the household, 19. Kitchen equipment such as sinks, gas stoves, plate holders, refrigerators, and preferably kitchen equipment in households in general. 20. Bathroom equipment, such as closest, water cramps and others 21. Bedding, such as: bed, mattress, pillow, air conditioner, fan, mirror, and other bedding equipment such as bedding in the household or room at the hotel.

This non-timber material is used when the stages of making the pinisi ship are almost complete. The ship's walls and floors were smoothed using scouring paper and a smoothing machine. After that, it is passed and then painted on the base, then painted in the color according to the taste of the ship's customer. Likewise steel plate and fiber, as well as layers of cloth and nylon rope, as well as ladder ropes, anchors, electrical cables, paralon pipes, as well as installation of generator engines and ship engines. To buy supporting materials can be obtained by 1) buying supporting materials at the nearest shop (local), 2) buying supporting materials in other cities.

Most of the auxiliary materials used to make the pinisi boat were purchased at the nearest shop in Tanah Beru Village, Bontobahari District, Bulukumba Regency, such as yarn, paint, yarn, air conditioning, glass, foam rubber, sail cloth. The results showed that non-timber materials for pinisi ships, said that generally entrepreneurs buy raw materials of low value, generally purchased at the nearest shop nearby, while materials of high value such as ship engines and generator engines are purchased in Makassar, Surabaya or Jakarta.

C. Procurement and Control of Raw Materials

1) Procurement and Control of wood Raw Materials

The results of interviews with pinisi ship entrepreneurs found that pinisi ship entrepreneurs in Bontobahari District, Bulukumba Regency, only ordered raw materials, especially wood, when they already had contracts with ship buyers. Therefore, the entrepreneurs of the pinisi ship made quite a lot of raw material stocks in the *bantilang* (warehouse for storing wood).

After an agreement was reached between the buyer and the seller of the pinisi boat in Bontobahari District, Bulukumba Regency. Baka the pinisi boat entrepreneurs contacted the wood suppliers both in Bulukumba Regency and in Southeast Sulawesi Province. To prepare the wood needed to make a pinisi boat. From the results of interviews with the entrepreneurs, it can be seen that the number of orders they make is always adjusted to the amount of wood raw material

needed for the ships to be made. The number of wood orders is calculated based on their experience in making boats.

Therefore, consideration of quantity and price is very much from the agreement between the supplier and the ship entrepreneur. Not a few ship entrepreneurs immediately order all the wood needed to build boats. This is done with the consideration that workers in Bontobahari District can leave their jobs if they run out of raw materials within one week, by demanding employers fulfill their rights according to the work agreement, and they can accept other jobs. The results also show that the inventory control system model applied in the management of raw materials, although it does not use an understanding of ABC theory, the wood raw material inventory control model tends to use the ABC model, where those that are considered expensive are stored properly in Bantinlang (Wood Warehouse) while those that are considered expensive are easier values are usually left stored outside the Warehouse.

2) Procurement and Control of Non-timber Raw Materials

The results of the study showed that the procurement of non-timber raw materials, such as paint and the like, was obtained at the nearest shop, in this case it was purchased in the city of Bulukumba when needed, and generally the entrepreneur made supplies for non-timber raw materials. Usually, the supply for the needs of use is a maximum of 1 month, and if the supply is running low, for example, only 3 days of use, then a repurchase is made. While purchasing ship engines and generator engines for ships, it is done by first making an agreement with the buyer of the ship, and most of the purchases are handed over to the ship owner.

D. Problems of Procurement of Wood Materials

The supply of wood raw materials is an important and main thing in the pinisi ship industry, both in terms of quantity and quality. The limitations of wood raw materials and the high cost of raw materials have become a problem for these entrepreneurs. In fact, the need for wood raw materials in the manufacture of pinisi boats is above 90 percent of all the required materials used in the manufacture of pinisi boats.

As the availability of wood raw materials decreases, it is estimated that in the next 10 years, pinisi ship entrepreneurs in this area will find it increasingly difficult to run their business.

For this reason, the local government has taken steps to anticipate the scarcity of wood raw materials by planting ironwood, teak, and bitti wood seeds in the area around the Pinisi boat building. Ship entrepreneurs and communities wishing to grow teak, iron and bitti wood can submit requests for seeds to the regent. The Regent has provided these seeds free of charge as proof of the government's seriousness, sincerity and real efforts in overcoming the scarcity of wood raw materials, the government has even planted 200 seedlings of trees consisting of iron wood, teak wood and bitti wood in Tanah Beru Village on opening of the pinisi festival in Bira in early September 2020.

The results of the study show that the problems faced by traditional shipbuilding entrepreneurs in Bulukumba, South Sulawesi today are the increasingly expensive and limited wood raw materials. The availability of wood and the high price of wood are the main problems in making pinisi boats.

It was found that the availability of iron wood was increasingly scarce because it had to be imported from Southeast Sulawesi, while bitti, kandole and teak wood were still imported from within South Sulawesi. Even though it feels like the type of wood is starting to be lacking. Increasingly expensive and rare, including red teak, some entrepreneurs are forced to use white teak in shipbuilding. The results of interviews with pinisi boat entrepreneurs also showed that supplies of both types of iron wood and red teak wood were often lost in the market. Even though at the same time it is needed in the shipbuilding process. In particular, iron wood imported from Kalimantan tends to be increasingly difficult to obtain, even though the need for iron wood is very much needed, because this wood determines the quality of the ship. The more ironwood or ironwood used in the shipbuilding process, the stronger, sturdier and tougher the ship in question is.

V. CONCLUSION

A. Conclusion

Procurement of wood raw materials by pinisi boat authorities in Bontobahari District, Bulukumba Regency, South Sulawesi Province, began when they already had contracts with ship buyers. Therefore, the entrepreneurs of the pinisi boat made a large supply of raw materials in the bantinlang (warehouse for storing wood). The amount of raw materials purchased is based on considerations, including (1) the amount of raw materials purchased based on the needs for making the pinisi boat, according to the size of the ship ordered, (2) the price of wood raw materials on the market, and (3) the availability of wood raw materials on the market. although the pinisi boat entrepreneurs do not understand the ABC control model, they have basically implemented the ABC control model, where high-value wood species are stored neatly in the wood warehouse) while those of easier value are usually left stored outside the warehouse. In this case, non-timber supplies that are of high value they really take good care of, and store in a safer place.

B. Suggestion

Empowerment of pinisi boat entrepreneurs needs to be done to provide an understanding of inventory control models and systems that can minimize the cost of supplying raw materials, both wood and non-timber raw materials. In the manufacture of pinisi boats in Bontobahari District, Bulukumba Regency, South Sulawesi Province. With this empowerment, it is hoped that entrepreneurs can use an inventory control model that can minimize inventory costs in making pinisi ships.

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