[1]Nor Suraya Aini Ngah
[1]Ramly Hasan
[2]Nor Syamaliah Ngah
[3]T.A.T. Mohd
[4]C. M. Azmi Ngah
[4]M. Iqbal Ma Mamat

Towards Sustainable Cultural Heritage: Exploring *Buah pir* and *Abah-abah* in *Perahu Besar Terengganu*

Journal of Electrical Systems

Abstract: - This study investigates the components of the sails, specifically the pulley blocks (*Buah pir*) and rigging (*Abah-abah*), of the *Perahu Besar Terengganu*, a traditional Malay vessel renowned for its contribution during its glorious period. Recognized as the most complex Malay traditional watercraft that remains until today, the *Perahu Besar* exemplifies the pinnacle of Malay naval technology in its components. Central to its components of sail, the *Buah pir* and *Abah-abah* demonstrate remarkable efficiency in sailing while addressing occupational safety and health concerns far ahead of their time. This qualitative research employed open-ended interviews and observations as primary methods, complemented by literature reviews to provide historical context, given the limited documentation on the *Buah pir*. Data were analyzed using Atlas.Ti 24 software and validated by the Maritime Unit of the Terengganu State Museum. The findings identified eight types of *Buah pir*, each associated with a corresponding *Abah-abah*, which function as stays, sheets, and halyards in the sail system. These components showcase the ingenuity of traditional boatbuilders, prioritizing functionality, efficiency, and sustainability. The study preserved the original Malay terms in the findings section to promote the resilience of the authentic traditional Terengganu Malay terms. The study contributes to preserving cultural heritage and also opening new avenues for exploring the materials and construction techniques of Malay traditional Malay *perahu*. It also aligns with Sustainable Development Goal (SDG) 11.4 by emphasizing the significance of protecting and celebrating the world's cultural and natural heritage, shedding light on the profound wisdom embedded in traditional maritime technologies.

Keywords: Traditional *Perahu*, *Perahu Besar Terengganu*, riggings, *Buah pir*, pulley blocks.

I. INTRODUCTION

Water transportation has played a pivotal role since ancient times, serving as a cornerstone of human connectivity and commerce [1-3]. The study of naval technology in Southeast Asia is particularly significant, as this region has demonstrated remarkable advancements in maritime capabilities throughout history. Manguin [4] highlighted that Southeast Asian maritime powers constructed, owned, and operated large ocean-going ships as early as the first centuries of the first millennium A.D. Similarly, Shaffer [5] emphasized the Malays invented and mastery of navigating monsoon winds, enabling voyages as far as the East African coast as early as the first millennium B.C.E. The historical significance of Malay maritime influence extends further. Griffis [6] noted that Malay sailors interacted with Japan's Ainu people during the classical period, influencing Japanese architecture. He posited that traditional Japanese dwellings were more influenced by Malay designs than by Chinese ones. This claim is corroborated by Porter [7], who posited the similarities between Ainu adaptability of Malay architecture as well as Malay culture seamanship. Artifacts such as the Vietnamese Dong Son drums, discovered in Terengganu and dated over 2000 years, provide additional evidence of Southeast Asia's maritime heritage. These drums, adorned with carvings of various boat types—including reed and wooden plank boats—indicate the longstanding connection between Vietnam and Terengganu [1, 8]. Horridge (1978) highlighted these carvings as proof of advanced maritime culture, and later Shaffer [5] suggested that Malay sailors played were the ones who responsible in spreading the Dong Son drum across the region, underscoring their maritime prowess of the Malays particularly Terengganu.

II. PROBLEM STATEMENT

Liebner [9] highlighted the scarcity of historical records on traditional *perahu* construction in the archipelago, underscoring the urgent need for further research in this area. Baco and Chia [10] similarly emphasized that underwater and maritime studies in Malaysia remain underexplored, lacking significant attention from

[1]*Corresponding author: Faculty of Architecture and Ekistics, Universiti Malaysia Kelantan, Kampus Bachok, Beg Berkunci 01, 16300 Bachok, Kelantan, Malaysia. Email: cloudciksu@gmail.com
[2]Faculty of Administrative Science & Policy Studies, UiTM Negeri Sembilan, Malaysia.
[3]Politeknik Ungku Omar, Jalan Raja Musa Mahadi, 31400 Ipoh, Perak, Malaysia.
[4]Lembaga Muzium Negeri Terengganu, 20566 Bukit Losong, Terengganu, Malaysia.

