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Technological Adaptation in the Transformation of Traditional Boats in the Spermonde Archipelago, South Sulawesi

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Abstract

Although traditional boats and boatbuilding techniques in Indonesia have drawn scholarly attention, attempts to analyze the technological development in wooden boatbuilding have been rarely made. After the introduction of modern technologies such as engines and western hulls in the 1970s, wooden boats have experienced rapid technological changes in which a combination of traditional and modern techniques can be observed. Based on a new typology of present boats in the Spermonde Archipelago, one of the important maritime regions in Indonesia, this study analyzed the transformation process of wooden boats in the second half of the twentieth century, in which modern technology played an important role, in order to understand the technological adaptation of the local people to the changing circumstances. The study was conducted through literature surveys, interviews with local people, and observation and measurements of the boats, and revealed that the modern technologies were effectively adopted and combined into the local people's existing knowledge system.

Keywords: boatbuilding technology, local knowledge, Spermonde Archipelago, South Sulawesi

I Introduction

Traditional boats of South Sulawesi, or "Bugis *prahu*" which often appear in western literature, have attracted the academic interest of both Indonesian and foreign scholars. However, most of the studies were conducted on the basis of literary sources and those based on direct observation were very limited. Collins who had local people build a *palari* type schooner in 1935 at Bira is a good example of providing detailed information on the structure of the type [Collins 1992]. Pelly [1975] who conducted his research on the social inheritance of boat craftsmanship of the Ara people succeeded to provide us with the *siporari*, the basic pattern of planks and frames of the traditional boat. Horridge [1979; 1985; 1986] discussed the Bugis *prahu* in details with wide perspectives containing legend, supernatural belief, rituals of boat building, routes and operations of trading, and

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technical features such as rigging and steering installation styles, hull structure, and plank and frame patterns. Hawkins [1982] described different types of the Indonesian *prahu* in detail and touched upon the older types of existing *prahu* in the 1970s. Detailed and comprehensive explanations on the evolution of the Bugis *prahu*, especially those of the *paqdewakang* type, are found in Horridge [1979] with a chapter specially dedicated to the topic.

Although these are valuable achievements in the study on traditional boats in Indonesia, research on boats and boat building technology has been rarely conducted despite the fact that the technological development has taken place in various ways since the 1970s. The time period from the 1970s to the beginning of the twenty-first century is an era of the most rapid technological changes that occurred in wooden boatbuilding in Indonesia. Traditional hulls were modified and new types of boat emerged under the influence of motorization. Diversity of the present boats in Indonesia is a result of such transformation.

In order to shed light on the development of boats and to understand the technological adaptation of the local people in this period, this study was conducted in the Spermonde Archipelago, which is a typical maritime region in Indonesia, by analysis of the process of technological transformation based on the typological classification of existing wooden boats.

II Study Site and Methods

"Spermonde" is a colonial name given to a group of islands distributed offshore of the southern part of the west coast of Sulawesi. In a colonial map of "Celebes" made in 1688 by Johannes Blaeu, the islands located northwest of Makassar were named "*Spaeramondij*" [Pelras 2006: 172]. However, the name of Spermonde was never used by local inhabitants. Even at present they generally identify themselves as To Libureng, Pallibureng, Pallibu-libu [BUG] Tu libukang or Tu Liukang [MAK][1] which simply means "islanders." Under the administration of South Sulawesi Province, the islands are divided into two *kecamatan* (districts): Kecamatan Liukang Tupabbiring consisting of 43 islands and belonging to Kabupaten Pangkajene dan Kepulauan (Pangkep Regency), and Kecamatan Ujung Tanah, consisting of 9 islands and belonging to Kota (Municipality) Makassar. In a map produced by the National Geographic Society [1996], the group of islands is named the Pabbiring Islands.

The Spermonde Archipelago is a scattering of 52 islands occupying an area of about 1,400 square nautical miles[2] extending from the west coast of South Sulawesi to the Makassar Strait (Fig. 1). The archipelago is inhabited by about 35,000 people, and they

1) [BUG]=Bugis language, [MAK]=Makassar language
2) 1 nm= 1.852 km; 1,400 nm^2= 4,800 km^2

live on 37 islands in total. It is situated on a shelf with many reefs, shoals, and sandbanks. The depth of the shelf commonly varies from 10 to 50 meters and the deepest point reaches up to 77 meters [Hydro-Oceanography Services of Indonesian Navy 2005]. The islands near the coast are at a relatively constant distant from each other and the outer islands are situated a little far away from each other.

With regard to the use of boats as an important means of livelihood, the history of the Spermonde Archipelago can be traced back to the age of petit kingdoms such as Siang, and Gowa which deserves a page in the history of boats in South Sulawesi in the fifteenth to the early seventeenth centuries.[3] The archipelago, particularly in the history

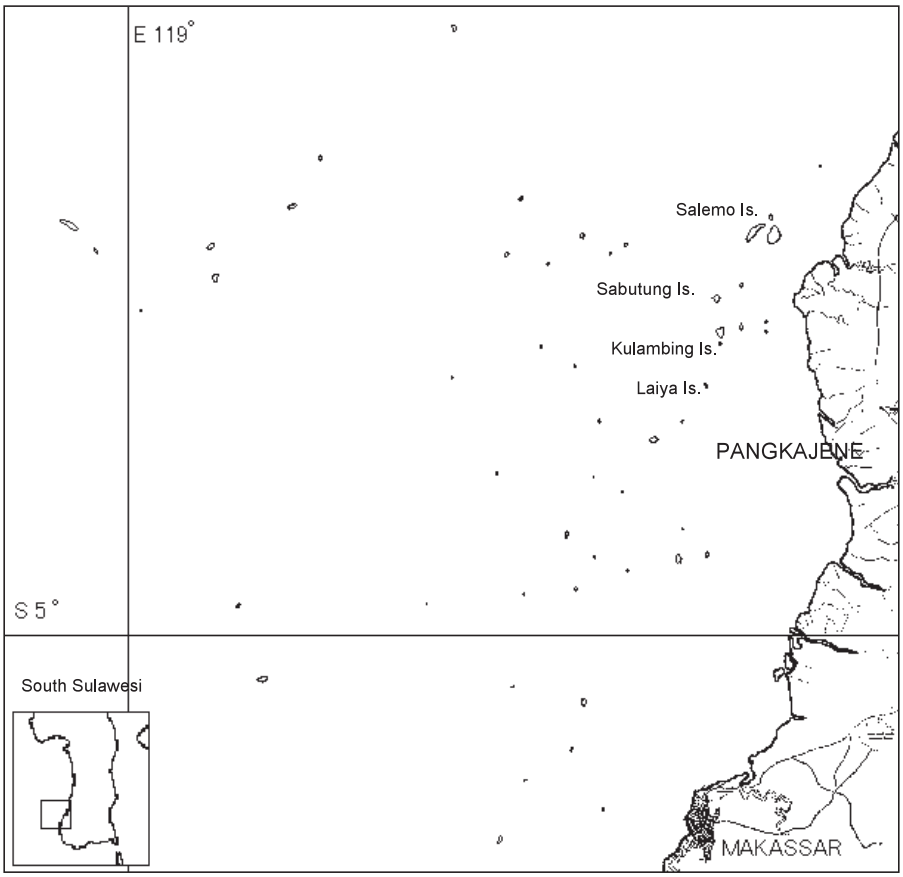


Fig. 1　The Spermonde Archipelago
Source: The first author has reproduced from a more detail sea map [Hydro-Oceanography Services of Indonesian Navy 2005].

3）Siang (modern Pangkajene) in the late fifteenth to the first half of sixteenth century [Pelras 1996]; Gowa-Tallo (modern Makassar), sixteenth to seventeenth century [Mattulada 1991].

of these coastal kingdoms, occupied a significant position as a provider of natural resources for trading, and, in times of turmoil, a haven for political refugees as well as places for execution or exile [Andaya 1981]. In later times, when Malay and Buginese traders began to inhabit the islands in the early eighteenth century of the Dutch colonial era, the trading activities on some of the islands such as Laiya and Salemo grew as a black market behind the formal trading controlled by the Dutch trading company, the VOC[4] [Knaap and Sutherland 2004].

The study was intermittently conducted in the period from October 2004 to March 2007 mainly in Kulambing, Sabutung, Salemo, and Laiya by applying various kinds of surveys; literature surveys, interviews to local people, and observations and measurements of the boats. Based on the results obtained from these surveys boat evolution in the earlier period in South Sulawesi is re-examined through literature, while recent development of the present boats is traced back through interviews, investigation of miniature models and photographs, and observation of the boats built in different stages of their development.

III Results and Discussions

III–1. *Boats in the Spermonde Archipelago*

Mainly engaged in fishery to earn a living, the islanders use various fishing methods such as line fishing, gillnet, fish trap, small- and middle-scale trawl, purse seine, lift net, reef-fish diving with harpoon, *teripang* (sea slug) gathering, and some destructive fishing methods. All require them to use various types and sizes of boat. On several islands, such as Sabutung, Kulambing and Laiya, those who engage in trade have developed their cargo ships to carry sacked cargo such as cement, rice, and salt and long-stem cargo such as timber. Their dependency on the mainland Sulawesi for logistics and education requires a type of boat for public transportation, carrying passenger and goods, which connects an island with ports or towns on the mainland.

