Safety Assessment Of Passenger Boat And Houseboat At Temenggor Lake, Malaysia

Muhd Farhan Abd Razak, Noor Apandi Osnin, Noorul Shaiful Fitri Abdul Rahman, Saharuddin Abdul Hamid , Abd Kader Ab Saman

Abstract: Temenggor Lake is located at 45 kilometers from Ulu Perak district capital, Gerik and it is a man-made lake that was created between 1960s and 1970s. Temenggor Lake consists the Temenggor dam and it is used to generate electricity for the local citizen on that area. Due to the large area, Temenggor Lake has been developed as a recreational lake. The purpose of this research is to identify the safety level of boat at Temenggor Lake. The first phase of this research is identified the total number of passenger boat and houseboat that has been registered with Persatuan Pengusaha Pelancongan Tasik Temenggor and types of life-saving appliances used on passenger boat and houseboat by observation and interview session with an expert. Interview session and questionnaires have been distributing in order to collect all the related data and this data has been analyzed by using risk matrix method to identify the rank of the risk that occurred at Temenggor Lake. The final phase involved a few data from Malaysia Marine Department, Persatuan Pengusaha Pelancongan Tasik Temenggor and United Stated Coast Guard and comparison has been made between those data to make some suggestions on increasing the safety of boat at Temenggor Lake by using bench marking method. Based on the result of this research, drown of children is the highest risk for passenger boat and man over board is the highest risk for houseboat. As the conclusion, most accidents involving navigation on inland water are the cause from the lack of safety equipment onboard at Temenggor Lake.

Index Terms: Life-Saving Appliances, Risk Matrix, Bench Marking, Malaysian Lake, Safety.

————————————◆————————————

1 INTRODUCTION

Temenggor Lake is located at the Eastern of Perak, Malaysia. It consists of tropical rain forest and it is the second largest lake in Peninsular Malaysia after Kenyir Lake, Terengganu. Temenggor Lake is located at 45 kilometers from Ulu Perak district capital, Gerik and it is a man-made lake that was created between 1960s and 1970s. It consists the Temenggor dam, which responsible for generate electricity for local population on that area. Temenggor Lake has a large area which is over 70 kilometers in length and up to 5 kilometers wide with 120 meters' depth. Other than that, Temenggor Lake was surrounded by Royal Belum rain forest. Due to its large area, Temenggor Lake is used as a resort for outside visitor, tourist and local citizens. According to Temenggor Lake Tourism Association (2019), the total number of tourist at Temenggor Lake can be estimated around 25,000 tourists on 2018 and around 32,000 tourists on 2019. The increasing number of visitors are affecting the marine traffic at the Temenggor Lake. Due to the increase of the number of visitors, the number of recreational boaters are also increased to fulfil the visitors demand. There are two types of boat at Temenggor Lake that serve tourist which are passenger boat and house boat.

———————————————

• *Muhammad Farhan Abd Razak is currently pursuing masters degree program in Nautical Science and Maritime Transportation in University of Malaysia Terengganu, E-mail: p3919@pps.umt.edu.my*
• *Dr. Capt. Noor Apandi Osnin is a senior lecturer in University Malaysia Terengganu. His research relies on safety of navigation on inland waters. E-mail: apandi@umt.edu.my*
• *Assoc. Prof. Ts. Dr. Noorul Shaiful Fitri is a senior lecturer in International Maritime College Oman. His research relies on maritime operations, maritime business and economics, logistics distributive, shipping and port management, risk assessment. E-mail: noorul@imco.edu.om*
• *Prof. Dato' Dr. Saharuddin is a senior lecturer in University Malaysia Terengganu. His research relies o maritime developmental policy, marine environmental and resource managements. E-mail: sdin@umt.edu.my Ir. Prof. Dr. Ab Saman is a senior lecturer in University Technology Malaysia. E-mail: abdsaman@utm.my*

