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eISSN: 2805-5195 Journal homepage: <https://journal.umt.edu.my/index.php/jml/index>

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**To cite this article:** Umi Syahirah Mohamed Fazlee, Mohammad Saifullah Yusoff, Nur Ruzana Mohd Rof'ie, Nurul Haqimin Mohd Salleh, Nor Hasni Osman, Mohd Azhafiz Abdullah, Kasypi Mokhtar, Lai Fatt Chuah & Awais Bokhari (2023): Maritime accident analysis in Malaysian waters, *Journal of Maritime Logistics*

DOI: <https://doi.org/10.46754/jml.2023.12.004>

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# MARITIME ACCIDENT ANALYSIS IN MALAYSIAN WATERS

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## ABSTRACT

The South China Sea and Malacca Strait witness over 60% of annual maritime trade, but the escalating fleet and ship sizes pose a heightened risk of accidents. This study analyses Malaysia's maritime accidents from 2018 to 2021, categorizing incidents and exploring ship types and ages. General cargo ships emerge as most susceptible to accidents, with collisions being the most frequent. The findings reveal significant correlations between accident percentages and ship ages. These insights can aid seafarers, government agencies and relevant organizations in formulating risk prevention measures, effective response plans and strategies to bolster safety management in Malaysian waterways.

Keywords: Maritime accidents, Malaysian waters, marine safety.

## Introduction

Maritime transportation is essential to worldwide trade and the global economy. Maritime shipment is the most ecologically friendly, secure, economical, and energy-efficient mode of transportation for goods (Chuah *et al.*, 2022). Over 90% of global trade occurs via the sea (Liu *et al.*, 2021). Seaborne trade is anticipated to make up almost 90% of all trade in 2020 and, after increasing 5%, to a total of 1.21 x 10<sup>9</sup> t in 2021, which is a significant part of the world economy (Chuah *et al.*, 2023). Approximately 105,500 merchant ships with a total tonnage of at least 100 GT (United Nations Conference on Trade and

Development, 2023) and a crew of 1.6 x 10<sup>6</sup> seafarers are thought to be in operation around the world (International Labour Organization, 2019). Bulk carriers make up 43% of the total merchant ship fleet, oil tankers 29%, container ships 13%, general cargo/multipurpose ships 4%, and others 11% (Chuah *et al.*, 2021).

Due to an expansion of worldwide maritime trade, the shipping sector has grown rapidly in the past few decades. The growth of international transportation has caused increasingly difficult safety challenges to the shipping sector. Maritime accidents continue to occur often and have had substantial effects despite the deployment of a variety of safety-enhancing actions. The size and quantity of ships are rapidly increasing and it is probable that this is increasing the chance of future maritime accidents.

Active shipping activities cause some navigation seas to become congested and invariably increase the risk of ship mishaps viz. collision, contact, and grounded. Substantial accident rates reported at seaports worldwide make it increasingly perilous to navigate maritime transportation at sea. Maritime accidents are the primary concern since it occurs often and can result in the loss of life, environmental damage, and economic

loss. As reported in the New Straits Times (2021), a massive container ship owned by a Taiwan company, the MV Ever Given, got stranded somewhere in the Suez Canal after a blast of wind pushed it off track, halting maritime operations through one of the busiest trade routes in the world. On December 15, 2021, a boat sank in heavy weather off the coast of southern Malaysia, killing at least 11 Indonesian migrants and leaving 27 people missing (New Straits Times, 2021). The Eastern Star ship, a passenger ship, capsized in 2015, killing 442 passengers (Wang & Yang, 2018). All 32 crew members were killed when the Sanchi oil tanker collided with Hong Kong-flagged cargo ship CF Crystal on January 6, 2018, while hauling 136 x 103 t of oil from Iran to South Korea. Accidents would cause a considerable amount of property damage and a significant number of fatalities. Maritime authorities, the shipping industry, and society are increasingly concerned about ship navigation safety.