In other words, boats are the backbone of their social and economic activities. The importance of boats is confirmed by the ratio of boat number to population that is estimated 1 : 10. It means that there is one boat available for every 10 persons or, if the average number of family member is five, one out of two families possesses a boat [Central Bureau of Statistics, Pangkep Regency 2005].

Table 1, which is obtained from the Fishery and Marine Services of South Sulawesi Province [2003], illustrates the number of boats in Pangkep Regency according to fishing methods and propulsion from 1997 to 2003. These data present only the number of "recorded" fishing boats of small and medium sizes using some major fishing and

4) Verening de Oost Compagnie

Table 1　Number of Boats of Major Fishing Methods and Propulsion in Pangkep Regency, 1997–2003

Year	Fishing Methods			Propulsion Methods		
	Purse seine (*pagae*)	Shrimp gillnet (*papuka*)	Set gillnet (*papuka*)	Non-powered medium size plank boat	Outboard engine outrigger	Inboard engine 0–5 GT (*jolloroq*＋*motoroq*)
1997	268	208	547	297	239	413
1998	264	190	649	274	347	349
1999	224	192	837	277	347	314
2000	167	—	940	277	347	547
2001	222	—	941	281	474	526
2002	222	—	923	251	401	475
2003	134	—	989	—	—	—

Source: [Fishery and Marine Services of South Sulawesi Province 2003]
Note: This table is extracted from more complicated tables; only categories with rather complete and continual data entry are picked.

propulsion methods.

The office of Biringkassi Port Administration in Pangkep Regency registers 1,085 boats within the period of 2003 to 2006. Although the record of registration is quite valuable data, including name of owner, name of boat, place of origin, length (L), breadth (B), and height (H) of the boat and brand name and capacity of engine, it lacks data on boat types. The boats that are registered within the range from 1 to 120 GT (Gross Tonnage), divided into two categories. Boats up to 7 GT number 1,001 with a total gross tonnage of 2,003 GT while boats more than 7 GT number only 84 with a total gross tonnage of 2,482 GT [Transportation Service of Pangkep Regency 2006]. Many cargo boats of sizes greater than 100 GT are registered at other ports and many small boats remain unregistered due to the boat surveyor limitation and the remoteness of the scattering islands. The numbers presented above are estimated to be only about one third of the real figures.

Boats in the Spermonde Archipelago are distinct and similar to boats of other regions in several ways. Some boat types, such as the *lepa-lepa* (dugout canoe) and *bilolang* (outrigger boat), are indigenous as they are in the Austronesian waters. Some were genuinely invented, such as the *jolloroq, pagae*, and *paes*, out of the urgent need of the local fishermen and, in this way, they are distinct to other boats that may perform similar functions in other regions. Boats of these types with their characteristics may be encountered at a remote place outside the archipelago with a certainty that they are owned and operated by fishermen from the Spermonde. Wooden motorboats and cargo ships exist commonly in Indonesia, and in the Spermonde Archipelago, their specific characters that derived from their transformation history make them different. Motorboats are called *motoroq* and cargo ships are called *pangangkuq* or *lambo*-type PLM (*perahu layar motor*/motorized sailing ship). Description and size of each boat type will be given later in this chapter.

III–2. *Boatbuilding in the Spermonde Archipelago*

There are three necessary requirements for the existence of boatbuilding activity, namely boatbuilding technology, boat demand, and availability of building materials. Tanahberu in Bulukumba Regency, one of the prominent wooden boatbuilding centers in the world, for example, is revived by these requirements. It inherits the most advanced wooden boatbuilding technology through the skillful craftsmanship of the local people, the Konjo speaking people of Ara and Lemo-lemo villages.[5] Boat orders to this boatbuilding village come from within the region, surrounding areas, different parts of Indonesia and the world. Building materials are partially supplied by local and regional traded-timber distribution in Eastern Indonesia [Salam 2005].

In Spermonde, a high demand for boats from islands within the archipelago seems to be the strong factor that attracts the availability of the other two requirements. The archipelago originally had the semi-planked boatbuilding technique but it needs the Konjo's planked-boat technique, which is the most advanced wooden boatbuilding technology in Indonesia. Most of boats are built by the Konjo craftsmen who stay, by unit of families, almost permanently at several islands and sporadically at islands that need their services. When a job that requires more hands is obtained, the head craftsman, usually also the head of the family, who is called "*punggawa tukang*" or "*punggawa*," summons his people from their village Ara or Lemo-lemo. These people have been providing boats and boatbuilding technology to traders and fishermen in the archipelago since the seventeenth century, when they served the Kingdom of Gowa and Tallo as boat builders [Andaya 1981].

The development of traditional boatbuilding technology in the Spermonde Archipelago is characterized by the local and the Konjo techniques, and the assimilation of both techniques. Further, it is dictated by practical, functional and aesthetical requirements of the desired boat, and determined by building materials.

III–2. 1. *Local Technique*

Local craftsmen possess a semi-planked boatbuilding technique which they used to build their outrigger canoe type called *bilolang*, a small boat that was traditionally used for fishing and trading, and nowadays generally used for one-man fishing using lines or nets. The semi-planked boatbuilding technique is indigenous to the Austronesians. It is a wide spread technique used to enlarge a dugout canoe into an outrigger canoe with sail(s) by the addition of one or two lines of side planks before installation of the outrigger [Haddon and Hornell 1997]. Until the 1990s this technique was still used by the local craftsmen to build *bilolang* and, later, also the *jolloroq* types.

After decades of interaction with the Konjo boat builders, local craftsmen have

5) Konjo is a Makassar language dialect used at some areas in southern part of South Sulawesi such as in Bulukumba Regency.

managed to learn the plank-boatbuilding technique by imitation and use the adopted technique to build their *jolloroq* and other types of small motor boats.

III–2. 2. *The Konjo Technique*

The plank-boatbuilding technique of the Konjo people is distinct from the western technique. The difference basically lies in the sequence of building. In the Konjo technique, planks are initially fixed to a keel until they form a considerable width of shell to put ribs on. The molded shape of the shell determines the ribs curvature. On the contrary, in the western technique ribs are initially arrayed to a keel upon which the shell planks are fitted to form the shape of the hull.

The Konjo boatbuilding technology is wide-spread in Indonesia since Konjo craftsmen go to all shores of the country, taking their skills and technique to build boats and ships and get closer to the demand and material source. The Konjo technique, including the one used in the Spermonde Archipelago, is a result of many innovations out of a combination of the inherited traditional technique and knowledge of modern technologies. There are some Konjo innovations invented in this archipelago under the influence of the changing circumstance of local needs and restrictions.

III–2. 3. *Wood Material*

Wood materials, used by the local and Konjo craftsmen for boatbuilding, were characteristically different due to the difference in their boatbuilding technique. Local craftsmen used a tree trunk, hollowed-out to produce a dugout, timber for additional side planks, especially for the *bilolang*, and bamboo for the outrigger floats and mast. The Konjo craftsmen with their planked-boat technique need a strong and long timber for the keel, straight beams, and crooked timber for the frames, and suitable planks that can be curved by shaping or bending. Ultimately, when logs became difficult to purchase and local boat-builders started to adopt the Konjo technique to build their *jolloroq*, their needs for wood materials become similar.

Local boat craftsmen traditionally use the trunk of breadfruit trees (*Artocarpus altilis*), which can be found throughout the islands, to make dugouts used for row-boat and the lower part of their semi-planked boat, the *bilolang*. For additional planks they use timber of Kalimantan origin such as *meranti* (*Shorea* sp.) which can be purchased from the timber-trading islands of Sabutung, Kulambing or Laiya, or occasionally, mostly in the west monsoon, found in the form of logs drifting in the sea.

Until about the 1950s wood material used by the Konjo craftsmen for boatbuilding in the islands, mainly *bitti*[6] (*Vitex cofassus*) and teak (*Tectona grandis*), were supplied from the mainland Sulawesi promptly in front of the archipelago and wood material for boats built under the orders of the islanders at the Konjo home-villages, i. e. Ara, Bira, Tanah-

6) Other local names: *katondeng* [BUG], *holasa, gofasa, kau mohute* [BON]＝Bonerate Language

beru, and Lemo-lemo, were taken from forests in the hinterland of Bulukumba Regency. From the 1950s to 1970s, boats, ordered by the islanders, were also built on shores where wood sources were plenty such as in Tanahjampea Island in the Flores Sea.

In the 1980s, ready-made dugouts called *batangan*, which were specially made for the lower part of the semi-planked *jolloroq*, were sold well in the Spermonde Archipelago. But the supply of *batangan* gradually decreased in the 1990s and in the mean time the supply of ironwood (*Eusideroxylon zwageri*) was plentiful. Ironwood was initially used mainly for housing and public utilities such as bridges and wharves, but the scarcity of the *batangan* had dictated the local boat craftsmen to adopt the Konjo's planked-boat technique and use ironwood as the main material for their *jolloroq*.

Although the Bornean ironwood has been imported to South Sulawesi since the mid-nineteenth century, it has been used for some important parts of the boat (other than the *bilolang* and *jolloroq*) such as the keel and engine foundation only since the 1980s and only since the 1990s ironwood has become the main material for boatbuilding in the archipelago. Ironwood reached the peak of its importation to South Sulawesi in the decades of 1970s and 1980s when many concessionaries started to exploit the forest of Kalimantan [UNEP-WCMC 2006]. The decades which timber traders of the Spermonde Archipelago remember as the era when "ironwood was afloat across the sea," implying a large flow of the ironwood supply.