governmental bodies, universities, and research institutions. This sentiment is echoed by local historians Azmi [11], Mohd Yusof [12] and experienced boatbuilders Johari [13], Nordin [14], Nawi [15] who collectively noted that maritime studies and related issues have received less attention from these entities but also by NGOs and the broader community. The vanishing of maritime heritage, particularly traditional watercraft, does not occur only in Malaysia. Horridge [16] observed that such losses have been ongoing in other countries, including Indonesia, for many years due to traditional methods that relied on the boatbuilder's eyes and experience and used no blueprint [1, 17, 18]. This is as noted by Abd Wahab, Bahri [19] who highlighted that boat-building skills and knowledge are inherited from one generation to another and there is no formal school for this purpose. Horridge [16] further emphasized that since certain traditional boatbuilding practices have already vanished together with the boatbuilders, hence, it is critical to preserve any surviving examples. Similarly, Longuet [20] stressed on the importance of research on Terengganu's traditional boatbuilding as a critical component of documenting the region's unique maritime history while it still can be witnessed 'alive'. In light of these concerns, this study seeks to address the demanding need for documentation and preservation of the *Perahu Besar Terengganu*, an invaluable maritime artifact of Malay heritage. This effort is not merely an academic pursuit but a necessary step towards safeguarding a cultural legacy that is at risk of being forgotten.

III. Research Objectives

To address the gaps in existing research, this study was conducted to achieve the following three objectives:

- To identify the types of *Buah pir* and the *abah-abah* associated with the *Buah pir* utilized in the sail system of *Perahu Besar Terengganu*
- To examine the number of each types of *Buah pir* on a *Perahu Besar Terengganu*.
- To classify the *abah-abah* based on their specific functions within the sail system.

IV. Research Methodology

This qualitative research investigates the sail system of the *Perahu Besar Terengganu*, with a specific focus on the pulley blocks, locally known as *Buah pir* and rigging associated to them known as *abah-abah*. The data collection methods for this study included open-ended interviews with three experienced boatbuilders and detailed observations of two samples: sample 1: *T65 Kemajuan* and sample 2: a prototype of the *Perahu Besar Terengganu*. Observations of the *Perahu Besar T65 Kemajuan* revealed that its *Buah pir* components were incomplete due to its dilapidated condition. Consequently, observations of the prototype became crucial to obtaining a comprehensive understanding of the *Buah pir* and its functionality. The collected data underwent a rigorous validation process and was endorsed by the Maritime Unit of the Terengganu State Museum, ensuring its authenticity and accuracy.

The primary aim of this study is to document and preserve traditional Malay maritime technology, which represents an integral part of the region's cultural heritage. By shedding light on the ingenious craftsmanship and functionality of *Buah pir*, this research contributes to efforts to safeguard and promote cultural heritage in alignment with Sustainable Development Goal (SDG) 11.4, which focuses on protecting the world's cultural and natural heritage by documenting its components. This study also moves towards achieving SDG 17 that promote partnership for the goals where collaboration between academicians and government sector in carrying out the study.

(a) **(b)**

Figure 1: Sample of the study: (a) *Perahu Besar T65 Kemajuan* (b) Prototype of *Perahu Besar*
(Source: Lembaga Muzium Negeri Terengganu)

V. SIGNIFICANCE OF THE STUDY

This study is significant as it enriches the documentation on the technical aspects of the *Perahu Besar Terengganu*, a vessel that officially has been gazetted as tangible cultural heritage under the Department of National Heritage Malaysia. With only two remaining units; *T.82 Sabar* and *T65 Kemajuan*; these traditional vessels are classified as an endangered heritage; hence documenting their technical details is crucial to mitigate the scarcity of recorded knowledge.

The data gathered from carefully selected second-generation boatbuilders with direct experience in constructing the *Perahu Besar Terengganu* adds significant value to this study, as many experienced master builders have passed away due to age [11, 15, 20, 21]. As aforementioned, traditional boatbuilding practices, including those for the *Perahu Besar Terengganu*, were executed without blueprints, relying heavily on the experience and keen observation of the boatbuilders. Therefore, this study presents a crucial opportunity to document and preserve this unique and invaluable knowledge for future generations.

The findings can benefit a wide range of stakeholders, including government bodies, museums worldwide, academicians, heritage organizations such as the Department of National Heritage, architects, engineers, traditional boat builders and conservators. It contributes to the broader care and preservation of heritage, with particular relevance to maritime heritage and traditional craftsmanship.

VI. LITERATURE REVIEWS

A. Malay Innovations in Nautical Technology

The word "Malay" refers to the Malay people, an ethnic group predominantly found in the region. "Archipelago" refers to a collection of islands clustered together. The term "Malay Archipelago" is often used to describe the region's shared history, cultural connections, and geographical features [22, 23]. Malay as according to Shaffer (2015) and Kimura [24] refers to inhabitants of Malay Peninsula and in wider scope to Indochina peninsula and Java islands. As according Smith [25], Malay specifically refers to inhabitants of Malay Peninsula, but often referred to a more generic and wider scope to Austronesian language speaker such as Sumatran, Borneo and other islands.

