



UDC 332

## STRATEGY TO IMPROVE SAFETY ON CARGO SHIPS

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### ABSTRACT

In sea transportation, shipping safety is the main goal. In Indonesia, the safety of shipping for commercial vessels refers to national regulations, namely the Law of the Republic of Indonesia Number 17 of 2008 concerning Shipping and international regulations regarding shipping safety, namely the Safety of Life at Sea 1974. The risk of emergencies and work accidents on ships can occur at any time. This study aims to provide a strategy to improve shipping safety. The method used in this study is a SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats), respondents in this study were the crew of an Indonesian flag cargo ship with the name motor vessel Y (MV.Y), totaling 18 people. Based on the results of the IFAS and EFAS calculations, the MV.Y safety SWOT analysis obtained a total strength factor score of 1.92, a total weakness factor of 1.17, a total opportunity factor score of 1.14, and a total threat factor of 1.68 meaning that MV.Y has strengths are greater than threats and weaknesses. Still, even so, MV.Y must take advantage of opportunities to minimize threats and weaknesses to improve ship safety. The MV.Y safety position in the SWOT analysis quadrant diagram at the second quadrant position (S-T) with coordinates (0.4; -0.3) so that the ship and MV.Y shipping company to diversify the strategy to improve ship safety, namely the condition of safety equipment in dealing with emergencies, the readiness of ship crews in dealing with emergencies, implementation of safety procedures in avoiding work accidents and emergencies on ships and readiness of equipment and safety documents by port authorities.

### KEY WORDS

Ship safety, strategy to improve safety, cargo.

The development of world trade and logistics distribution cannot be separated from the support of the maritime industry (Chen et al., 2019). Cargo ships are ships that carry cargo in the form of goods (Rausyan et al., 2016). Cargo ship is a ship designed to transport goods from shipper to consignee by sea. Ships that are included in the type of cargo ship such as container ships, general cargo ships and bulk ships. A cargo ship is a type of commercial ship whose purpose is to make a profit, but the main objective is shipping safety.

In shipping, shipping safety is very important, ships must have shipping safety equipment, including lifeboats, life jackets, fire extinguishers, seaworthy documents, and certificates (Hendrawan, 2019). In an effort to ensure the safety of ships, the maritime industry requires good and wise safety practices to avoid accidents (Oluseye et al., 2015). In terms of documentation of the safety of commercial vessels, 87.85% were carried out, in terms of human resources, namely crew members in safety, the survey results showed the readiness of 83.38% (Prasadjia et al., 2021)ю

Different sea conditions can also cause accidents, such as when the ship is in narrow waters, the risk of accidents will increase (Ozturk & Cicek, 2019). The causes of marine accidents that cause overall losses vary, one of the causes of ship accidents at sea caused by human error is 60% to 90% (Baker & McCafferty, 2005).

International regulations governing the safety of commercial vessels are regulated in the 1974 Safety of Life at Sea (SOLAS) regulation issued by the International Maritime Organization (IMO). Life-saving appliances and arrangements on commercial vessels are regulated in the 1974 Chapter III Safety Of Life at Sea (SOLAS) regulation, this chapter covers requirements for safety equipment (life Jackets, life buoys, life rafts, lifeboats,



Immersion suits, and the number of safety equipment, muster station, emergency training, and drill (IMO (International Maritime Organization), 2020).

In SOLAS chapter IX there are regulations for commercial vessels regarding management for the safe operation which are described in the International Safety Management Code. In the ISM Code part, A, rule 8 (eight) regulates emergency preparedness and rule 10 (ten) concerns ship maintenance and maintenance (IMO (International Maritime Organization), 2015).

National regulations governing shipping safety in Indonesia are regulated in Law Number 17 of 2008 concerning shipping. Shipping safety is a condition of the fulfillment of safety and security requirements concerning transportation in waters and the maritime environment. The minister gives ships that meet safety requirements a safety certificate. The captain is responsible for the safety of the ship, and the crew is obliged to obey the captain. Every ship must be manned by crew members who meet the qualification and competence requirements according to national and international regulations (Law Number 17 of 2008).