In South and West Sulawesi, the ironwood is at great demand for house construction, but the highly prized wood is not found. Most of the lowland areas of southwest Sulawesi are densely populated wetland that experience frequent flooding. Traditional houses are preferably constructed on strong and water resistant poles, for which the ironwood is well suited. It is a Class-I timber[7] for durability and strength, these characters are also suitable for boatbuilding material. It is far stronger and more durable than the *bitti* and teak.

Islands with trade and shipping activities have good reason to import ironwood. They have no self-sufficient timber source and their trade relationship with Kalimantan has been an easy way to purchase the ironwood, initially for private use, and eventually as a commercial commodity. The various and broad range of uses of the wood have stimulated a high demand, thus increasing the volume of trade. The demand was at highest peaks during the 1970s and maintained a quite stable supply until about 1997 when the economic crisis caused its steady decline to the present, as it was observed until 2006.

III–3. *Typology and Classification*

Wooden boats in Indonesia generally are not listed in the government official classifica-

7) According to a *List of the Indonesian Commercial Timber* issued by Forestry Research and Development Agency (FORDA), Indonesian Ministry of Forestry [n. d.].

tion due to the reasons that wooden boats fail to fulfill the construction and seaworthiness requirements necessary for the classification. Wooden boats are built without technical planning and drawings and lack a number of design calculations concerning stability, strength, etc. The government authority, i. e., Department of Transportation, classifies wooden boats into categories according to hull form and propulsion regardless of their specific hull structure and function that determines type. Apart from the general boat classification, i. e. fishing, cargo, and passenger, wooden boat is officially classified into: PL (*perahu layar*/sailing ship), PLM (*perahu layar motor*/motorized sailing ship), KM (*kapal motor*/motor-ship), and KLM (*kapal layar motor*/motor-ship with sail). Port custom and tax regulations are applied upon the boats based on this classification.

During the last three decades of the twentieth century, new technologies, fishing methods, and functions of boats have been introduced to the Spermonde Archipelago. Responding to that situation, traditional boats have undergone a transformation resulting in the emergence of a variety of boat types. In order to analyze the transformation, it is necessary to have a reliable typology and classification. Typology is a study of types which in this research is articulated as a way or method to define types of boat, and classification is the assignment of boat types into groups within a system of categories distinguished by hull structure. Each type is associated with a variety of functions and fishing methods (see Table 2).

Boat classification in the Spermonde Archipelago is established as a classification of wooden boat because almost all boats and ships operating in this archipelago are made of wood. Only recently a small number of small single-outrigger canoes made of glass-fiber have been introduced to some islands in the archipelago, but the presence of the material is ignorable and, besides, the glass-fiber canoe can be classified morphologically into the *bilolang* type.

Based on their hull structures, boats are classified into dugout, semi-planked boat, and planked-boat categories. This classification is useful in observing boat transformation because essentially the transformation is manifested in the changes of structure and form of the hull.

The dugout is the simplest form of boat; generally known as *sampan* in Indonesia, and also known as *lepa-lepa* in the Spermonde Archipelago. A dugout which is made for *lepa-lepa* is different in design to a dugout made for the lower part of a *bilolang* and to a *batangan* of a *jolloroq*. The length of the dugout ranges from 2 to 4 meters and its breadth ranges from 40 to 50 centimeters. The dugouts are used for on-shore/near-shore activities such as fishing and as ship-to-shore commuter. They are also used as recreational boat for playing and racing in sea-festivals or celebrations, such as the *mandi safar* festival[8] and the Independence Day.

8) Four Wednesdays in the month of Safar of the Islamic calendar, when people, especially youngsters, throng to the sea for pleasure by swimming and eating.

Table 2 Classification of Boat in the Spermonde Archipelago

Hull Structure	Type (size)	Fishing Method (f) or Carrying Function (c)
Dugout (canoe)	*Lepa-lepa* (small)	Ship-to-shore commuter (c) *Pekang*/Line & hook (f)
Semi-planked boat	*Bilolang* (small)	*Pekang*/Line & hook (f) *Puka*/Gillnet (f)
Planked boat	*Jolloroq* (small)	*Pekang*/Line & hook (f) *Puka*/Gillnet (f) *Pete-pete*/logistic boat Private vehicle, commercial passenger & goods (c) *Maqbilolang*/fish trading (c) Dive fishing
	Motoroq (small)	*Pekang*/Line & hook (f) *Puka*/Gillnet (f) Private vehicle, commercial passenger & goods (c) *Trol*/Trawl (f) *Bubu*/Fish trap (f) Dive fishing (f)
	Pappalimbang (medium)	Passenger & goods (c)
	Bagang (medium)	*Dari*/lift net (f)
	Pagae (medium)	*Gae*/purse seine (f)
	Pacantrang (medium)	*Denreng*/Dragnet (f)
	Paes (medium)	Fish cold storage (c/f)
	Pangangkuq (medium to big)	Cargo (c)

Small boats which have planks constructed over a dugout are placed in semi-planked boat category. The *bilolang* type is the original constituent of this category and *jolloroq* and *bagang*, built in the same way prior to the 1990s, were also in this category. Due to their high and upright sides, hulls of the *bilolang* and *bagang* are unstable without the support of the outrigger(s), or unless they are made into catamarans like the 1970s *bagang* reported by Horridge [1979]. The present *bilolang* has single outriggers with an outboard engine and a triangle sail, used for line and gillnet fishing. Its hull is a double-ended dugout with additional side planks; its breadth is not more than 50 centimeters, and its length rarely exceeds 5 meters.

The hull of a planked boat is a complex structure. Its whole body is constructed by pieces of wooden planks, frames, and beams. Every boat in this category has a keel which is the backbone of its hull construction and ribs are arrayed in a relatively close interval

along the keel. In the *jolloroq* type, the keel replaces the function of the *batangan* in the old semi-planked *jolloroq*.

In the planked boat category boats of all sizes are available: Small boats of sizes up to 7 GT and medium-size ships of more than 7 to 20 GT and ships of more than 20 to 250 GT. In the Spermonde Archipelago, small boats with engines, including *jolloroq*, are generally called *motoroq*, which is a borrowed word from the English "motor" or "motored." Boats of medium and big sizes are referred as *kappalaq*, a word derived from Indonesian word, *kapal*, which means ship. *Kapal* has a different meaning with *prahu* or *perahu*. *Kapal* has the connotation of "modern" that refers to ships with modern hulls and propulsion engines, while *prahu* has the connotation of "traditional" that refers to boats with traditional hulls, although nowadays commonly with propulsion engines.

The small sizes of planked boat category are the multipurpose *jolloroq* and *motoroq*. Both can be used for line fishing, gillnet fishing for crab and fish, dive-fishing, private means of transport, and commercial passenger and goods carrier. The *jolloroq* type is remarkable with its extremely slim body and sharp-double-ended stem and stern (refer to Table 3 for dimension characteristic). With big engine capacity the *jolloroq*, which has length ranges from 6 to 15 meters, can reach the average speed of 15 to 20 knots. It has a slim and hydrodynamic v-shaped hull designed for speed and without outriggers it has low-stability but becomes more stable when running in high speed. Its open hold without a deck and low hull sides make it at risk of water inlets on rough seas. In the Spermonde Archipelago the *jolloroq* is estimated to amount 740 in number. This signifies the important role of the *jolloroq* in the daily lives of the islanders. It is an original design innovation of the islanders to fulfill their need of fast delivery.

The *jolloroq* reincarnates the traditional functions of the *bilolang* as fishing and trading boat. Fish traders use *jolloroq* for *maqbilolang*, i. e., trading activity of buying fish at fishing ground for selling, because of its ability to run in high-speed while carrying heavy load. High-speed is also needed to reach the fishing ground immediately whenever the news of big catch spreads. Likewise, they need to reach a fish-landing port as early as possible to sell the fresh fish. *Jolloroq* is also operated as a *pete-pete*, a logistic boat that escorts a fishing boat that is out for a relatively long period of time, to supply food and fuel and as a stand-by *jolloroq* to deliver the catch to the nearest and most profitable port.

Table 3　Dimension Characteristics of Boat in the Spermonde Archipelago

Dimension	*Jolloroq*	*Motoroq*	*Kappalaq*
L (length, m)	6.0 – 15.0	5.0 – 13.5	7.0 – 23.8
B (breadth, m)	0.70 – 1.55	1.0 – 2.0	2.10 – 7.75
H (height, m)	0.65 – 1.15	0.65 – 1.65	0.65 – 3.80
L/B	6.9 – 13.0	3.5 – 6.9	2.4 – 6.8
B/H	0.9 – 2.1	0.6 – 2.9	1.4 – 5.0
L/H	7.8 – 18.8	3.6 – 17.4	6.2 – 20.0

Note: Figures were obtained by authors' measurement.

Pappalimbang, a mid-size boat, is used for passenger commuting from the islands to the main land. The *pappalimbang* always has a continuous fore-and-aft superstructure leaving the bow for passenger entrance and the stern for anchor and ropes stacks. The steering cabin can be at the front or at the middle right above the engine. Space for passengers is continuous from front to aft, only interrupt by the engine installation that is often without partition. A common *pappalimbang* has no chair for passengers to sit on; they sit facing each other on the floor leaning against the side walls. Some *pappalimbang* have benches along the sides inside the passenger space. Bigger *pappalimbang* have rows of benches facing forward. The roof is flat to stack the excess luggage and sometimes filled with people. On the sides of the passenger boats windows are often small.