Wallace [26] highlighted the profound connection between native Malays and water, emphasizing two key observations: Malays rarely built houses on dry land if water was accessible and avoided traveling on foot when boats could be used instead. This affinity for the sea not only shaped the Malays lifestyle but also solidified their reputation as master seafarers who favored building homes over water and traversing their surroundings by *perahu*. Supporting this, Smith [25] recognized Malays as the first long-distance seafarers, pioneering navigation between the South China Sea and the Indian Ocean long before the Greeks or Romans.

B. The Sails System of South East Asia

Kimura (2016) and Manguin (1980) identified key characteristics of Southeast Asian ships, including rigging, bamboo-battened sails, bowsprits, and stern rudders. Horridge (1982) further discussed the use of pulley blocks and rigging within the archipelago, noting their placement primarily at the top of the mast but without specifying the types employed. Shaffer (2015) credited the Malays as independent inventors of the world's first balanced lug sail. These sails, crafted from woven mats reinforced with bamboo, showcase early Malay innovation and advanced maritime expertise. Shaffer also emphasized that this invention predated similar Chinese technology by several centuries, with woven mat sails appearing in Chinese use by the Han Dynasty (206 B.C.E. to 221 C.E.). The innovative marine technology of the Malays, including the invention of the balanced-lug sail and their ability to reach Ceylon (Khalid, 1991) and New Guinea around 1000 BCE (Cremin, 2007), underscores their remarkable achievements in boatbuilding and navigation as early as the first millennium BCE.

These historical accounts collectively emphasize the Malays' innovative contributions to the advancement of nautical technology and their lasting influence on seafaring traditions. These facts are also challenging the claims that the sail design of the *Perahu Besar Terengganu* was derived from Chinese technology. Instead, these narratives affirm the originality and ingenuity inherent in Malay maritime heritage.

C. Early Documentation on Perahu Besar Terengganu

The writings on *Perahu Besar Terengganu* are also limited and scattered. There are proceeding papers, books, journals and thesis on *Perahu Besar Terengganu*, but the information is on history and redundancy of data is inevitable. The earliest record on *Perahu Besar Terengganu* as mentioned by researchers such as Mohd Yusof [27], Mohd Salleh [8], Kamal [28] and [3] started back in reign of Sultan Mansur in 1769. The record stressed on

importance of *Perahu Besar Terengganu* during that time that included for trading purposes, war, international relation as well as to transport people. There is no proper documentation on *Perahu Besar Terengganu* earlier than that. However, the verbal story has uncovered that *Perahu Besar Terengganu* have been used long before that documented period. There were hundreds of *Perahu Besar Terengganu* before WWII, however most of them were destroyed in bombing [1]. One of the earliest writings on *Perahu Besar Terengganu* is Mohd Yusof [27]that uncovered a brief history *Perahu Besar Terengganu* and its types. Then, Mohd Salleh [8] correlated the existence of *Perahu Besar Terengganu* with the ancient commerce port in Terengganu as well as the importance of *Perahu Besar Terengganu* in international relation matters. Later, Hashim [29] once again wrote on *Perahu Besar Terengganu* with the focus on history *Perahu Besar Terengganu* in relation to Terengganu state. *Perahu Besar Terengganu* has attracted Kamal [28] to write his thesis on this topic. He correlated the existence and functions of *Perahu Besar Terengganu* in spreading Islam in South East Asia especially Terengganu. Later, Maidin [21] studied the construction team system of *Perahu* in Terengganu including *Perahu Besar*. He highlighted on the and hierarchy of boatbuilder team known as *Tukang Timbal* (Master boatbuilder), *Tukang Perahu* (Boatbuilder) and *perantis* (apprentice). Later, M.Yusof (2017) once again wrote another paper on *Perahu Besar Terengganu*. This time, he stressed on the materials and sailing skills among Terengganuan. In 2021, Mohd Yusof once again highlighted *Perahu Besar Terengganu* in his book with certain focus on the history and components. Later, Kamaruddin and Rosli (2023) focused on the traditional boatmaking in support of preservation. However, all the documentation lack of focus on the technical aspect especially the sail system of *Perahu Besar Terengganu*.