According to Allianz Worldwide Corporate and Specialty (2022), there were 2,703 marine incidents and casualties reported in 2020, including the loss of 49 large ships on a global scale. It also stated that the most frequent reasons for losses at sea during the previous 10 years were hull/machinery damage, collision (involving vessels), fire/explosion, wrecked/stranded (grounded), and foundered (sunk, submerged). The Global Integrated Shipping Information System (GISIS, 2023) estimates that between 2011 and 2022, there were roughly 3,821 maritime accidents. All the aforementioned maritime accidents caused fatalities, damage to property, and harm to the marine ecosystem (Ceyhun, 2014). Numerous studies on incidents and casualties have been conducted and their findings may be utilised to provide decision-makers with accurate information to help reduce maritime accidents.

Discussions of marine safety and navigation are becoming more important

and analysing maritime accidents has become one of the most efficient methods of decreasing the risk of sea transport (Fan *et al.*, 2020). In accordance with the International Maritime Organization (IMO) proposal, every serious maritime incident should be investigated to glean lessons and create the foundation for the conventions and contracts developed for prevention. Once the risk information has been analysed, it can be utilised to establish risk control, create suitable policies, and assign resources to reduce the risk. For instance, in 1914, following an examination of the Titanic catastrophe, the International Treaty for Safety of Life at Sea (SOLAS), the first international convention intended to increase the safety of life at sea, was ratified. The International Safety Management Code (ISM code), which was developed because of the Ro-Ro ferry Herald of Free Enterprise disaster inquiry findings, is now a comprehensive measure to emphasise the significance of management concerns in the marine industry. The public, the shipping industry, and maritime authorities are all growing more concerned with navigation safety.

Most research on maritime accidents focuses on the frequency, consequences, or risk assessment of accidents, whereas studies on the complex relationship between accident rates and ship ages, as well as other contributing factors, are extremely uncommon. Only a few pieces of literature have claimed to be about maritime accidents in Malaysian waters. There was no research on the characteristics and interactions of accident-related factors. Haron (2015) looked at the amount and pattern of incidents, ship types, and fatal marine incident analyses in Malaysian waters. Hanafiah *et al.* (2022) investigated the state of marine traffic and created a decision-making model for the Malacca Strait but not the entirety of Malaysian waters. It is hard to adequately show the density of occurrences in Malaysian waters

because the data was only limited to the Malacca Strait.

In this study, a dataset of maritime accidents in Malaysian waters from 2018 to 2021 involving 197 ships was collected from the IHS SeaWeb® database, Google Alert database, the Marine Department Malaysia, the GISIS, and other trusted sources. This study aims to analyse the maritime accident occurrence in Malaysian waters from 2018 to 2021 based on ship type, ship age, and accident categories. It is important to establish risk control and create suitable policies, including assigning resources to minimise the risk of maritime accidents.

This paper is organised as follows: A review of earlier research on maritime casualties in Section 2, an evaluation of previous maritime accidents and the data collection in Section 3, and findings of the analysis reviewed in Section 4. A more in-depth study of the link between the ship age and accident percentage was undertaken. The conclusion and further research for the study are provided in the last Section.

## Literature Review

Maritime accidents are unexpected, unusual occurrences involving ships that regularly result in fatalities, serious injuries or property damage. These challenges have grown to be a major problem in the maritime industry (Jiang & Lu, 2020). Serious maritime accidents might result in deaths, economic loss, pollution, and traffic congestion, as well as an increase in trade costs and volume (Liu *et al.*, 2021).

There has also been an exploratory statistical study of accident data using various quantitative techniques. Banda *et al.* (2015) studied the risk of winter navigation in Finnish marine regions using descriptive accident statistics by integrating accident data with historical ice condition data. In order to create a BBN model for accident outcomes, Zhang *et al.* (2016) statistically analysed accident information in the Tian