Thus, this study compares the compliances on the lake safety at Temenggor lake with the international guidelines of US Coast Guard and Merchant Shipping Ordinace. The findings of this study can help the stakeholder to reduce the accidental and mortality risk at the Malaysian Lake. This study on inland navigation operational framework could be as a catalyst harmonisation of national and international standard and practices in order to enhance safety of navigation operational framework to another body of inland water where involved in inland navigation. The government and local authority will gain benefit from the collected data on this study in enhancing inland navigation operational framework toward developing and sustaining Malaysia as a world class for tourist and cultural destination. Malaysian lake is used for transport, livelihood and leisure which has been involved in inland navigation (NAHRIM, 2010)[1][2]. The increasing number of boaters and tourist are affecting the boat traffic at the Malaysian Lake. Marine Department of Malaysia (2019) clarified that there is no unified regulatory for safety equipment on Malaysian Lake. Therefore, any rule or requirement needed for Malaysian Lake will be involved by local authority. However, most of the boat operators does not prepare enough safety equipment such as life jacket, first aid and fire extinguisher to prepare from any emergency situation that would occur during navigation. Life-saving appliances is used to ensure the safety of person while they are under sail (Malaysian Police Marine, 2019). International Maritime Organization (IMO) (2000) has been enforced a few regulations about life-saving appliances and it should be followed by all merchant vessel to ensure the safety of crew life at sea[3]. United Stated Coast Guard (USCG) (2012) reported that 459 people were drowned out of 4,515 recreational boating that had an accident. Based on the number of the drowning victims at United States, only 15% of the drowning victims were wearing personal floating device which is life jacket. (USCG, 2013). As a result, life jacket can reduce the risk of drowning when the risk of drowning occurred. The observation was made and the data collected showed that the used of life jacket among US adult recreational boaters on open motorboats was only 5.3% and the others were not used the life jacket in 2010 (USCG, 2013;

JSI 2016)[4]. The main objective of this research been conducted is to access the safety status of passenger boat and houseboat during navigate at Temenggor Lake by establishing the status of safety of passenger during navigation at Temenggor Lake by observation, comparison to other established lakes and provide recommendation in order to enhance the safety status of the lake.

2 METHODOLOGY

In order to determine the safety status of passenger during navigation at Temenggor Lake, this study has been conducted based on a combination of a few method such as risk matrix method and bench marking method. The first step in this study is to carry out an observation on research area to collect and gather all the related data and information. For the second steps has been conducted to compare any applicable regulatory matter relating to safety requirement at Temenggor Lake. This collected and gathered data has been compared with other lake where safety requirements is applied for passenger boat and houseboat at inland waters. The results is to establish the safety status of passenger at Temenggor Lake and provided recommendation to enhance the safety status of passenger at Temenggor Lake. However, secondary data from any related sources such as lake authorities will also be gathered and collected in order to determine any applicable regulatory and the types of water craft at Temenggor Lake.

2.1 Risk Matrix

Risk matrix is a part of formal safety assessment. However, formal safety assessment is process of ensuring that action need to be taken before any tragedy that might occur on certain area (IMO, 2018)[5]. For the first step of this method which is to identify any hazard at Temenggor Lake, literature reading, expert engagement and observation on research area has been conducted. Sample is randomly selected among the respondent having different background including the navigator, the owner of the boat, business owner, and stakeholder. The study area is precisely located at the Temenggor Lake Jetty, Gerik, Perak, Malaysia (5°33'28.7"N, 101°20'48.5"E). However, most of literature such as (Kopacz et.al., 2001), (Hu et.al., 2007) and (Kuwata et.al., 2014)[6][7][8] were focused on open water that related to navigation and it is not specified on inland waters or any locked bodies of waters. Therefore, review on a critical risk that related to navigation were listed down and opinion from the expert were considered to determine which hazard or risk that relevant to Temenggor Lake.

TABLE 1

REVIEW OF CRITICAL RISK OF NAVIGATION THAT RELEVANT TO TEMENGGOR LAKE

Hazard	Description	Source
Collision	Contact between vessel and any vessel or object that may cause damage to vessel or object	Marine Insight, 2016b; House, 2012 [9]
Sinking	Ingress of water that may cause damage to vessel	Wartsila, 2018[10]
Capsize	Occur when vessel lost its control and turn over upside down	Marine Insight, 2017b[11]
Fire	Presence of smoke and fire that may cause damage to vessel	Marine Insight, 2016a[12]
Drowning	An emergency situation where a vessel's crew or passenger falls out into the water and cause lost of life	Ketengah, 2017; Malaysian Marine police, 2017
Man Overboard	An emergency situation where a vessel's crew or passenger falls out into water	Marine Insight, 2018b [13]