D. Perahu Besar Terengganu

A *Perahu* is defined as a traditional Malay watercraft that exclusively utilizes traditional techniques in both its construction and sailing methods[28, 30-33]. This implies a *perahu* operates without the use of an engine or propeller, relying instead on oars, a rudder, and sails [1, 20, 27, 30, 32, 34]. The focus of this study is on the *Perahu Besar Terengganu*, which is recognized as the most complex traditional watercraft that still exists today. There are anecdotes that mention the existence of an even larger vessel known as the Jong, surpassing the size of the *Perahu Besar Terengganu*, as highlighted by Mohd Yusof [1], Shaffer [5], Sabri [35].However, to the locals, these accounts are solely oral traditions passed down through generations with no tangible remains or records.

At present, there are only two last remaining units of the *Perahu Besar Terengganu*, which have been conserved and are now exhibited at the Terengganu State Museum. They serve as tangible evidence of the splendor and wisdom of our Malay ancestors.It is truly remarkable that such a large vessel could be operated by fewer than 15 *awak* (sailors), including a nakhoda (captain) [1, 34].

Those two units of *Perahu Besar* are T.82 *Perahu Besar Sabar* dan T.65 *Perahu Besar Kemajuan*. For various unavoidable reasons, the exhibited *Perahu Besar Terengganu* currently lack sails. However, a fully authentic prototype of the *Perahu Besar Terengganu* has been constructed, as shown in Figure xxx. The prototype showcases the impressive size of the sails. This efficiency stems from traditional local wisdom, which led to the invention of pulley blocks, locally known as *Buah pir*. Moreover, the absence of oars further reduced the number of crew needed (*awak*) *[1, 32]*.

Figure 2: *Perahu Besar Sabar* entering the dock (Source: Lembaga Muzium Negeri Terengganu)

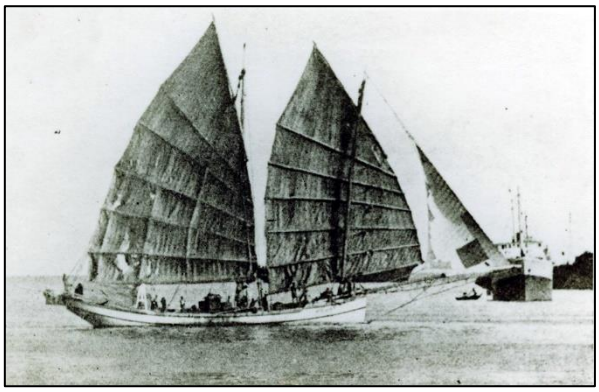


Figure 3: *Perahu Besar Terengganu* in voyage (Source: Lembaga Muzium Negeri Terengganu)

E. Types of Sails

Sails are essential components of any traditional watercraft. *Perahu Besar Terengganu* itself consists of 3 sails that play vital role in controlling its speed and safety precautions against the storm during the voyage. Schooner is sail boat that consist of two or more sails [36]. Hence, *Perahu Besar Terengganu* fall under schooner type of sailboat. Mohd Yusof [1], Gibson [34], Gibson [37] and Longuet [20] listed three sails of *Perahu Besar Terengganu* namely; *Layar Agung* (Prime Sail), *Layar Topang* (Secondary Sail) and *Layar Jib* (*Jib* Sail/ Head Sail/Fore Sail); were made of woven *kercut* matt (Lepironia articulata) which is heavy, durable and sturdy to stand against the strong wind and climate. *Layar Agung* (Prime Sail), *Layar Topang* (Secondary Sail) and *Layar Jib* are hold by *Tiang Agung* (Mainmast), *Tiang Topang* (secondary mast) and *Tiang Jib* respectively. Tiang *Jib* is the only horizontal mast whilst the other two masts stand vertically. The sails are rested down on the *Sangga* when the *Perahu* anchors whilst during the voyage, the sails will be pulled up to the top of mast. In situation where the storm hits during the voyage, the sails need to be rolled half way down for safety measure [12, 32]. Controlling the huge and heavy sails is impossible without *Buah pir*. *Buah pir* plays vital roles as blocks and charm locks so as to ensure sails and masts are ready for the voyage. *Buah pir* is meaningless without *abah-abah*. *Abah-abah* plays their important roles as halyards, sheets as well as stay and shrouds.

VII. FINDINGS

A. Definition of Buah pir

Buah pir are significant components of *Perahu Besar Terengganu* that play critical roles in sail support and control system. Some of them played their roles as blocks (on boat, pulley is called as block) in while the others as charm locks. Some of them works as masts support system whilst some other works as sail controlling components. There 8 types of *Buah pir* that will be explicitly discussed later. *Buah pir* is a group of essential components on *Perahu Besar Terengganu* that:

1) allow a vast vessel like Perahu Besar Terengganu to voyage with small number of sailors including the captain. This is because Buah pir have taken the role of human in loading and unloading heavy goods, raising up and lowering down sails as well as sails control.