Port region. The descriptive data showed the accidents related to the location/area and the ship types. Ventikos *et al.* (2017) analysed historical data as part of efforts to create a model for forecasting accident rates in various Aegean Sea regions. They discovered that more than half of accidents involved bulk carriers and Ro-Ro vessels, and the majority of the ships were more than 25 years old. Eleftheria *et al.* (2016) analysed the frequency of ship accidents (normalised by yearly operational ships) of various kinds of vessels using a sample of 4,572 incidents worldwide. Bulk carriers, general cargo ships and other Ro-Ro cargo vessels were discovered to be the most prone to accidents. Fishing, liquefied natural gas (LNG), liquified petroleum gas (LPG) and reefer vessels were the least accident-prone. The study found that increasing ship age heightened the chance of accidents and discovered a favourable relationship between the age of vehicle carriers and bulk carriers and accident frequencies. De Vos *et al.* (2021) conducted a statistical analysis to ascertain the breakdown of human fatalities and lost ships by accident type, ship type and ship size. It was concluded that foundered ships and collisions are the most dangerous accidents, with fires/explosions accounting for the majority of fatalities and ship losses. It also found that the likelihood of a ship loss was greater for smaller vessels under 120 m in length. Using a gray relational analysis, Xu *et al.* (2020) analysed the maritime accident data for New Zealand from 2015 to 2018 to examine the distribution and relationships between specific variables (ship type, water area, and season) and maritime accidents.

Numerous scholars have examined the accidents that take place in various marine locations due to the majority of maritime accidents having links to specific geographical features. Through a geographical study, Wang *et al.* (2014) analysed the safety of shipping across the South China Sea and discovered that the

environment's hazard level decreased over time from the north to the south. Wang and Yang (2018) highlighted that the kind and area of accidents, as well as the ship type and age were the key factors impacting the accident severity of maritime transportation in China. Goerlandt *et al.* (2017) looked at the pattern of the sea ice conditions and atmospheric circumstances of different accident and operation types that occurred during winter nautical incidents in the Northern Baltic Sea between 2007 and 2013. Kum and Sahin (2011) investigated the underlying factors that led to the Arctic maritime accidents from 1993 to 2011 and made recommendations on how to avoid human error in Arctic waterways.

According to the literature review, many researches on maritime accidents mostly emphasised the examination of causes and the likelihood of accidents in the open sea. Only a few studies investigated accidents in coastal waters. This current study endeavours to investigate the contributing elements using original data obtained from the accident reports, as well as analyse the related aspects, such as ship types, accident categories and ship age. It also examined any potential relationship between the accident percentage and the ship age.

The IMO was established in March 6, 1948, in Geneva, Switzerland and entered into force on March 17, 1958. The IMO has historically made a conscious initiative to enhance the effect on the safety of all vessels, specifically vessels registered under flags of convenience, and this work rightly emphasises the safety of the ships directly (Abuelenin, 2017). The IMO acknowledges the significance of marine safety investigations into maritime accidents and events in order to prevent recurrence, enhance maritime safety and prevent pollution. The IMO adopted the Investigation of Marine Casualties and Incidents Code by "(resolution A.849 (20)" amended by "(resolution A.884 (21)" and "(resolution A.849 (20)" on November 27.

The 84<sup>th</sup> meeting of the Maritime Safety Committee (MSC) held in London between 7 and 16 May 2008 resulted in the IMO adopting the accident research code as a requirement. Such a code would incorporate safety studies, suggested methods and worldwide regulations for maritime accidents or incidents. Members of the convention must conduct a maritime safety investigation for each maritime accident in line with the code and report its findings to the IMO (International Maritime Organization, 2022). Electronic reporting to IMO is performed using the GISIS, which features the Maritime Casualties and Incidents (MCI) dataset, comprising a unique collection of MCI data.

## Methodology

After the study's broad and precise objectives were established, the study's design and instruments used to gather data were created. Figure 1 depicts the method used for this study.

The maritime accident record in Malaysia from 2018 to 2021 was statistically analysed based on ship types, accident categories and ship age. The study also investigated the potential relationships between accident percentage and the ship age. In this study, both quantitative and qualitative methodologies were employed in the data collection and analysis processes. Examining the work area served as the main method of information gathering, which required a thorough evaluation of significant material from earlier investigations and records.