Fishing boats of middle sizes operate with bigger fishing gears such as the *bagang* with a lift net, *pagae* with a purse seine net, *pacantrang* with a dragnet, and the *paes* or the cold-storage boats. As indicated above, *bagang* was in the semi-planked boat category until wood material changes and local craftsmen adopted the Konjo technique. The *bagang* is now made according to planked boat technique and falls into this category. The *bagang* is remarkable with its massive outrigger platform. The platform construction must be strong to install the lift net and the huge amount of fish-attracting lamps. The platform is also supported with wire stays hanging from the tops of two masts at the front and aft of the boat. Bigger *bagang*, called *bagang rambo*, is usually equipped with an electric generator to light up the lamps but without propulsion engine. The *bagang rambo* reaches the fishing ground by being tugged by a smaller boat of *motoroq* or *jolloroq* types. Smaller *bagang*, called *bagang pete-pete*, is maneuvered with self-propulsion and escorted by one or two logistic supplier *jolloroq*.

The modern *pagae* has a western hull, operating with a purse seine net, crewed by 10 to 12 people. There is an auxiliary tool installed onboard called *gardan*, a motored capstan. It is a combination of a diesel engine and the used differential gear of a car connected by a belt. The *gardan* is used to haul the purse seine net in round hauling procession. There are a wheel room, an engine room, a narrow accommodation for crew, a kitchen and a hole at the rear end of the stern used as toilet. The middle part of the boat is the hold to put the catch and the net when not in use. *Pagae* in the Spermonde Archipelago is hydro-dynamically built in consideration of enough speed to reach remote fishing grounds for long periods of operation.

The appearance of a *pacantrang* is not much different from *pagae* because in the Spermonde a *pacantrang* is always modified from a *pagae* to operate relatively new fishing gear introduced in the 1990s in the area. *Cantrang* is a kind of pocket net dragged in the water between the surface and the sea bed. On a *pacantrang*, a tugging structure is installed at the stern with a motored capstan. The capstan, different from the *pagae*'s one, is transversal to the length of the boat. This newly introduced fishing method has gained little popularity at some islands in the archipelago.

Due to the increasing necessity of fish preservation derived from longer operation to

catch fish as much as possible and also due to the introduction of destructive fishing methods, a special type of boat is required to transport and preserve the catch. The *paes* is specially designed for that purpose. On average it is same in size as the *pagae* but with raised hull sides and bigger holds. The hold is divided into compartments with insulation. The *paes* takes ice blocks to the fishing ground and brings back fish with crushed ice.

The biggest boats in the Spermonde Archipelago are the inter-island cargo ships operating mainly between Sulawesi and Kalimantan Islands. These kinds of ships are concentrated only in Sabutung, Kulambing, and Laiya Islands where timber trading is the main occupation of the inhabitants. The ships are locally called *pangangkuq* and officially categorized into PLM. The ships may reach 250 GT and are designed to carry long stem cargo such as timber. With an opening at the rear, the ship can load timber which is sometimes two thirds of the ship's length. The ship can also carry sacked cargo such as rice, salt, flour, and cement.

III–4. *Boat Transformation*

Regardless of time period, boats are always subject to progressive modifications by their users, which lead to transformation that drives the boat evolution. The introduction of the engine in the 1970s was one of the most important events in the development of boats in Indonesia. It brought a principal transformation to the hull, propulsion and steering systems, and ultimately to the whole boat design.

Due to the transformation of the boat's hull, the nature of hulls is categorized into "traditional hull," "modern hull," and "transitional hull" that comes in between. Traditional hulls belong to the indigenous boats, which in Sulawesi are known as the *pajala, paqdewakang, palari, pinisi, baqgo, lambo*, and *bilolang*. The hulls are double ended with a sense of simplicity in the roundness of its curves. The modern hull is the category given to boats with "western" hull which is designed to accommodate an engine as main propulsion and necessities of the engine operation such as an engine foundation, engine room, wheel room, propeller, rudder, and steering installations that determine the shape and structure of the hull. The transitional hull was resulted from an instant response to the introduction of the engine. It is characterized by a traditional hull with additional structures for the engine, propeller, stern rudder, and a rudder-shoe that protrudes out from the lower part of its curving stern-post.

The remarkable difference between the traditional and modern hulls lies in their backbone constructions (see Fig. 2). The backbone construction is the central structure that bears the longitudinal strength of a boat comprising the keel, stem, and stern structures. The backbone of a traditional hull may be seen as one solid structure, made up by the "true keel" called *kalebiseang* (literally means "the center of the boat"), two keel extensions which are called *panyambung* that extend the *kalebiseang* at its ends, the stern- and stem-posts which are fixed to the keel extensions, and two plank-like pieces of wood called *pangepe* or clampers which are fixed along the keel at a length that covers the

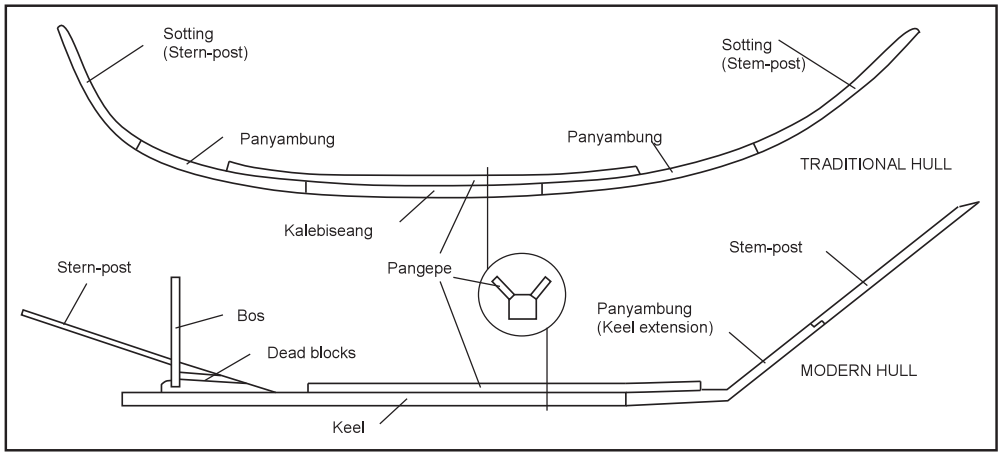


Fig. 2 Comparison between a Traditional Hull and a Modern Hull Backbone Structures

joints between the *kalebiseang* and the *panyambungs*. The clampers stiffen the structure, preventing the keel from bending, and keep the *panyambungs* fixed to the keel. All of these pieces are curved woods so that they form the backbone structure when put together, making a curving structure with stem- and stern-posts pointing upward.

The backbone construction of a modern hull, on the contrary, consists of straight pieces of wood. Joints are made in clumsy angles that in appearance give the image of stiffness. The construction is built-up by three basic structures: the keel, the stem, and the stern. The keel structure comprises the keel, the clampers, and the horizontal part of the keel extension. The keel extension, by the influence of the Konjo's traditional knowledge and wisdom, must be a naturally crooked timber shaped from a trunk and its adjoining branch, and its upwardly pointing part becomes the lower part of the stem structure. A second keel is occasionally needed when the profile dimensions of the keel are insufficient to the ratio with the hull dimension. The clampers in this case only cover one joint that is the aft joint between the keel and the keel extension, but its extra function remains to provide stiffness to prevent the keel from bending. Stern structure in a modern hull bears multiple functions that are to support the propeller and rudder installations and the buttock structure of the stern. The stern comprises the protruding rear end of the keel, the stern-*bos* or the *linggi*, the dead-blocks, and the nearly horizontal beam of the "stern-post." The stern-*bos* (most likely this is a chronic mis-pronunciation of "stern-post" by the Konjo boat builders) stands vertically on the keel at a distance from the rear end; it is the vertical standing post that bears the burden to erect the whole stern construction of a boat and the medium where the propeller's tube is installed to let the shaft go through from the engine to the propeller. The protruding keel functions as a rudder-shoe that supports the rudder shaft hanging from the stern's hull behind the propeller; it also protects the propeller from hitting a shallow ground. The dead-blocks that are of

solid wood blocks, which are to give extra strength to the propeller installation, are occasionally absent in small boats. The "stern-post" that is projecting to the rear determines the shape of the buttock and provides the longitudinal strength in that part.

III–4. 1. *Traditional Boat Evolution*

The oldest source about Sulawesi boats is available from an account written by Tome Pires in 1512 [Cortesao 1990]. He mentions in his report a type of boat that he called *pangajava* which he encountered in Palembang and along the north coast of Java. From his writing and the fact that he had never been to Sulawesi, we noticed that Pires seemed to encounter the Makassarese in the port town of Malakka and possibly learned the name of their ships before he started his journey. He might then have labeled the name *pangajavas* to all the planked boats or ships with lateral rudders and square sails, the common characteristics of all native trading ships of Indonesia at that time. Pires might have seen, in ports of Java, the larger type of the *prahu pencalang* that more or less looks like the drawing presented in Horridge [1986: 14], a sketch based on a model displayed in the Ethnology Museum in Leiden. And the "large well-built *pangajavas*" of the Makassarese might be the larger *biseang*, used for overseas trading. A sketch based on a photograph postulated to be a resemblance of the Makasserese *pangajavas* may be seen in Horridge [1985: xvii]. The *pangajavas* might be the same size but without the *ambeng*[9] platform, like of the *prahu* in the sketch (Fig. 3).