2) satisfy the Occupational Safety and Health requirements when:

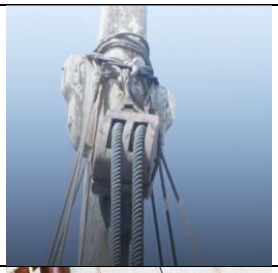
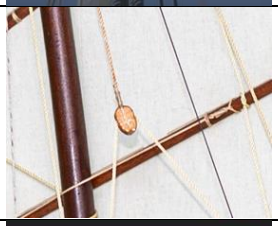
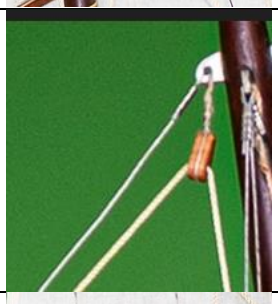
- *a) no awak is required to climb up the mast especially during the voyage since Buah pir take control of sail control system.*
- *b) no sailors is required to carry heavy loads/goods as Buah pir also works as block in loading and unloading goods.*

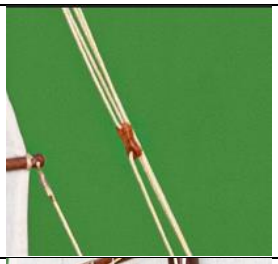
B. Types of Buah pir and the rigging associated with the Buah pir utilized in the sail system of Perahu Besar Terengganu.

The findings from interviews identified eight types of *Buah pir* utilized in the construction of the *Perahu Besar Terengganu*. However, through additional observation, this study revealed an eighth type—*Buah pir Jib*—increasing the total to eight. The *Buah pir* operate in conjunction with the *abah-abah* (rigging) connected to each pulley block. Notably, each *abah-abah* is named after the specific *Buah pir* to which it is attached.

Table 1 below presents the types of *Buah pir* alongside their shapes, positions and corresponding *abah-abah*.

Table 1: Types, shapes and positions of *Buah pir* with corresponding *abah-abah*

No.	Types of *Buah pir*	Picture		*Abah-abah* / Rigging
		Shape	Position	
1	*Buah pir Bubut* *Description:* Functions as a standalone component without requiring a pair.			*Tali bubut*
2	*Buah pir buai* *Description:* Single skit pulley block that functions as a standalone component without a pair.			*Tali buai*
3	*Buah pir anjor* *Description:* A dead eye pulley block that *f*unctions as a standalone component without a pair.			*Tali anjor*
4	*Buah pir lang brang* *Description:* Function in a pair of two similar shapes of dead eye pulley block.			*Tali lang brang*
5	*Buah pir temerang* *Description:* Combination of a pair of single and double skit pulley blocks.			*Tali temerang*/ *Temerang* turut
6	*Buah pir jib* *Description:* A dead eye pulley block that functions in a pair of two.			*Tali jib* / *tali* misai

7	*Buah pir kelat* *Description:* A pulley block that works in a pair of two units.			*Tali kelat*
8	*Buah pir kelai dara/ kelandra* *Description:* Eye drop pulley blocks that work in a set of 4.			*Tali kelai dara* / *tali* kelandra

C. Number of each types of buah pir on a Perahu Besar Terengganu

In order to ensure efficiency of the riggings, observations revealed that each type of *buah pir* varies in quantity. A summary of these findings is presented in Table 2 below:

Table 2: Number of each types of *Buah pir* on a *Perahu Besar Terengganu*

No.	Types of ***Buah pir***	Quantity/pairs
1	*Bubut*	2 units
2	*Buai*	4 pairs
3	*Anjor*	2 units
4	*Lang brang*	8 pairs
5	*Temerang*	6 pairs
6	*Jib*	2 pairs
7	*Kelat*	4 units
8	*Kelai dara*	2 units

Two units of *Bubut* are employed, with one positioned on the top *Layar Agung* and the other on the *Layar Topang*, serving as essential components for their respective sails. Similarly, the *Buai* consists of four sets, with two sets allocated to each of the *Layar Agung* and *Layar Topang*.

The *Anjor* is used exclusively for the *Layar Jib* and includes two units, highlighting its specialized function in the rigging system. The *Lang brang* is more extensive, with eight pairs in total noting the importance of mast support. These are evenly distributed, with four pairs assigned to the *Tiang Agung* and four to the *Tiang Topang*. On each mast, two pairs are positioned on the left and two on the right side, ensuring balanced lateral support.

The *Temerang* comprises six pairs, with four sets dedicated to the *Layar Agung* (two on each side) and the remaining two pairs assigned to the *Layar Topang*. For the *Layar Topang*, the *Jib* includes pairs, one on the left and one on the right side, enhancing the sail's adjustability and performance. Additionally, the *Kelai dara* consists of two units, with one unit located on each of the port and starboard sides. Finally, the *Kelat* includes four units, evenly divided with two units for the *Layar Agung* and two for the *Layar Topang*.