In order to gather real, accurate, and solid information regarding maritime accidents in Malaysian waters, the researchers focused on reports, rules, laws, and regulations related to maritime accidents in Malaysian waters. Pertinent information on maritime accidents in Malaysian waters was discovered via Google Alert, which was subsequently utilised to assess a variety of archival sources. According to Neuman

(2014), the principle of interpretation is a key component of qualitative research. In this context, documents, papers, and studies were picked based on the reputation of the website, an organisation or an institute that

published it, as well as the organisation or institute's contributions to the maritime industry. The data were analysed using RapidMiner and Minitab 19, with the goal of determining the factors that led to maritime accidents in Malaysian waters.

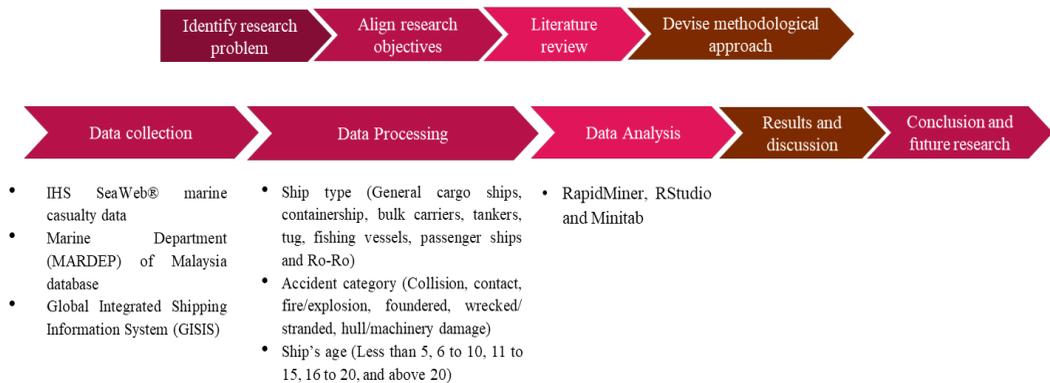


Figure 1: Research methodology

**Maritime Accident Data**

The collection of accident records is necessary in order to create an accident dataset, which has strict requirements for both quantity and quality. IHS SeaWeb® marine casualty data, Google Alert, the Marine Department Malaysia, the GISIS database, and other reliable sources were used to compile a dataset of maritime accidents in Malaysian waters from 2018 to 2021.

**Ships Included in the Analysis**

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**Categorisation of the Accident Type**

In this study, there are six categories of accidents: Contact, collision, fire/explosion, foundered, wrecked/stranded, and hull/machinery damage. Collision means when one vessel strikes or is struck by another vessel on the water's surface, regardless of whether the ship is moving, anchored or moored. The term 'fire/explosion' refers to a circumstance in which the fire or explosion is the first occurrence to be recorded unless a hull/ machinery failure precedes the fire or explosion (Wang *et al.*, 2021). The term "foundered" encompasses ships that capsized for reasons other than those listed in the other accident categories, such as bad weather, leaks, etc. While "wrecked/stranded" refers to ships that have been recorded hitting the sea bottom or running aground, including running into bars and other obstacles. Entanglement in submerged wrecks falls under this category. Ships that have been lost or damaged due to hull/machinery failure are included under hull/machinery damage.

## Results and Discussion

The statistical analysis was undertaken to determine the proportion of accident incidence for all ship types and accident categories, as well as relating the ship age. The major findings are then analyzed and summarized. This Section displays the accident percentage by ship type, year accident category and ship age.

### Statistic per Ship Type

Figure 2 presents the percentage of accidents per ship type. In 2018, container ships had the lowest percentage at 4%, followed by Ro-Ro (6%), bulk carriers (7%), tankers (9%), fishing vessels (9%), and passenger ships (11%). Tugs (20%) and general cargo ships (33%) had the highest accident percentages. In 2019, fishing vessels had the lowest accident percentage, with a value of 2%, followed by bulk carriers (7%), passenger ships (9%), containerships (15%), tugs (16%), and tankers (20%). The highest accident percentage was general cargo ships (31%).

Ro-Ro and containership had the lowest accident percentage in 2020, with a value of 2%, followed by bulk carriers (6%), passenger ships (13%), tugs (21%), and tankers (23%). The highest accident percentage was for general cargo ships (32%). In 2021, the lowest accident percentages were Ro-Ro and bulk carriers, namely 2% and 5%. On the other side are tankers (7%), containerships (10%), and Tugs (20%). The highest accident percentage was general cargo ships (24%) and passenger ships (32%).