The evolution and transformation of boats in South Sulawesi is briefly illustrated in Fig. 4.

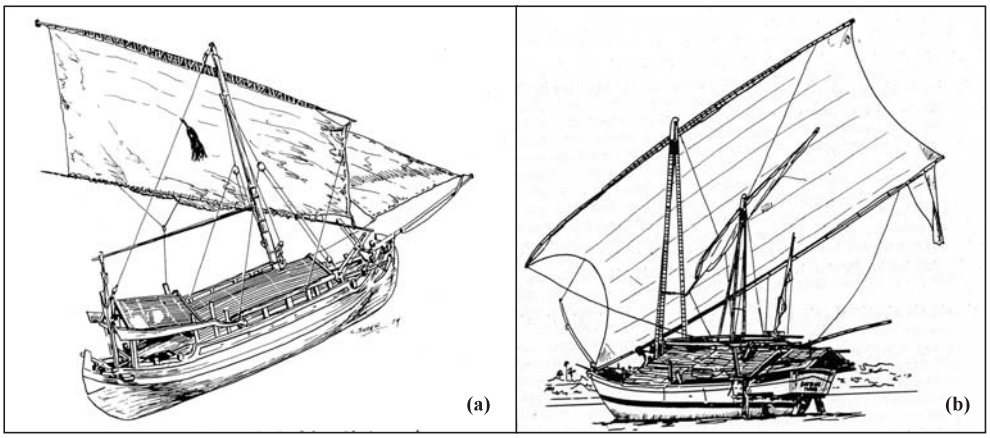
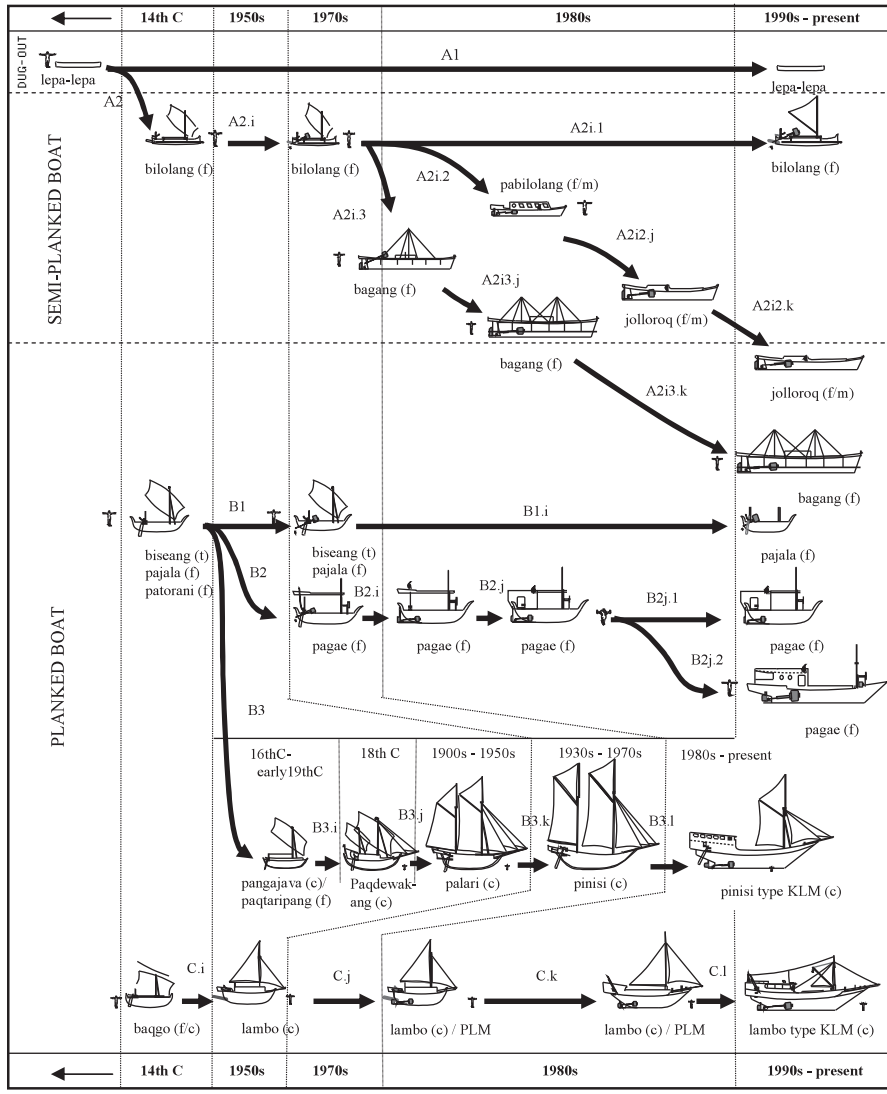


Fig. 3 (a) A *Perahu Pencalang* of the Mid-nineteenth Century
Source: [Horridge 1986: 14]

(b) A Makassarese Trading *Prahu*
Source: [Horridge 1985: xvii]

9) A quarter-platform at the stern.



Legend:
- = man scale
c = cargo boat
f = fishing boat
t = trading boat
m = multipurpose boat
PLM = Perahu Layar Motor
KLM = Kapal Layar Motor

transforms:
A1 = no change
A2 = side planks, outrigger, square sail
A2.i = outboard engine
A2i.1 = triangle sail
A2i.2 = inboard engine, deck house
A2i2.j = slim hull
A2i2.k = fully planked hull
A2i.3 = catamaran, outboard engine
A2i3.j = one hull, inboard engine
A2i3.k = fully planked boat
B1 = outboard engine
B1.i = sail omitted
B2 = outboard engine, overhead platform
B2.i = inboard engine
B2.j = deck house
B2j.1 = gardan
B2j.2 = modern hull
B3 = enlarged
B3.i = quarter deck house, twin square and jib sails
B3.j = partially decked, schooner rig
B3.k = enlarged, fully decked
B3.l = inboard engine, modern hull, deck house, sail reduction
C.i =enlarged, kurung C.j=inboard engine
C.k=quarter deck house C.l=modern hull, deck house, sail reduction

Fig. 4 Evolution of Boats in South Sulawesi

The *biseang, pajala*, and *patorani*[10] are the same in hull shape and size. They are the earliest structure-hull or planked-boat used in Makassar for trading and for fishing that may have well preceded the *pangajavas*[11] and the *paqtaripang*.[12] The "large well-built *pangajavas*" of the Makassarese from the sixteenth century [Cortesao 1990] used for overseas trading and the *paqtaripang* from the eighteenth century used for distant fishing are the larger version of *biseang* or *pajala* made without any significant alteration in its construction pattern.

The transformation of *paqdewakang* is explained in detail by Horridge [1979: 24–36]. A *paqdewakang* is a large *biseang* used for overseas trading with two tripod masts and two square sails and jib sails and with rigid and square house structure. At the stern platform, the *ambeng* is built up with a box-like structure with openings where the tillers of the quarter rudders are placed. The *paqdewakang* was the major boat used by traders in Makassar in the eighteenth century.

The *palari* type came into being when the hull of a trading boat was enlarged by adding the height of the hull sides with planks and adopting the rig system of a schooner. The size of the boat, by the additional planks on the hull sides, anyhow has exceeded the basic traditional plank pattern of the *pajala* and *biseang*, thus the main deck is extremely higher than the aft and stern of the ship. The problem is solved by the construction of *ambeng dua kali* which is a double platform hangs under one another at the stern, and at the aft the splashboard is set to the height of the main deck. When a bigger ship is made based on the model of a *palari* to produce a *pinisi* type, the problem of the aft construction is solved by extending the additional side planks until the stem-post, thus eliminating the splashboard. This requires the stem-post to be a little far away from the point where the upper side-planks start to bend inward, resulting in a forward leaning stem-post of the *pinisi*.

The *pinisi*-type KLM was emerged in the 1980s when the traditional *pinisi* fleet of Indonesia, the so called *Pelayaran Rakyat* or "people's shipping," was encouraged to adopt motorization. The installation of an engine required some constructional reformation of the *pinisi* hull. A strong structure for the engine foundation, the propeller and center rudder installations, engine room, and wheel room were needed. And because the traditional accommodation for the crew inside the hull has already inconvenient due to the engine installation, narrow cabins for the crew are built in the same deck house with the wheel room. Now the function of the sails is largely replaced by the engine, so the number of masts and sails is reduced. The main mast and sails are deleted leaving the

10) The Makassarese boats with hulls of the basic planking pattern. *Biseang* literally means "a row boat" as well as a general term for all kinds of vessel in Makassarese. *Biseang* is for trading, *pajala* is for net fishing and *patorani* is for flying-fish fishing.

11) A boat type coined by Tome Pires (1512–15) for the native trading boats he encountered in Java.

12) A large *biseang* or *pajala* used for *teripang*/sea cucumber fetching.

fore mast with the main sail, top sail and jib sails that are also reduced to only one or two sheet(s).

III–4. 2. *Traditional to Modern*

The transformation of boats in the Spermonde Archipelago occurs within the framework of boat evolution in South Sulawesi. It took place in the latter half of the twentieth century and the first decade of the twenty-first century. The transformation began in the 1950s when the *lambo* as trading vessels gradually replaced the vanishing *pinisi* from the archipelago.