Although there are already national and international regulations on safety, accidents at sea in Indonesia are still increasing. According to the Indonesian Maritime Transportation Accident National Committee investigation data in 2010-2016, as in Figure 1, ship accident data.

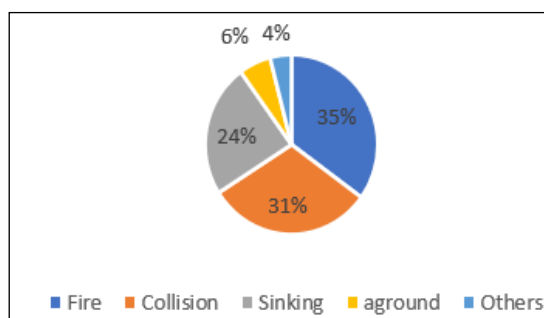


Figure 1 – Ship Accident Data % (Source: National Transportation Safety Committee of the Republic of Indonesia, 2010-2016)

Ship accident data based on Figure 1, it can be seen that the number of ship accidents increased from 2010 amounting to 5 accidents to 15 accidents in 2016, the types of accidents that occurred consisted of fire 35%, collision 31%, sinking 24%, aground 6%, others 4% (The National Committee for Transportation Safety of the Republic of Indonesia, 2016).

In addition to the threat of emergency situations such as fires, aground, collisions, leaks, there are also risks from work accidents and ship operations. There is a relationship between knowledge of p-value of 0.037, attitude of p-value of 0.044 and supervision of p-value of 0.037 on unsafe behavior in workers (Jesica et al., 2018). The cause of work accidents on ships is due to the lack of discipline in the use of safety equipment at work (Rahmat & Islami, 2016).

Work safety is a process of planning and controlling situations that have the potential to cause danger through the preparation of procedures that become a reference in work. Work safety is related to work in the work environment, work tools, workplace, and workers (Qomariyatus, 2018).

In cases of ship traffic accidents, the human factor is a crucial factor causing accidents, apart from the relationship between humans and machines (Han et al., 2021). In dealing with emergencies, influencing factors include crew training, safety culture, and crew preparedness (Kuncowati et al., 2023). Based on the results of the investigation by the National Transportation Safety Committee of the Republic of Indonesia, 2022, it can be explained that the main factors influencing shipping accidents are human factors, namely 16 accidents, then technical factors causing 14 shipping accidents, and natural factors causing



1 shipping accident. So this research aims to provide strategies to reduce the number of accidents on cargo ships.

### METHODS OF RESEARCH

This research was conducted on the Motor Ship Y (MV.Y), which is a type of Indonesian-flagged cargo ship with a crew of 18 people.

Population is a generalization that includes subjects or objects that have certain characteristics and qualities determined in the study to then draw a conclude (Sugiyono, 2013). The sample collection technique used is a saturated sample, that is, all populations are used as samples because the population is less than 30 people (Sugiyono, 2018). In this study, the sample was 18 people, a number of crew members of Motor Vessel Y (MV.Y)

The research method used is descriptive quantitative with technical analysis of SWOT (Strengths, Weaknesses, Opportunities, and Threats). The steps of the SWOT analysis are identifying internal environmental factors, namely strengths and weaknesses, identifying external environmental factors, namely opportunities and threats, then calculating IFAS (Internal Factor Analysis Summary) and EFAS (External Factor Analysis Summary) on the results of the questionnaire, which has been distributed to respondents which includes weighting, rating and score. After getting the results of calculations with IFAS and EFAS then mapping the SWOT matrix to get the company's strategy (Dwi & Indra, 2019).

In this study, identification is carried out on the internal factors on Motor Vessel Y (strengths and weaknesses) that affect the safety of the ship and the identification of external environmental factors of the ship (opportunities and threats) that affect the safety of the ship, then entered the IFAS calculation, EFAS then made a SWOT matrix to provide a strategy for improving safety on cargo ships.