From this statistic, it is clear that general cargo ships are the most vulnerable to accidents, whereas containerships, bulk carriers, Ro-Ro and fishing vessels are the least vulnerable. This makes sense given that general cargo ships frequently travel routes with several port calls, increasing their exposure to the dangers associated with low-speed maneuvering (Ventikos *et al.*, 2018). All accident types typically involve cargo ships. This might be accounted for by the fact that these ships are often quite small and their crew members need to be better trained.

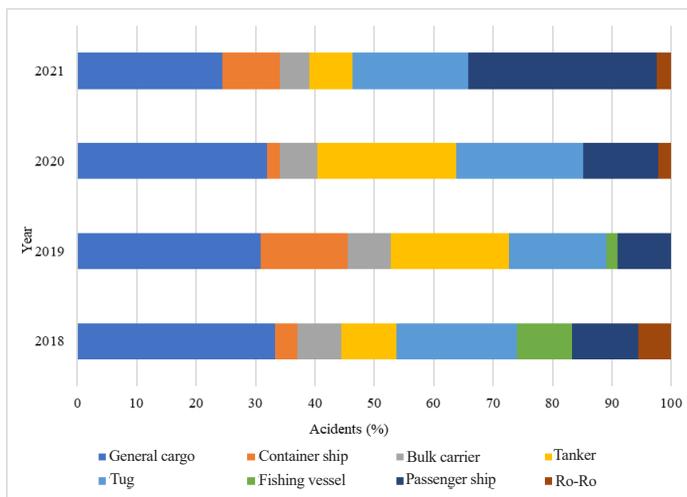


Figure 2: Accidents percentage of ship types per year

### **Statistic per Accident Category**

Collisions are the category of accidents that occur most frequently at 30% (Figure 3). Collisions at sea can result from crew members making mistakes or being careless. Similar to going against the flow of road traffic while travelling abroad, variations in marine traffic plans across different locations can confuse ships' crews. The primary factor in marine collisions is human error, including negligence by crew members or lack of understanding of maritime traffic schemes across different regions. There are also several other causes of ship collision, such as equipment failure, which include loss of maneuvering, engine failure or other malfunctions and bad weather conditions (high winds, storms at sea, ice flows, and fog). In many cases, weather is only a contributing factor in a collision.

Figure 4 presents the accident percentage by ship type and accident category. In terms of hull/machinery damage, containerships, fishing vessels, and Ro-Ro vessels continue to account for the smaller percentages, with each type of vessel making up 3%. The higher percentages of accidents involved tugs (15%), tankers (15%), bulk carriers (12%), and general cargo ships (12%). Passenger ships had the highest percentage at 38%. The majority of hull/machinery damage events were due to improper maintenance and overloading or hull deterioration on a vessel. To minimise the risk of accidents caused by hull/machinery damage, a standard maintenance and repair procedure involving testing, repair and maintenance of equipment is needed. Individuals conducting these procedures must use the correct parts and tools and ensure system integrity and safe operation according to specifications. It is also important to identify the deterioration of ships' hull/structure to minimise accidents. The crews of ships must be aware of the vulnerability of the ships.

According to Papanikolaou *et al.* (2015), the majority of wrecked/stranded events occur on cargo ships including tankers, bulk carriers and general cargo ships. General cargo ships and tugs make up the bulk of wrecked/stranded events at 29% and 25%, respectively. Containerships and fishing vessels make up the lowest percentage, 4% each. The most frequent cause of wrecked/stranded incidents is intensifying storms as a ship lies at anchor until it starts to drag (Shigunov & Papanikolaou, 2014). This decreases maneuverability and power for secure operation in poor weather (Papanikolaou *et al.*, 2015). Rotational tides can cause wrecked/stranded incidents. Many ports around the world only allow ships to enter the port during high tide due to the problem of draft. This incident may occur to ships anchored in a port due to unexpected tide shifts. When a ship is wrecked/stranded, the bottom part of the ship strikes the ocean floor, causing structural damage. Similar to collisions, human error has also resulted in shipwrecks and strandings.