As can be seen from Fig. 4, there are three major branches of evolution that directly affect the ultimate results in the diversity of boat types in the Spermonde Archipelago. The major branches are as follows: the evolution from *pajala* to *pagae* and the boats resulted in innovative derivations from the *pagae*, the evolution from *baqgo* to the *lambo*-type PLM, and the evolution from *bilolang* to *jolloroq* and *bagang*.

The evolution of the *biseang* in the line of trading boat evolution in the Spermonde Archipelago has reached its final form as *pinisi* and was terminated in the late 1950s by the withdrawal of the *pinisi* from the waters of the archipelago as a result of security turbulence. This line of trading boat evolution followed the main trunk of evolution of the trading boats of South Sulawesi. Salemo Island was the only island in the archipelago which possessed *pinisi*, and after its bombing and destruction in 1945 the *pinisi* gradually vanished from the archipelago. Some of them were sunk by the Allied air force during air raids and some survived, but were taken to Surabaya or Jakarta where the owners migrated.

From Pajala *to Modern* Pagae

Pajala can be understood, as mentioned by Horridge [1979; 1985; 1986], as a basic hull-type which has the basic planking pattern of all traditional boats in Sulawesi; and as a type of fishing boat using *jala*, the traditional form of the purse net. As a basic hull type, the form of *pajala* hull may be used in a *biseang*, a *patorani*, a *paqtaripang*, a *paqdewakang*, a *palari*, and a *pinisi*. As a fishing boat, the *pajala* is used in the Makassarese fishing tradition in the waters where the Makassar influence exists.

The *pajala*, powered with square sail(s) and rowing crews, catches the pelagic fishes that aggregated close to the sea-surface in a round-hauling process propelled by rowing. During the 1950s and 1960s, *maqjala rompong* was a common fishing practice throughout the islands, which uses the combination of *rompong*, the man-made traditional fish aggregating device (FAD), and the *pajala*. The aggregated fish under the *rompong*, such as sardines and mackerel, is caught by round-hauling the *rompong*.

In the 1970s when the outboard engine came into use in the Spermonde Archipelago, the *pajala* boats took the advantage by installing it onboard. Now, manpower can be saved only for throwing and pulling the net and the speed gain is reliable to chase the

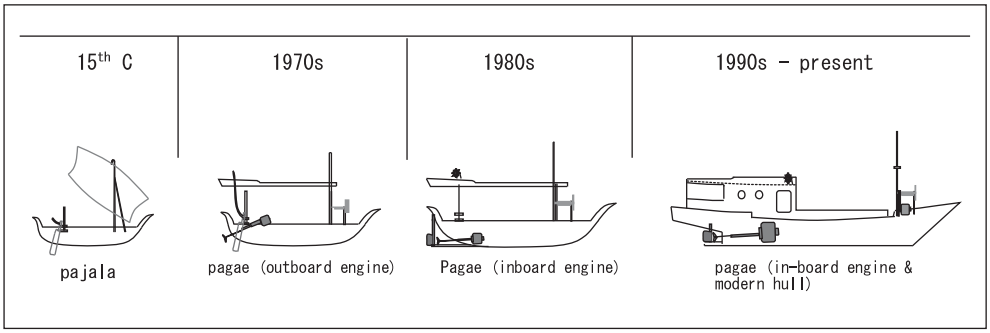


Fig. 5　Transformation of the *Pajala* and the *Pagae* in the Spermonde Archipelago

schooling fish near the surface. Fishermen started to use purse-seine or locally called *gae*, so the boats are called *pagae* (Fig. 5). To gain more speed, a *pagae* may install two, or even three outboard engines. The installation of the outboard engine is simple; the engine is set on a foundation made of wood beams placed on the brink of the hull side. The propeller(s) intrude to the water by the side of the hull. At this stage, there was yet no change applied to the hull.

Only when the inboard engine was introduced in the 1980s, the *pagae* needed an additional beam, which resembles an aft-keel extension protrudes out of the lower part of the stern, for a rudder-shoe. Now, the *pagae* hull has the engine installation inside the hold and the propeller goes out through the buttock nearly to the center line beside the stern-post. For better maneuverability, the propeller installation necessitates a stern rudder, which is more compatible to the new propelling system rather than the old fashioned lateral rudder. The stern rudder in turn needs the rudder-shoe, which also functions as protection for the propeller from shallow ground. This type of hull is a transitional hull to the modern hull because the center-lined propeller and the stern rudder installations which need a more complex stern structure stimulated the use of the western-style hull.

The modern *pagae* that totally adopted the western hull style came to use by replacing the old *pagae* in the 1990s. The boats now have the engine room, the wheel room or an open space where the wheel is installed, a small space for accommodation and a space for cooking, all in a deck house. In other words, the modern *pagae* (Fig. 6) is a result of remarkable transformation that involves total acceptance of a new concept of boat.

From Lambo *to PLM*

From the eighteenth century until 1945, Salemo Island was a small trading center sharing goods distribution to the rest of the islands and the mainland. Merchants of the island owned more than a hundred trading *pinisi* that sail to the western parts of Indonesia. In the approaching of the west monsoon, the whole fleet would take a rest and cast their

Fig. 6 A Modern *Pagae* with Its Purse-seine Onboard

anchor on the east shore of the island, which is a 650 meters long. An informant's childhood testimony revealed the scene that "The *pinisi* would form an uninterrupted line, as they anchor side by side, along the shore. One may go on board a *pinisi* from one end; walk over the decks of the vessels and get off at the other end; so that one may move from the south to the north of the island without stepping on the soil between." The prosperity yielded from the trading activity had been supporting the island as one of the Islamic teaching centers in South Sulawesi.

The islands ceased to be a trading backdoor to Makassar after the Independence in 1945, initially due to the stagnant economy situation and later by the full control of trade from Makassar when the Indonesian Administration became stronger. Briefly before the Independence Day, Salemo Island was targeted by the Allies' air strike that flattens the islands into ruins. Many of the *pinisi* were apprehended or bombed at sea. Many owners immediately fled to Surabaya and Jakarta along with their *pinisi*. Some stayed until the 1950s, but finally most of them fled too in fear of the rebel groups (*gerombolan*) that frequently robbed the islands. Because of the stagnant economy situation, the reminders and new merchants could only afford to build *lambo*, which is smaller in size than the *pinisi*.

Until the 1970s, many *lambo* were built replacing the lost and impaired *pinisi*. This type was generated from the old model of the *baqgo*, which was of a Mandar type rooted from the Mandar influence that came to the region in the eighteenth century. The type was chosen by the newly emerged traders with small capital, maybe because of its size which is affordable and feasible for near-overseas trade across the Makassar Strait to reach the eastern Kalimantan. The vessel has a typically *pajala* hull with *kurung*, a

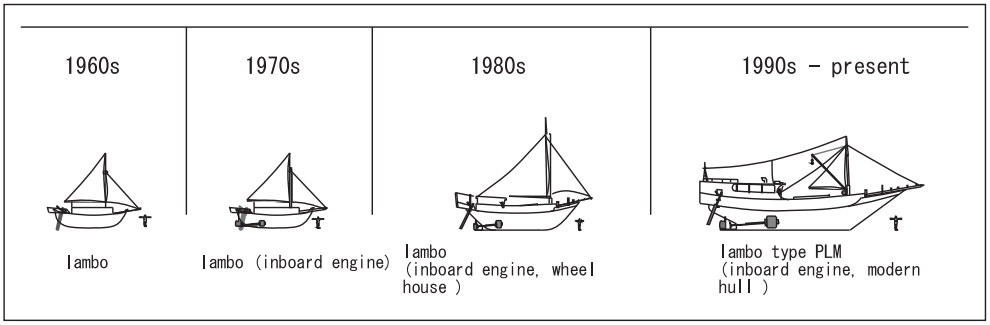


Fig. 7　Transformation of the *Lambo* in the Spermonde Archipelago

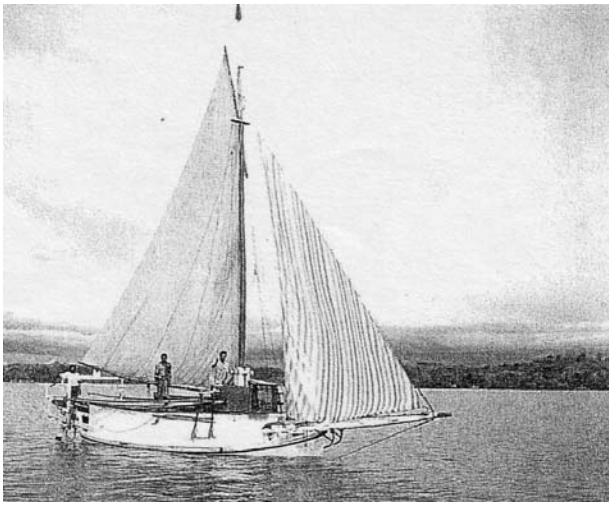


Fig. 8　A Mandar Quarter-rudder *Lambo* with Sumatran-triangles *Nade* Rig
Source: [Horridge 1986: Plate 23]

structure built upon the hull. The flat top of the *kurung* functions as a deck. The sails are of Sumatran *nade*, consisting of a triangle main sail and a jib sail (Fig. 7).

By the introduction of the engine, the *lambo* experienced the same steps in imposing the stern structure for rudder and propeller as the *pagae* did. In the 1980s some *lambo* placed a deck-house-like structure above the rear of its *kurung*, the house is used for steering and also for accommodation.