For the second step of this method is conducting risk analysis. Risk Matrix has been conducted to identify the likely and the highly risk that occurred at Temenggor Lake. Risk matrix is a matrix that used during risk assessment and to define the level of every risk that occurred by considering the category of probability or any likelihood against the category of consequence severity (Julian Talbot, 2018)[14]. Risk matrix is a simple mechanism to identify and increase the visibility of risks and could assist management decision making during research activities. However, the objective of this research is to assess the safety of passenger during navigation at Temenggor Lake. Therefore, this method only consume 2 steps in this formal safety assessment. In order to gather all the related data regarding the level of safety of passenger at Temenggor Lake, questionnaire using Likert Scale has been distributed randomly with five response categories (1-5) for the hazard (Sullivan &Artino, 2013)[15] to different background such as lake authority, marine police of Temenggor Lake, boat navigator and local citizen. All the collected data were analyzed by using risk matrix formula and data were presented in the form of risk matrix table to show the highly and likely risk that occurred at Temenggor Lake, Malaysia. For example, the data value for collision of passenger boat is calculated as follows for each respondent:

Risk = Likelihood x Severity

$$Collision = \frac{R1 + R2 + R3 + etc..}{Total\ Re\ spondent}$$

The mean value indicating the preferred choice is calculating using the Equation:

$$\bar{x} = \frac{R}{Total\ Re\ spondent}$$

The mean value for each critical risk of navigation that related to Temenggor Lake were presented in Risk Matrix table and risk level of critical risk of navigation at Temenggor Lake were identified and ranked based on the highest risk to the lowest risk.

2.2 Bench Marking

Bench marking is about the measurement of the quality in an organization and a comparison between two organization's qualities (Wren Hawthorne, 2015)[16]. There are few objectives of the important of bench marking which is to determine what is the improvement and where the improvement can be implant in order to increase the level of the safety status in an organization (Eddie W.L, 1998)[17]. This research is comparing the minimum safety requirement status based on a few requirement safety status from major organization such as Merchant Shipping Ordinance (MSO) and The United State Coast Guard Safety Requirement. The collected data regarding the safety requirement from a few major organization then were compared with current safety

requirement that has been practiced at Temenggor Lake.

3 SECTIONS

3.1 Risk Identify

A set of survey form were distributed and used interview and observation on safety equipment of passenger boat and houseboat at Temenggor Lake. All the data has been analysed by transfer it to the Microsoft Excel Spreadsheet® 2016 to depicts the research output in the form of risk matrix table. For example, all collected data will be analysed by using risk matrix and transfer it to the Microsoft Excel Spreadsheet® 2016. the data for drown of children for passenger boat is calculated as follows:

$$Collision = \frac{3+2+8+...n}{70} = 3.66$$

The results of the respondent judgement regarding the risk level of critical risk of safety navigation at Temenggor Lake for passenger boat are listed in table 2 and risk level of critical risk of safety navigation at Temenggor Lake for houseboat are listed in table 3 as below.

TABLE 2
RISK LEVEL OF CRITICAL RISK OF SAFETY NAVIGATION AT TEMENGGOR LAKE FOR PASSENGER BOAT

Hazard	Mean ($\bar{x}$)
Collision	3.66
Drown of children	13.23
Sinking	9.44
Capsize	6.74

TABLE 1
RISK LEVEL OF CRITICAL RISK OF SAFETY NAVIGATION AT TEMENGGOR LAKE FOR HOUSEBOAT

Hazard	Mean ($\bar{x}$)
Drown of children	10.77
Fire Onboard	6.41
Sinking	3.33
Man Overboard	13.2

All analysed data were ranked based on their mean in order to identify the highest risk at Temenggor Lake. Based on the Table 4, it shows that the higher risk that occur at Temenggor Lake is drown of children for passenger boat followed by sinking of passenger boat, capsize of passenger boat and lastly collision of passenger boat. Other than that, Table 5 shows that man overboard is the highest risk of accident for houseboat and at the top of the rank and followed by drown of children, fire on board and lastly sinking of houseboat.