### RESULTS AND DISCUSSION

An internal factor which is the strength factor and weakness factor, Internal safety strength factor of Motor Vessel. Y, there are 5 (five) factors are as in Table 1, Factors of ship safety strength MV.Y.

Table 1 – Strength factors of MV.Y

No	Strength
S1	The ship has a safety certificate
S2	Condition of safety equipment
S3	Crews have certificates of competence and professionals
S4	The ship is equipped with ship safety procedures and documents
S5	Ships are equipped with personal protective equipment

An internal factor which is a safety weakness factor of Motor Vessel. Y (MV.Y) consists of 6 (six) weakness factors as shown in Table 2, weakness factors of MV.Y.

Table 2 – Weakness factor of MV.Y

No	Weakness
W1	Inspection and maintenance of safety equipment by ship crew
W2	Implementation of crew safety training
W3	Personal Protective Equipment
W4	Safety meeting
W5	Filling of safety documents
W6	Leadership and teamwork skills

External factors which are opportunity factors MV.Y amounted to 5 (five) opportunities as shown in Table 3, Opportunity factor of MV.Y.



Table 3 – Opportunity factors of MV.Y

No	Opportunity
O1	Implementation of safety training
O2	Implementation of updating competency certificates
O3	Implementation of refreshing certificate of proficiency
O4	Support from the government, shipping companies, shipping company agents National and international safety Regulations
O5	Regulations

External factors that are a threat to the safety of MV.Y consists of 5 (five) threats, that is weather factors, safety equipment, emergency on board, and inspection as shown in Table 4, factors of ship safety threat.

Table 4 – Safety Threat factor of MV.Y

No	Threat
T1	Weather factors that occur in the voyage
T2	Improper operation of safety equipment
T3	Emergency on board (collision, aground, fire, leak, blackout, abandon ship, a man overboard)
T4	Work accidents (falls from heights, slips, falls on objects, gets injured)
T5	Inspection and supervision of the port authority

Internal Factor Analysis Summary (IFAS) calculation results in strength factor MV.Y got a score of 1.92, as a Table 5, calculation of strength factors.

Table 5 – Calculation of strength factors

Strength	Weight	Rating	Score
S1	0.12	4	0.48
S2	0.09	3	0.27
S3	0.11	4	0.44
S4	0.10	4	0.4
S5	0.11	3	0.33
Total			1.92

As shown in Table 5, calculation of strength factors, the highest internal strength score is the ship safety certificate (0.48) and the lowest score is the assessment of the condition of the safety equipment on board (0.27).

The result of the calculation of the Internal Factor Analysis Summary (IFAS) factor is the safety weakness factor of Motor Vessel Y (MV.Y) gets a score of 1.17. The highest weakness is the use of work safety equipment (W3) as shown in Table 6 Calculation of Weakness Factors.

Table 6 – Calculation of Weakness Factors

Strength	Weight	Rating	Score
W1	0.07	2	0.14
W2	0.08	3	0.24
W3	0.09	3	0.27
W4	0.07	2	0.14
W5	0.07	2	0.14
W6	0.08	3	0.24
Total			1.17

Based on calculation of strength factor, total strength value is 1,92 and calculation of weakness factor, total weakness value is 1,17 so it can be seen that the internal factor of ship safety is 3.09.

The results of the calculation of the probability factor on the safety of MV.Y get a score of 1.14. The highest chance to meet safety is safety regulation (O5) as in Table 7 Calculation of Opportunity factor.



Table 7 – Calculation of Opportunity Factors

Strength	Weight	Rating	Score
O1	0.09	2	0.18
O2	0.08	2	0.16
O3	0.08	2	0.16
O4	0.09	3	0.18
O5	0.10	3	0.30
Total			1.14

Calculation result of safety threat factor Motor Vessel (MV.Y) is 1.68. Threat factors to high safety are weather factors (T1 and T5) and ship readiness factors during supervision or inspection by the port authority as shown in Table 8, Calculation of Threat Factors.