The *lambo*-type PLM emerging in the 1990s is the ship used by the timber traders in the islands of Sabutung, Kulambing, and Laiya until present. The PLM traceably preserved the *kurung* structure of the *lambo* whereas the *kurung* is a concept of multiplying the capacity of a ship without raising the hull's side planks. This method may have been developed by Mandarese boat-builders, in need of capacity, as a different method of

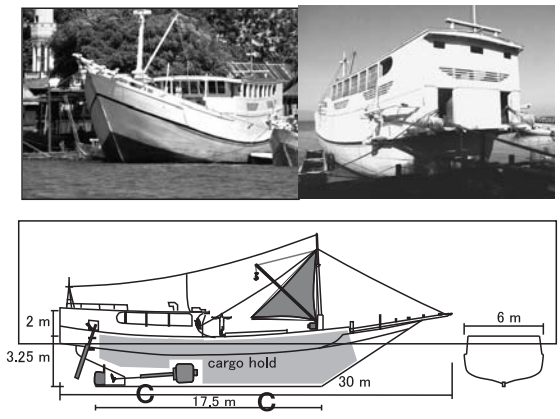


Fig. 9 A One Hundred Cubic Meter *Lambo*-type PLM in Service as Ironwood Carrier

anticipation from the *palari* solution to the *paqdewakang* hull in the Konjo technique. The *lambo*-type PLM is now a modern ship which may be equipped with an electronic compass and GPS (Global Positioning System), and a winch for loading and unloading through a hatch on the deck.

The design of the ship is compatible with carrying timber and sacked cargo like cement, rice, and salt. Even with a modified hull and deck house, the design of today's *lambo*-type PLM still maintains the principal of the loading system of the traditional *lambo* which has a hold opening at the rear end of the poop deck and quarter platform structures at the stern with a releasable back-seal. The PLM preserves the concept of the rear-opening which is compatible with loading and unloading timber which is sometimes about two thirds of the ship length (Fig. 9).

From Bilolang *to* Jolloroq

The transformation from *bilolang* to *jolloroq* is summarized in Fig. 10. The *bilolang* still exists at present in the outrigger-canoe style. It still has the same hull structure but without the tripod mast that has a hook-like top because the present outrigger-canoe uses no rectangular sail anymore. It has a one-pole mast with a simple triangle sail and an outboard engine for propulsion. The rudder support is much simpler with two cross beams. The upper beam functions as a rest for the propeller's shaft and tube, while in a traditional one an additional beam above the rudder support was for the sail-rest.

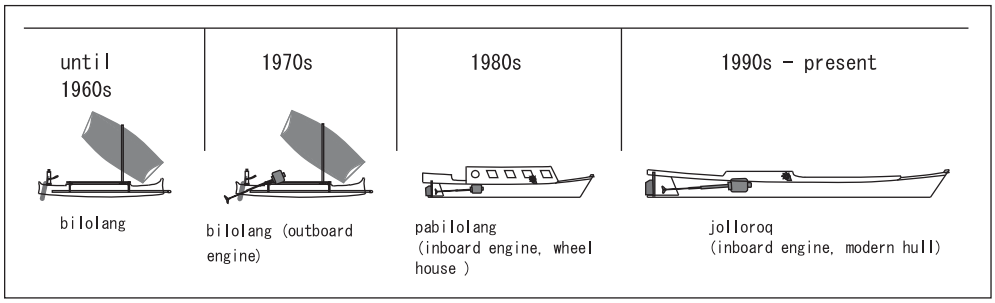


Fig. 10 The Evolution from *Bilolang* to *Jolloroq*

Fig. 11　A Model of the 1970s *Bilolang* and a Present *Jolloroq*

Installation of inboard engines on outrigger canoes is impossible due to breadth restriction; therefore outboard engines are still used today.

The *jolloroq* type was once a product of an advanced semi-structure technique. For its need of speed it adopted the inboard engine to be combined with its slim body. The hull of a *jolloroq* has sharp double-ends with just enough breadth to accommodate the diesel engine, and with this it can reach the speed of 20 knots. The semi-structure technique is becoming obsolete in building *jolloroq*, though it is still used for outrigger canoes, due to the scarcity of big logs for the lower part of the body. Nowadays, all *jolloroq* are made with the plank boatbuilding technique (Fig. 11).

Another type that originated from the semi-structure technique and now is also built with the plank boatbuilding technique is the *bagang*. Initially *bagang* was catamarans whereupon square platforms of beams and cross beams for the lift net are built. Ever since the *bagang* was made self-propelled it was then turned to single hull wherein engines for propulsion and electric generation are installed (see Fig. 4).

III–5. *Technological Adaptation*

Readiness of the boat craftsmen to adapt the introduced technologies into their traditional knowledge and techniques has made it possible to promote and accelerate the transformation process in boatbuilding in the Spermonde Archipelago.

As the Konjo people believe that the planked-boatbuilding technique is their ancestral heritage, they have tried to preserve the technology to some extent. On the other hand they responded positively to the influences of new knowledge and technologies.

Under this situation the local boat craftsmen necessarily challenge their skill in adopting the technique of planked-boatbuilding and accept ironwood as principal material. With the adoption of the technique and materials they are now able to produce the fully planked-boat, the *jolloroq*, with a piece of keel made of ironwood instead of *batangan*. Thus, by the 1990s both types of *jolloroq*, semi-planked or planked hull, came to exist and by the first decade of the twenty-first century with the full stop of *batangan* supplies, all *jolloroq* were transformed to planked-hull type (see Fig. 4). The semi-planked boat

technique remains for building single-outrigger canoes with outboard engines.

III–5. 1. *Introduction of the Outboard Engine*

The outboard engine with a long propeller shaft, familiar to the islanders in the Spermonde Archipelago as *katinting*, was first introduced in the early 1970s to outrigger-canoes, which easily accommodated the engine installation. The engine sits upon a foundation built on the platform of the outrigger beams slightly outside the hull. The shaft intrudes into the water by the hull's side exceeding the quarter rudder which is on the other side. Likewise, the outboard engines were also installed on *pajala* and *pagae*.

III–5. 2. *Introduction of the Inboard Engine*

The *pajala, biseang, pagae*, and *patorani* share exactly the same hull structure because their sizes are on average the same, only the functions and method of fishing make them different. Introduction of the inboard engine to these hulls in the 1970s necessitated a modification of the stern, in particular of the keel extension. The keel extension horizontally protrudes at the lower part of the stern as a foothold for the center rudder which is suitable for the centered propeller to gain maneuverability, thus replacing the lateral quarter rudder. The engine also reduces the function of the sail to auxiliary propulsion and thus changed the structure and function of the mast. On a *pagae*, for example, the mast becomes the aft support of the platform and the upper part of the mast is designed as a stand for fish-watch.

The Adoption of the Western Hull

It was the introduction of the engine that, in the 1980s, revolutionarily changed the hull's shape of the South Sulawesian boats into the modern shape. The western hull better accommodates the installation of the engine, which in turn necessitates a deckhouse for a shelter, a wheelhouse for controlling and steering, and a specific stern structure for the propeller and the center rudder. A detailed description on the structure of a modern hull can be seen in Salam and Osozawa [2005].

New types of boats, fishing vessels with various fishing methods and boats for cargo and passenger transportation, have been emerging for new functions. In the present, all boat types are equipped with engines and classified into the modern-/western-hull type. As this indicated, the introduction of engines and the modern hull types have been the "renaissance" of boat building technology in South Sulawesi and particularly in the Spermonde Archipelago.

III–5. 3. *Recent Examples of Technological Adaptation*

Creative interactions between boat builders and boat users have forwarded innovations and technological adaptations in boatbuilding in the Spermonde Archipelago. When a boat user or owner requests new things, tools, design or structure to be added or applied

to his new boat based on fishing operation necessities, for examples, or caused by certain restrictions, the boat builders try their best to fulfill the request within the limits of their skills and technology, and thus new innovations and/or technological adaptations take place. There are some examples that may be closely observed to get the illustration of how changes actually occurred and resulted in a transformation.

Timber price is shooting up in this decade and ironwood's price increases even more drastically. But ironwood is the prime material for boatbuilding which is easier to purchase than other kinds of timber in big quantity in the Spermonde Archipelago and its strength and bending properties is, above all, the most suitable for boatbuilding. The Konjo boat builders and boat owners in Kulambing Island have been developing a solution to the price problem by utilizing the ironwood qualities. In order to lower the cost they reduce the thickness of the shell plank up to 30% of the usual thickness; and to maintain the stiffness of the whole shell they apply a new technique of plank fastening.

The traditional plank fastening method of the Konjo technique uses internal and thorough wooden dowels between planks and joining dowels between the planks and the ribs. By the new technique, the wooden dowels are reinforced with long fully-threaded steel bolts that fasten, at once, thorough four or five rows of plank transversally, right from the keel to the shell edges. After the one meter length of each bolt is used up to bind four or five rows with nuts screwed down to each row, another bolt is inserted, at a 10 cm interval, binding the next rows of the shell plank to the last row of the previous bolt (Fig. 12). Longitudinally, the fasten bolts are set at one meter interval from aft to fore resembling a fishbone with the keel as its backbone. This method can save up to 10% of the total building cost of a boat of 24 meters in length (LoA), 4.8 meters in breadth (B) and 2 meters in height (H) [Salam *et al*. 2006].