While containerships and bulk carriers were not involved in any accidents, tankers and Ro-Ros have the lowest rate of foundered occurrences (4% each). The highest percentage were general cargo ships (61%), followed by tugs (14%), and passenger ships (11%). Weather conditions, particularly hurricanes or tropical storms, can cause ships to founder. Ships may also founder if there is a fire or explosion that causes them to take too much water. Capsized and foundering of smaller vessels can also be the result of lifting too heavy loads. Of all accident types, foundering can result in the greatest loss (Weng *et al.*, 2016). The ship's cargo may be lost, the whole crew could drown, and the ship could spill fuel or other contaminants into the environment. Ship safety should be improved by making sure that they are in good condition. Training is also necessary to guarantee that mariners can react swiftly and effectively in the case of a foundering accident.

According to observations, container ships (7%) and fishing vessels (7%) had the lowest rates of fire/explosion accidents, followed by tugs (13%), while passenger ships (33%), tankers (20%), and general cargo ships (20%) had the greatest percentage. De Vos *et al.* (2021) state that fire/explosion often involves ships carrying hazardous cargo, such as tankers. This study had a different result from the study by Eliopoulou *et al.* (2016), where car carriers and Ro-Ro cargo ships had the highest percentages of fire/explosion accidents, whereas the present study shows passenger ships had the highest percentage. A fire on a ship might occur in a variety of different ways, such as bad electrical wiring, leading to a shortage in the electrical system. A fire may also be started by an overheated engine or motor, and a gasoline leak has the potential to start or significantly worsen an existing fire. A stove or other cooking equipment in the galley can potentially start fires. The engine room is where a fire is most likely to originate and equipment failure is the most frequent cause of shipboard fires. Based on accident reports, defective machinery and cargo storage, insufficient ventilation, and sparking electrical wiring are causes of fire.

Bulk carriers and fishing vessels were the least involved in contact events, each with a percentages of f 4%, followed by passenger ships (7%), Ro-Ro (7%), tankers (11%), tugs (15%), and containerships (19%), while general cargo ships made up the majority of such events at 33%. It has the same causes as collision events. According to the accident accounts, a ship striking a pier either as it was maneuvering to berth or as it was leaving the port caused the majority of these mishaps.

For collision events, general cargo ships, tugs and tankers were the most involved, at 29%, 25%, and 22%, respectively. Passenger ships (6%), bulk carriers (7%), containerships (10%), and Ro-Ro (1%) are the least involved in collision events. Because general cargo ships, tugs and tankers often operate in crowded terminal areas, they have a higher percentage of being involved in collisions and contact events. Local maritime administrators need to pay special attention to collision accidents because they frequently have harmful impacts, especially when two ships are in situations that might result in an overtaking or crossing that could result in serious and life-threatening incidents in the coastal waters.