TABLE 4
RANKING OF RISK OF ACCIDENT FOR PASSENGER BOAT

RISK \ SEVERITY	1	2	3	4	5
Collision of passenger boat	(1-4)	(5-8)	(9-12)	(13-16)	(17-20)
Drown of children for passenger boat	(1-4)	(5-8)	(9-12)	(13-16)	(17-20)
Sinking of passenger passenger boat	(1-4)	(5-8)	(9-12)	(13-16)	(17-20)
Capsize of passenger boat	(1-4)	(5-8)	(9-12)	(13-16)	(17-20)

TABLE 5
RANKING OF RISK OF ACCIDENT FOR HOUSEBOAT

RISK \ SEVERITY	1	2	3	4	5
Drown of children for passenger boat	(1-4)	(5-8)	(9-12)	(13-16)	(17-20)
Fire Onboard	(1-4)	(5-8)	(9-12)	(13-16)	(17-20)
Houseboat Sinking	(1-4)	(5-8)	(9-12)	(13-16)	(17-20)
Man Overboard	(1-4)	(5-8)	(9-12)	(13-16)	(17-20)

3.2 Safety Requirement Benchmark

Due to the minimum requirements that has been setup by the lake authority that responsible in Temenggor Lake, every passenger boats should bring at least: Total number of life jacket must be equal to the total capacity of boat

1. 1 unit of first aid should be onboard.

However, minimum requirements that has been setup by the lake authority, every houseboat should bring at least;

1. 4 units of fire extinguisher
2. 1 first aid
3. 2 rescue boat for each houseboat
4. Muster station plan
5. Total number of life jacket based on the total capacity of houseboat.

Table 6 shows the comparison between United Stated Coast Guard and Temenggor Lake Authority requirements. There is a slight different between both, whereby the US Coast Guard is more stringent than Temenggor Lake Authority. Regarding to the Table 7, MSO had few differences on the requirement such as every boat shall bring at least 1 unit of lifebuoy and at least 4 unit of child life jacket[18]. Meanwhile, Temenggor Lake Authority does not have the requirement to bring 1 unit of lifebuoy and 4 unit of child life jacket. Last but not least, there

264

is no different on safety requirement between MSO and Temenggor Lake which is every boat shall bring at least 1 unit of first aid and 1 of unit fire extinguisher based on Malaysia Shipping Ordinance requirement.

TABLE 6
COMPARISON BETWEEN USCG AND TEMENGGOR LAKE AUTHORITY

EQUIPMENT	US COAST GUARD	TEMENGGOR LAKE AUTHORITY
LIFE JACKET	Based on total capacity of passenger + 1 lifebuoy (more 16ft)	Based on total capacity of passenger
FIRST AID	1 first aid	1 first aid
FIRE EXTINGUISHER	1 fire extinguisher	1 fire extinguisher

TABLE 7
COMPARISON BETWEEN MSO AND TEMENGGOR LAKE AUTHORITY

EQUIPMENT	MERCHANT SHIPPING ORDINANCE	TEMENGGOR LAKE AUTHORITY
LIFE JACKET	Based on total capacity of passenger + 2 lifebuoy + 3 child life jacket	Based on total capacity of passenger
FIRST AID	1 first aid	1 first aid
FIRE EXTINGUISHER	1 fire extinguisher	1 fire extinguisher

Based on the findings, we suggest an organization that has responsibilities should observe the level of safety of boat at Temenggor Lake so that the safety level can be implement. Moreover, the precaution should be taken by organizational to plan and to monitor every boat operator to ensure that the safety of boat at Temenggor Lake maintained their high level.

4 CONCLUSION

Based on table 4, the highest risk of accident that occur for passenger boat at Temenggor Lake is drown of children and table 5 shows that the highest risk of accident that occur for houseboat is man overboard. According to District Council of Hulu Gerik (2019) stated that most accidents involving passenger during navigation on inland water are the cause from the lacks of safety equipment onboard of passenger boat and houseboat at Temenggor Lake. Thus, the recreational boater activities should be determined and the level of safety of boat should be at safe level because it will affect the number and the average of tourism to the Temenggor Lake. In addition, there are several practicable ways to improve the safety of boat at Temenggor Lake such as following all the requirements that has been set up by lake authorities to ensure all the safety equipment can be use on the mean time. Lastly, the method that has been used in this study could be applied to other body of inland water that involved in inland navigation. This should be done towards harmonisation of practices and requirement for inland navigation in order to improve safety of passenger and operational efficiency

5 ACKNOWLEDGEMENT

6 AUTHORS' DECLARATION

On behalf of all authors, the corresponding author stated that there is no conflict of interest.