Table 8 – Calculation of Threat Factors (Treat)

Strength	Weight	Rating	Score
T1	0.12	3	0.36
T2	0.10	3	0.30
T3	0.11	3	0.33
T4	0.11	3	0.33
T5	0.12	3	0.36
Total			1.68

Based on the calculation of EFAS (External Factor Analysis Summary) on the total number of opportunity and threat factors, the EFAS score is 2.28.

Based on the calculation results of EFAS and IFAS Motor Vessel Y, it can be seen the MV.Y safety position in the SWOT analysis as shown in Figure 2 quadrant the following SWOT diagram.

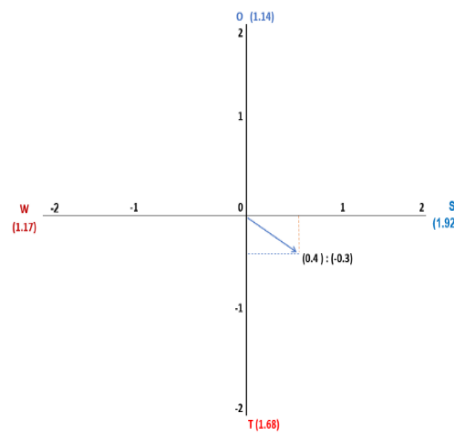


Figure 2 – SWOT Quadrant Diagram

Based on Figure 2, the SWOT quadrant diagram can be explained that the total strength factor depicted on the X axis is positive from 0 (zero) to the right of 1.92. The total weakness factors are depicted on the X axis from 0 (zero) to the left, with a negative value of 1.17. The total opportunity factor depicted on the Y axis is positive from 0 (zero) upwards of 1.14 and the total threat factor of 1.68 depicted on the y axis downward is negative from 0 to -1.68. Positional MV ship safety SWOT analysis. X is obtained from the internal analysis coordinates; the coordinates of the external analysis are ((S-W):2); (O-T):2)) so to get the coordinates of the MV SWOT analysis. X((1.92-1.17):2); (1.14-1.68):2). So that the coordinates of the MV.Y safety SWOT analysis position are (0.4; -0.3). The coordinates are in the second quadrant which is located between the strength axis (S) and the threat axis (T), which is located on the X axis which is the strength axis (S) of 0.4 and the Y axis which is the threat axis (-0.3).



EFAS	OPPORTUNITY	THREAT
<b>IFAS</b>	Q1 Implementation of safety training; Q2 Implementation of refreshing certificate of proficiency; Q3 Implementation of competency certificate updating; Q4 Support from the government, shipping companies, shipping company agents; Q5 National and international safety regulations	T1 Weather factors that occur in the voyage; T2 Improper operation of the tool; T3 Emergence of an emergency on board (collision, aground, fire, leak, black out, abandon ship, man over board); T4 Occupational accident (fall from height, ship, fall from object, injury); T5 Inspection and supervision of the port authority
<b>STRENGTH</b>	<b>STRATEGY S-O</b>	<b>STRATEGY S-T</b>
<b>S1 Ship has safety certificate;</b> <b>S2 Condition of safety equipment;</b> <b>S3 Crews have certificates of competence and proficiency;</b> <b>S4 Ships have safety procedures;</b> <b>S5 Availability of personal protective equipment</b>	Provide opportunities for ship crews to improve their knowledge and skills in conducting inspections and maintenance of safety equipment on ships through safety training, updating competency certificates and refreshing proficiency certificates. (S1, S2, S3, O1, O2, O3, O4, O5); Maximizing the improvement of safety knowledge through safety training (S1, S2, S3, O1, O2, O3); Maximizing the support of shipping companies and the government in the fulfillment of safety equipment, increasing awareness of safety equipment and procedures. (S2, S3, S4, S5, O4, O5)	Safety equipment must be in a proper condition to deal with emergencies due to natural, technical and human factors. (S1, S2, T1, T2, T3); Increase the readiness of the crew in dealing with emergencies that may occur on the ship. (S3, T1, T2, T3); Implement safety procedures to avoid work accidents and emergencies. (S4, T1, T2, T3, T4); Equipment and safety document must be ready to be checked at any time by the port authority. (S1, S2, S3, S4 S5, T5)
<b>WEAKNESS</b>	<b>STRATEGY W-O</b>	<b>STRATEGY W-T</b>
<b>W1 Safety equipment inspection and maintenance;</b> <b>W2 Crew safety training;</b> <b>W3 Use of personal protective equipment;</b> <b>W4 Safety meeting;</b> <b>W5 Safety document filling;</b> <b>W6 Leadership and teamwork skills</b>	Provide safety training and safety meetings for crew members to carry out inspections, maintenance and carry out safety procedures (W1, W2, W3, W4, O1, O2, O3, O4, O5); Increase knowledge and awareness of ship crews about the importance of maintaining safety equipment, use of personal protective equipment, safety training, safety meetings and filling out safety documents through updating and upgrading marine certificates. (W2, W3, W4, W5, W6)	Carry out inspection and maintenance of safety equipment according to procedures (W1, T1, T2, T3, T5); Carry out safety training according to regulations. (W1, T1, T2, T3, T5); Use personal protective equipment while working. (W1, T2, T4); Carry out safety meetings. (W4, T2, T3, T4, T5); Filling out safety activity documents (W5, T5); Supervision, evaluation of the leader of the ship team. (W6, T1, T2, T3, T4, T5)