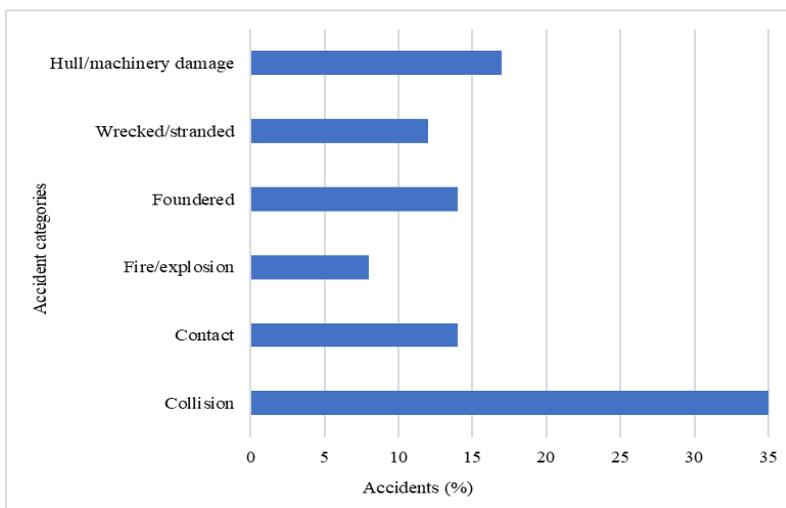


Figure 3: Percentages of accident category

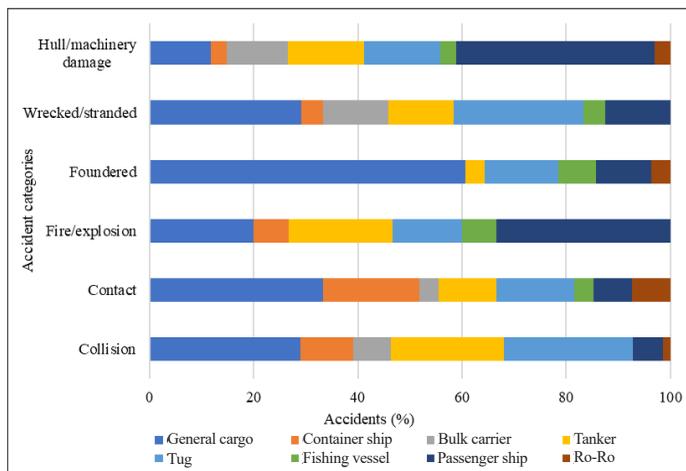


Figure 4: Accident percentages by ship type and accident category

### Statistics by Ship Age

In order to explore the potential impacts of ship age on accident rates, the sample of ships analysed is divided into five age groups: Less than 5 years old, between 6 and 10 years old, between 11 and 15 years old, between 16 and 20 years old, and over 20 years old. Figure 5 displays the average number of accidents by age group and basic ship type. Based on Eleftheria *et al.* (2016), two categories were identified: One with recognisable high percentages and the other with significantly lower percentages.

The high percentage category includes general cargo ships, passenger ships, tugs, and tankers, whereas the lower percentage category involves container ships, bulk carriers, Ro-Ro and fishing vessels. It should be noted that in all group ages, except for ships older than 20 years, the values of the first category of ships are almost twice as high as those in the second.

According to the data, accidents involving fishing vessels have the lowest overall percentage and practically the same value for all age groups, suggesting that the age of the ship appears to have little effect on the likelihood of accidents for this ship type. The fact that shipmasters are also frequently (principal) owners of

fishing vessels is one rationale for this as they have extensive knowledge of how their ship operates and how to deal with accident risks (Eleftheria *et al.*, 2016). Bulk carriers and fishing vessels less than five years old are not reported to be involved in accidents, and the rest of the ship types in this age group are the least involved in accidents, except passenger ships, which report the highest involvement in accidents among all age groups for this type of vessel. The high involvement of young passenger vessels in accidents could be due to poor shipbuilding in order to reduce costs (Chuah *et al.*, 2022) or inadequate crew training, communication issues and lack of competence in using the latest technology (Papanikolaou & Eliopoulou, 2008). In order to minimise the burden on shipowners, government financial assistance and favourable national shipping policies are needed. Tankers showed relatively low involvement in accidents till up to 20 years, but the incidence of accidents went up threefold after that. This indicates that accidents and ship age are almost linearly correlated in general cargo ships.

Accidents involving general cargo ships show an increasing trend in progressively older age groups. The percentage of

accidents involving general cargo ships in the age group of 16-20 years is higher than general cargo ships less than five years old. This indicates that accidents increase as ships age, with older ships reported to be involved in accidents at a rate three times higher than new-build vessels. General cargo ships and Ro-Ro older than 20 years are involved in significantly more accidents as fatigue and other structural issues gradually grow more serious. As was previously discussed, general cargo ships commonly navigate routes with several port calls, increasing their vulnerability to the risks related to low-speed maneuvering. A similar justification may be made for Ro-Ro accident rates. Ventikos *et al.* (2017) showed that the bulk of ships involved in accidents are older than 20 years, which supports the findings of this study.