This distribution demonstrates the intricate rigging system of the *Perahu Besar Terengganu*, with each *buah pir* tailored to its specific role, reflecting the wisdom and precision of traditional boatbuilding practices.

D. Classification the rigging based on their specific functions within the sail system

Abah-abah are lines connecting to *buah pir that form rigging systems*. Their names are given based on *Buah pir* they are connected to. Originally, *abah-abah* was made from coconut fibre ; as agreed by all respondents; but, As time passes time, the material evolved into nylon, iron cable and jute. *Tali jib*, lang *brang* and *temerang* also known as *temerang turut* evolved from coconut fibre rope to iron cable to suit its function as mast support.

The rigging system of the *Perahu Besar Terengganu* is a well-engineered arrangement designed to efficiently control sails and provide structural support to the mast. It is divided into three main functional categories.

First, the halyards, consisting of *Tali Bubut* and *Tali Anjor*, are responsible for raising and lowering the sails. Second, the sheets, which include *Tali Temerang*, *Tali Buai*, *Tali Kelat*, and *Tali Kelai Dara*, control the angle and tension of the sails, optimizing performance during navigation. Lastly, the stays and shrouds (mast support), made up of *Tali Temerang*, *Tali Lang brang*, and *Tali Jib*, provide crucial structural stability to the mast, ensuring safe and stable operation while sailing.Since *tali temerang* plays two roles as mast support and sail adjustment, hence, it is important to note that not all *tali temerang* can be released simultaneously. Instead, if the *tali temerang* on the port side is released, the *tali temerang* on the other side must remain secured in its cleat.

Together, these components create a highly efficient and cohesive rigging system. The design reflects the ingenuity of traditional Malay maritime craftsmanship, prioritizing ease of use and adaptability to diverse sailing conditions. Each type of rope (*tali*) plays a specific yet interconnected role, ensuring the rigging system is both functional and secure, safeguarding the vessel and its crew during voyages. The detailed classification is illustrated in Fig. 4 below, providing a clear framework for understanding their functions and roles within the rigging system.