A recently found new simple way to produce wooden dowel is another valuable example of the technological adaptation in boatbuilding in the Spermonde Archipelago. Using the new technique, a craftsman can make better quality wooden dowels, which is indicated by its cross sectional round profile, in shorter time. In traditional way, the raw material is made into square sticks to be shaped into cylindrical dowels using a hand

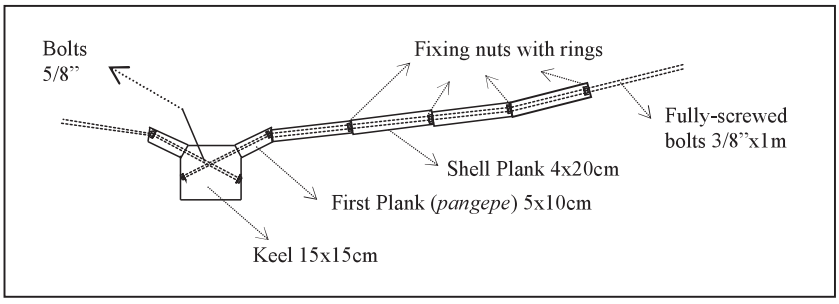


Fig. 12　The Cross Section of a "Fishbone" Plank Fastening Method

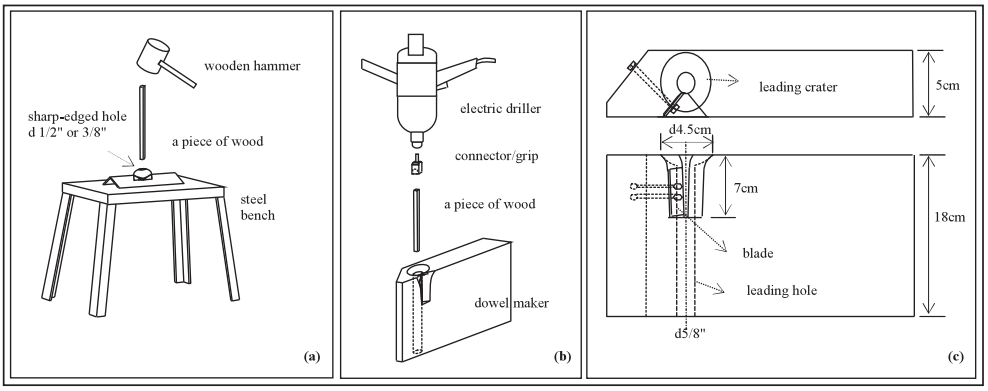


Fig. 13 (a) Steel Bench Dowel Maker; (b) Semi-electric Dowel Maker; (c) Detail Drawing of the Tool

machete. More advanced than that of the traditional, the craftsmen use sharp-edged metal holes set on a bench with various diameters (3/8, 1/2 or 5/8 inches) as patrons to drive the raw materials through with a hammer to produce more cylindrical dowels with more time efficiency (Fig. 13–(a)).

More recently in 2006, a head craftsman made a new semi-electrical tool for wooden dowel making. In the process of dowel making, the tool, which resembles a big-size pencil sharpener, is paired with an electric driller that equipped with a connector to hold the raw material and drives it spirally into the hole, which is set with a blade. The dowel product would have a cylindrical part that is homogenous, smooth and precise, the characters most suitable for ribs dowel in order to gain water tightness and stronger grip.

These examples of new innovations that use the advantages of the present technologies testify how wooden boatbuilding technology in the Spermonde Archipelago responds to the changing conditions and how boat transformation is made possible is clearly understandable.

IV Conclusions

Wooden boatbuilding development in the Spermonde Archipelago is supported by the co-existence of three factors: (1) boat demand, (2) boat technology, and (3) wood materials. The necessity of boat is inherent and boat technology and building materials are supplied from outside. The presence of the Konjo craftsmen to provide technology in the archipelago has been creating a bond of socio-economic network between the archipelago and the home villages of the Konjo tribes. The importation of wood materials, in the same sense, has been creating the trade network between South Sulawesi, particularly the Spermonde Archipelago, and Kalimantan. Thus, it is sufficient

to state that boatbuilding development in the Spermonde Archipelago has been resulted from the socio-economic networks synergy over centuries.

The traditional boats of Indonesia have found its ultimate form today as the boats evolve in the course of time. Such evolution, or transformation in a more instantaneous manner, is observable in the Spermonde Archipelago during the latter half of the twentieth century and continuing to the new millennium, when new functions of boats, fishing methods, and technologies, were introduced. The most rapid transformation occurred in the 1970s and 1980s when the outboard and inboard engines were introduced for the first time. The traditional hull embraced the motorization initially by transforming into a transitional hull form and ultimately turned into the adoption of the modern hull. Although the transformation leaves some traceable traditional features, the modern hulls, which emerge in a number of new boat types, are manifestation of a new concept of boat.

Local and Konjo boat builders and boat users adopted the new concept as a solution to overcome the socio-economic changing conditions. They have been successfully responding to the changes by making technological adaptations to transform their boats to more suitable forms in order to fulfill the contemporary requirements. The transformation obviously has been the reason of the present diversity of boat types in the Spermonde Archipelago.

The transformation of boats in the Spermonde Archipelago occurs within the framework of boat evolution in South Sulawesi. The transformation occurs in three main courses: (1) the transformation of the *bilolang* to the *jolloroq*, (2) the transformation of the *pajala* to the *pagae*, and (3) the transformation of the *baqgo* to the *lambo*-type PLM.

Results of this study are expected to benefit science by providing information on the physical transformations of boats as well as the dynamic of its social, cultural, and economical backgrounds. The results obtained from typological analyses are expected to provide a basis for further studies on wooden boats in other regions of Indonesian, as well as Southeast Asian, archipelago and to present a basic concept which can be utilized for the development of boat registration system.

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References

Books and Articles

Andaya, Leonard. 1981. *The Heritage of Arung Palakka, a History of South Sulawesi (Celebes) in the Seventeenth Century*. The Hague: Martinus Nijhoff.

Collins, G. E. P. 1992. *Makassar Sailing*. Singapore: Oxford University Press.

Cortesao, Armando, trans and ed. 1990. *The Suma Oriental of Tome Pires and the Book of Fransisco Rodrigues*. Vol. I. New Delhi – Madras: Asian Educational Services.

Haddon, A. C; and Hornell, James. 1997. *Canoes of Oceania*. Honolulu: Bishop Museum Press.

Hawkins, Clifford W. 1982. *Praus of Indonesia*. London: Nautical Books.

Horridge, Adrian. 1979. *The Konjo Boatbuilders and the Bugis Prahus of South Sulawesi*. Maritime Monographs and Reports No. 40. London: National Maritime Museum.

————. 1985. *The Prahu: Ttraditional Sailing Boat of Indonesia*. Singapore: Oxford University Press.

————. 1986. *Sailing Craft of Indonesia*. Singapore: Oxford University Press.

Knaap, Gerrit; and Sutherland, Heather. 2004. *Monsoon Traders: Ships, Skippers and Commodities in Eighteenth-Century Makassar*. Leiden: KITLV Press.

Mattulada. 1991. *Menyusuri Jejak Kehadiran Makassar dalam Sejarah*. Ujung Pandang: Hasanuddin University Press.

Pelly, Usman. 1975. *Ara dengan Perahu Bungisnya*. Ujung Pandang: Pusat Latihan Penelitian Ilmu-ilmu Sosial.

Pelras, Christian. 1996. *The Bugis*. Oxford: Blackwell Publisher.

————. 2006. *Manusia Bugis*. Nalar and Forum Jakarta – Paris, EFEO, Jakarta.

Salam, Aziz. 2005. Timbers for Boat Building in Bonerate Island, Changes and Current Situation. *Jurnal Ecocelebica* 1(3): 164–169.

Salam, Aziz; Djafar, Wihdat; and Osozawa, Katsuya. 2006. Introducing Boats of the Pabbiring Island. In *Proceeding of the 5th Biennial Conference on Marine Technology, Shipbuilding Engineering Department, Hasanuddin University*, pp. 241–252.

Salam, Aziz; and Osozawa, Katsuya. 2005. Construction of Phinisi Cinta Laut, a Research Ship. *Jurnal Ecocelebica* 1(3): 177–183.

UNEP-WCMC (United Nations Environment Programme – World Conservation Monitoring Centre). 2006. *Global Trees Campaign*. Tree Conservation Information Service. http: //www.unep-wcmc.org/trees/GTC/gtc_front.htm (as seen on 10 January 2007)

Official Records

Biro Pusat Statistik, Kabupaten Pangkep [Central Bureau of Statistic, Pangkep Regency]. 2005. *Kabupaten Pangkep dalam Angka 2004/2005, BPS Kabupaten Pangkep* [Statistic of Pangkep Regency 2004/2005].

Fishery and Marine Services of South Sulawesi Province. 2003. *Statistics of Fishery in South Sulawesi*. Annual Reports 1997–2003.

Forestry Research and Development Agency, Indonesian Ministry of Forestry. n.d. *A List of the Indonesian Commercial Timber*.

Transportation Service of Pangkep Regency. 2006. *Boat Register*. Port of Biringkassi Administration Office.

Maps

Hydro-Oceanography Services of Indonesian Navy. 2005. *Makassar Strait, Sulawesi-West Coast*.

National Geographic Society. 1996. *Indonesia*.