The statistical analysis, encompassing accident percentages across different ship types, accident categories and ship ages, offers a comprehensive understanding of

the maritime accident landscape in Malaysia from 2018 to 2021. It is recommended that stakeholders in the maritime industry consider implementing targeted risk mitigation measures. Table 1 shows that general cargo ships have been identified as particularly vulnerable, emphasizing the need for enhanced safety protocols, especially in areas with multiple port calls. Given the prevalence of collisions and their significant impact on coastal waters, local maritime administrators are encouraged to prioritise collision prevention measures, especially in crowded terminal areas. The study's insights on the correlation between ship age and accident rates call for industry-wide attention to vessel maintenance standards, crew training and the development of stringent policies for older vessels. By translating these findings into actionable recommendations, the study aims to contribute not only to academic discourse but also to the enhancement of practical safety measures within the maritime sector.

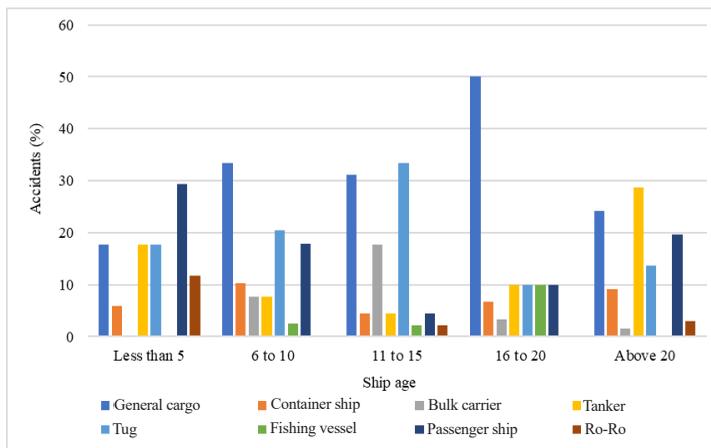


Figure 5: Accident percentages of ship type and age group

Table 1: Number of accidents by the ship type, for the years 2018 to 2021

General Cargo Ship	Container Ship	Bulk Carrier	Tanker	Tug	Fishing Vessel	Passenger Ship	Ro-Ro
60	15	13	30	38	6	30	5

## Conclusion and Future Research

This study used statistical analysis to examine probable correlations between accident percentages and ship ages and to analyse maritime accidents in Malaysia in relation to the proportion of ship accidents. Data from maritime accident investigation reports from Malaysia from 2018 to 2021 were used in the study. The study's findings show that general cargo ships are the most vulnerable to maritime accidents. This could be because general cargo ships regularly travel routes with several port calls, increasing their exposure to the risks related to the need for slow maneuvering and these ships are frequently small and have crews with relatively low levels of expertise.

Collisions are the most common type of accident. When two ships collide, the effects are devastating, including loss of life and environmental damage. Ecological harm is particularly pronounced in accidents involving vessels hauling chemicals or other potentially dangerous goods.

Advanced ship age does not necessarily correlate with higher incidences of accidents. It is more of a complex relationship that is influenced by a number of factors, including the type of ship and quality of (new) shipbuilding, the quality and extent of the ship's maintenance and the age of the ship. It is evident that an older ship, particularly one over 20 years old, is more vulnerable to maritime accidents.

Given these findings, it is suggested that the authorities and organisations take into account the following suggestions. First, it is important for local maritime administrators to pay close attention to collision accidents because they frequently result in serious consequences. Especially when two ships are crossing or attempting to overtake one another. Second, better design, building and survey with more exact regulation and inspection standards would help prevent structural or mechanical failure and

accidents involving new ships. To lower the risk of maritime accidents, the authorities must also make sure that maintenance plans and procedures are appropriate, especially for ships older than 20 years.

This research has several limitations. First, several important elements, such as navigational circumstances at the time of accidents, the ship sizes and weather conditions, could not be considered due to limitations in the source data and information. The sample duration could only span 48 months due to the availability of data. It is advised that the data quality of accident reporting be improved. Research for each ship type was not conducted, which may be helpfully taken into consideration in future studies. It is advised to take into account the geographical patterns of Malaysian maritime accidents using GIS in subsequent studies. Lastly, data on further incidents throughout the course of 17 years, from 2005 to 2021, are being gathered to help with data quantification and research the many causes of maritime accidents in the Straits of Malacca.

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