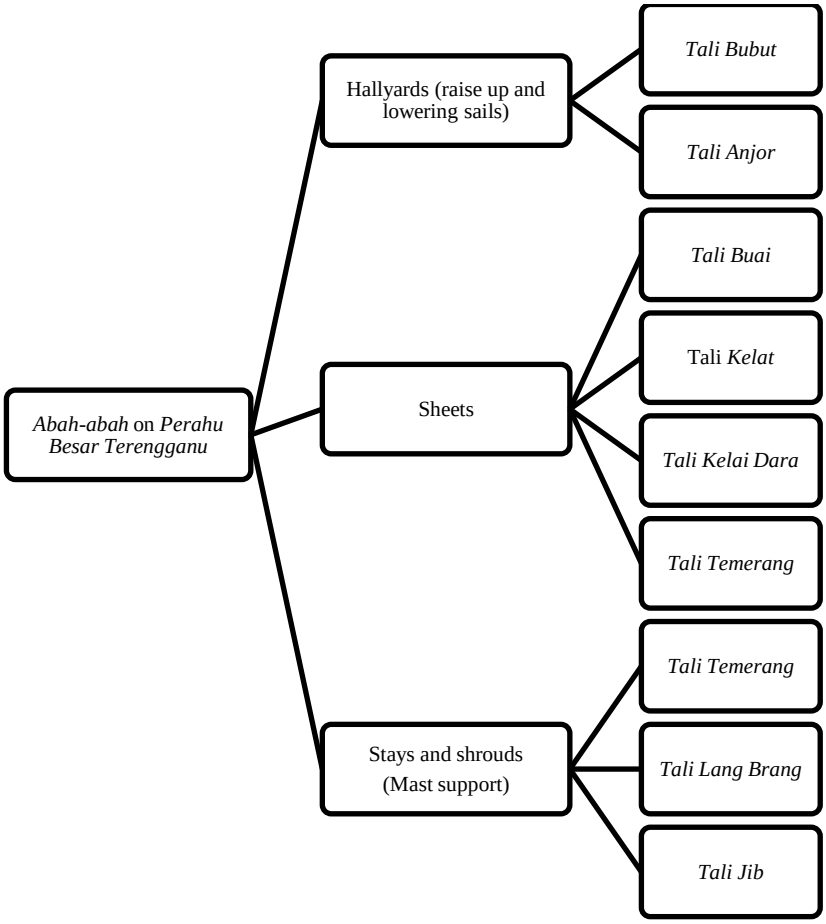


Figure 4: Summary of Classification of aba-abah on *Perahu Besar Terengganu*

VIII. Discussion and Conclusion

Terengganu, located on the Malay Peninsula, has been acknowledged by scholars such as Shaffer (2015), Smith (2008), and Kimura (2016) as the historical heartland of the Malays, famed for their advanced maritime technologies. The Malays' groundbreaking marine innovations, including the invention of the balanced-lug sail and their navigation capabilities, which enabled voyages to destinations like Ceylon (Khalid, 1991) and New Guinea around 1000 BCE (Cremin, 2007), underscore their remarkable achievements in boatbuilding and navigation during the first millennium BCE.

This study, centered on the sail components of the *Perahu Besar Terengganu*, provides a significant contribution to the understanding of maritime heritage. It offers valuable insights into the traditional Malay vessels' structural components, potentially connected to the advanced sailing systems referenced in historical records. As

Kimura (2016) highlighted, distinctive features of Malay vessels—such as their bowsprit and bamboo-reinforced sails—are remarkable achievements in naval design. This study discovered that those distinctive features are also shared by the *Perahu Besar Terengganu* which sails are made from woven *kercut* (*Lepironia articulata*) mats and battened with bamboo that is called as *buluh apit*. By documenting and analyzing these components, this research serves as a bridge between the ingenuity of historical maritime technologies and contemporary understanding, emphasizing the importance of preserving and studying traditional nautical knowledge.

The study identified and classified the types and numbers of *buah pir* and their corresponding *abah-abah* (rigging) on the *Perahu Besar Terengganu* based on their functional roles. A total of eight types of *buah pir* and their associated *abah-abah* were categorized into three functional groups: halyards, sheets, and stays and shrouds. Notably, the classification of *buah pir* is based on their function rather than their shape. For example, while the *buah pir* jib shares a similar design with the *buah pir anjor*, the former is employed as a single unit, whereas the latter is used in pairs. These findings challenge the statement by Horridge (1982) regarding the use of pulley blocks and rigging within the archipelago, which he noted as being primarily placed at the top of the mast. Instead, the findings indicate that pulley blocks and rigging are utilized not only at the top of the mast but also along the mast itself and secured on the deck.

This documentation not only enhances our understanding of the *Perahu Besar Terengganu* but also highlights the ingenuity of traditional Malay shipbuilding technology. It highlights the necessity of preserving such knowledge for future generations, bridging historical narratives with modern efforts in cultural preservation, and contributing to sustainable heritage management.

ACKNOWLEDGMENT

This study was carried out under Faculty of Architecture and Ekistics Universiti Malaysia Kelantan, sponsored by Ministry of Higher Education Malaysia under Biasiswa Hadiah Latihan Persekutuan (HLP) KPT(BS)790812115356 in collaboration with Universiti Teknologi Mara Seremban, Politeknik Ungku Omar and Terengganu State Museum. Therefore, we would like to express our gratitude to all stakeholders involved.