7 REFERENCES

[1]. Noor, B., & Bin, A. (2010). Developing A Strategy Plan for Lakes and Reservoir Management i M in Malaysia l i Presentation Outline Lake Issues in Malaysia Lake Management Initiatives in Malaysia That In conjunction. March, 1–28.

[2]. Rohács, J., & Simongáti, G. (2007). The role of inland waterway navigation in a sustainable transport system. Transport, 22(3), 148–153. https://doi.org/10.1080/16484142.2007.9638117

[3]. Distress, G. M., & Search, M. (2000). Surviving disaster – life-saving at sea. Surviving Disaster – Life-Saving at Sea, 44(0), 1–13.

[4]. Quistberg, D. A., Bennett, E., Quan, L., & Ebel, B. E. (2014). Low life jacket use among adult recreational boaters: A qualitative study of risk perception and behavior factors. Accident Analysis and Prevention, 62(October), 276–284. https://doi.org/10.1016/j.aap.2013.10.015

[5]. IMO. (2018). MSC-MEPC.2/Circ.12/Rev.2 | Revised Guidelines for FSA for use in the IMO rule-making process. 44(2).

[6]. KOPACZ, Z., MORGAŚ, W., & URBAŃSKI, J. (2001). The Maritime Safety System, its Main Components and Elements. Journal of Navigation, 54(2), 199-211.

[7]. HU, S., FANG, Q., XIA, H., & XI, Y. (2007). Formal safety assessment based on relative risks model in ship navigation. Reliability Engineering & System Safety. 92, 369 – 377.

[8]. KUWATA, Y., WOLF, M.T., ZARZHITSKY, D., & HUNTSBERGER, T.L. (2014).Safe Maritime Autonomous Navigation With COLREGS, Using Velocity Obstacles. IEEE Journal of Oceanic Engineering. 39, 110 – 119.

[9]. HOUSE, D.J. (2012). Seamanship Techniques. New York. Routledge.

[10]. WARTSILA. (2018). Angle of flooding. https://wartsila.com/encyclopedia/term/angle-of-flooding. Accessed 16 July 2018

[11]. MARINE INSIGHT. (2017c). Reasons for capsizing of a ship. https://www.marineinsight.com/know-more/reasons-for-capsizing-of-a-ship/ . Accessed 16 July 2018.

[12]. MARINE INSIGHT. (2016a). Basics of Fire Prevention on Board Ships. https://marineinsight.com/marine-safety/basics-of-fire-prevention-on-board-ships/ . Accessed 16 July 2018

[13]. MARINE INSIGHT. (2018b). Man Overboard Situation on Ship and Ways to Tackle it. https://www.marineinsight.com/marine-safety/man-overboard-situation-on-ship-and-ways-to-tackle-it/   . Accessed 16 July 2018

[14]. Julian Talbot. (2018). Security Risk Management. https://www.juliantalbot.com/post/2018/07/31/whats-right-with-risk-matrices

[15]. SULLIVAN, G.M. & ARTINO, JR A.R. (2013). Analysing and Interpreting Data from Likert-Type Scales. Journal of Graduate Medical Education. 5(4), 541 – 542

[16]. What is Benchmarking? - Definition, Types, Process & Examples. (2015, September 18). Retrieved from https://study.com/academy/lesson/what-is-benchmarking-definition-types-process-examples.html.

[17]. Wah Fong, S., Cheng, E. W. l., & ho, D. C. k. (1998). Benchmarking: A general reading for management practitioners. Management Decision, 36(6), 407–418. https://doi.org/10.1108/00251749810223646

[18]. United States Coast Guard. (2012). a Boater'S Guide To the Federal Requirements for Recreational Boats and Safety Tips. 45