Figure 3 – Combination of Safety SWOT Matrix MV.Y

Based on the position of MV.Y on the SWOT analysis diagram which is in position II which is located between the strength axis (S) and the threat axis (T), this means that MV.Y still has a safety strength factor of 0.4 which is greater than the factor of safety. threat which has a value of 0.3. On the quadrant MV.Y SWOT analysis diagram. X is in quadrant II (S-T), which is a position where ships and shipping companies must diversify. Diversification is a strategy to add or diversify efforts to increase safety on board in order to reduce or eliminate threats. So the strategy (S-T) that needs to be improved or diversified is the condition of safety equipment in dealing with emergencies, readiness of ship crews in dealing with emergencies, implementation of safety procedures in avoiding work accidents and emergencies on ships and readiness of equipment and safety documents by port authorities. In accordance with CHAPTER III SOLAS 1974 concerning requirements for safety equipment, ships must ensure the number and condition of safety equipment according to the requirements, so the company and ships must make efforts to ensure the number and condition of safety equipment is in a seaworthy condition. In accordance with CHAPTER IX SOLAS 1974 that shipping companies and ships must ensure procedures in an emergency situation are implemented properly, ready in an emergency and at the time of inspection by the harbormaster.

The SWOT matrix is in tool for determining strategic decisions. The value of internal and external factors of ship safety is seen from the quadrant diagram and SWOT matrix. The SWOT matrix matching aims to obtain alternative strategies that can be applied to the ship to achieve safety which is depicted in Figure 3, Combination of SWOT matrix for ship safety MV.Y.



## CONCLUSION

The results of the IFAS and EFAS calculations in this study indicate that the value safety strength factor of MV.Y (1,192), is greater than the weakness factor MV.Y (1.17). Opportunity factor MV.Y (1.14) is smaller than the threat factor to the safety of the ship of 1.68.

The results of the IFAS and EFAS calculations depicted in the SWOT quadrant show the ship's safety position is in quadrant II. The safety of the ship in this position is threatened from outside such as weather, emergencies, or work accidents, but still has internal strength so that it requires differentiation to increase ship safety.

Based on the SWOT matrix, a strategy (ST) is generated that can be carried out by shipping companies and ships in accordance with the MV.Y safety position including a strategy so that crew members, equipment, and safety documents are ready in the event of an emergency, a situation that threatens work safety and is ready to respond. checked by port authorities:

- Provide opportunities and maximize ship crews to participate in safety training, updating competency certificates and refreshing seafarers' proficiency certificates to increase knowledge, awareness, and skills in inspection, maintenance of safety equipment, and implementing safety procedures, maximizing support from the government, and shipping companies for the provision of safety equipment and safety training;
- Motivate crew members to conduct safety procedures by providing rewards and sanctions;
- Scheduled and continuously provided crew members with safety meetings and briefings.

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