REFERENCES

[1] Mohd Yusof, A., Pengangkutan Air Negeri Terengganu. 2021, Terengganu, Malaysia: Penerbit UMT.
[2] Altun, S., The Reflection of Mesopotamia Water Transportation to Figurative Arts. International Journal of Environment and Geoinformatics, 2015. 2(3): p. 57-60.
[3] Fauzi, M. Pengangkutan Air di Terengganu. in Seminar Kearifan Tempatan Maritim, Merungkai dan Memperkasa Warisan Jatidiri Bangsa. 2022. Lembaga Muzium Negeri Terengganu.
[4] Manguin, P.-Y., The Southeast Asian Ship: An Historical Approach. Journal of Southeast Asian Studies, 1980. 11(2): p. 266-276.
[5] Shaffer, L.N., Maritime Southeast Asia to 500. 2015: Routledge.
[6] Griffis, W.E., The Japanese Nation in Evolution: Steps in the Progress of a Great People. 1907: New York: TY Crowell.
[7] Porter, R.P., The ten republics: an introduction to the South American series in Porter's progress of nations. 1911: G. Routledge and sons, Limited.
[8] Mohd Salleh, H.A., Mohd Yusof,A.(1987), Bunga Emas Terengganu. . 1987. Pesaka IV.
[9] Liebner, H., Perahu-perahu tradisional nusantara. Eksplorasi Sumberdaya Budaya Maritim, 2005: p. 53-124.
[10] Baco, Z. and S. Chia, Penyelidikan Arkeologi Bawah Air di Semenanjung Malaysia (1902-2015). Jurnal Arkeologi Malaysia, 2020. 33(1): p. 49-63.
[11] Azmi, N.C.M., Kepentingan Perahu Besar Terengganu, N.N.S. Aini, Editor. 2024.
[12] Mohd Yusof, A., Perahu Besar Terengganu; History and Sailing N.S.A. Ngah, Editor. 2024.
[13] Johari, H., Buah Pir Perahu Besar Terengganu, N.S.A. Ngah, Editor. 2024.
[14] Nordin, W.A.W., Importance of Buah Pir. 2024.
[15] Nawi, Y., Komponen dan Pembinaan Perahu Besar Terengganu. 2024.
[16] Horridge , G.A., The design of planked boats of the Moluccas. 1978: National Maritime Museum.
[17] Holmes, G.C., Ancient and Modern Ships-Part I. Wooden Sailing-Ships. 2016: Read Books Ltd.
[18] Mark, S., NOTES ON THE MEDITERRANEAN AND RED SEA SHIPS AND SHIP CONSTRUCTION FROM SAHURE TO HA TSHEPSUT. Journal of Ancient Egyptian Interconnections, 2014. 6(2): p. 34-49.
[19] Abd Wahab, N., N.A.S. Bahri, and N.S. Mohamed, Tukang Timbal: Kebijaksanaan Akal dan Teknologi Tradisional dalam Pembuatan Perahu di Terengganu, 1900-1941: Tukang Timbal: Wisdom and Traditional Technology in Boat Building in Terengganu, 1900-1941. SEJARAH: Journal of the Department of History, 2023. 32(1 (April)).
[20] Longuet, R., Update on Boats and Boat Building in the Estuary of the Terengganu River, 1972-2005. MBRAS 2009.
[21] Maidin, P., Tukang timbal membina perahu: Tradisi dan inovasi. Sari, 2003. 21: p. 39-56.

[22] Smyth, H.W., Boats and boat building in the Malay Peninsula. Journal of the Society of Arts. 1902: p. 570-588
[23] Varadarajan, L., Indian boat building traditions. The ethnological evidence. Topoi. Orient-Occident, 1993: p. 547-568.
[24] Kimura, J., Archaeology of East Asian Shipbuilding. 2016: University Press of Florida.
[25] Smith, R.L., Premodern trade in world history. 2008: Routledge.
[26] Wallace, A.R., The Malay Archipelago: The land of the orang-utan, and the bird of paradise: A narrative of travel, with studies of man and nature; in two vols. Vol. 2. 1869: Macmillan.
[27] Mohd Yusof, A., Perahu Besar Terengganu, in PESAKA 1985: Muzium Negeri Terengganu.
[28] Kamal, M., Pembinaan Perahu Besar dan Ilmu Pelayaran Umat Islam Terengganu, in Fakulti Pengajian Islam. 1992, Universiti Kebangsaan Malaysia: Selangor.
[29] Hashim, M.Y., Terengganu Darul Iman Tradisi Persejarahan Malaysia. 1991, Kuala Lumpur: Dewan Bahasa dan Pustaka, Kementerian Pendidikan Malaysia.
[30] Maidin, P., Evolusi dan Pelestarian Teknologi Perkapalan Melayu di Semenanjung Malaysia: Kajian Kes di Terengganu, in Institut Alam dan Tamadun Melayu. 2005, Universiti Kebangsaan Malaysia.
[31] Ghawi, A., Dokumentasi Perahu dan Simbol-Simbol Yang Terdapat Dalam Perahu Tradisi Terengganu, in Fine Art. 1981, Institut Teknologi Mara: Shah Alam, Malaysia.
[32] Mohd Yusof, A., Ilmu Kelautan, Perahu Dan Pelayaran Melayu Terengganu. Pembentang, Persidangan Antarabangsa Manuskrip Melayu, 2017.
[33] Maidin Pisol , T.A., Kemahiran Tukang Kayu Dalam Kejuruteraan Perahu Melayu:Mengiktiraf Keahlian Mereka Berdasarkan Teori Malakh Ibn Khaldun. Journal of Contemporary Islamic Studies, 2015. I 2015.
[34] Gibson, H.C.A., M.A, F.R.A.I, Cargo Boats of the East Coast of Malaya. Journal of the Malayan Branch of the Royal Asiatic Society, 1949. 22(3 (149)): p. 106-125.
[35] Sabri, M.M., Sejarah Perahu Besar Terengganu, N.S.A. Ngah, Editor. 2024.
[36] Fraser, K., A Dictionary of the World's Watercraft: From Aak to Zumbra. Reference Reviews, 2000. 16(1): p. 36-36.
[37] Gibson, H.C.A., M.A, F.R.A.I, The Origin of The Trengganu Perahu Pinas. MBRAS 1953.