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Crew Capability Assessment in Using Portable Fire Extinguisher during Fire Drill Implementation on MV. Vinca

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Abstract

Years ago, a fire extinguisher was invented as an active fire protection device used to extinguish or control fires in emergencies. On board, fire extinguisher plays an important role to prevent and overcome any danger or threat resulted from a fire. Thus, crew's capability in using the fire extinguishers is highly needed. In this case, crews are supposed to be trained in using the fire extinguisher by implementing a fire drill (at least once a month). However, in fact, in this research, it was found that most of MV. Vinca's crews were not aware of fire-fighting procedure especially on how to use the portable fire extinguisher. This phenomenon was the reason why this research was conducted focusing on the crew's low capability in using portable fire extinguishers during the fire drill implementation. The data were collected through observation, structured interviews, documentary studies, and library research. The data were then analyzed by using Fault Tree Analysis (FTA) and Urgency, Seriousness, Growth (USG). Based on the analysis, it was found that the crews had a low capability in using a portable fire extinguisher. There were some reasons: (1) They lacked the knowledge and understanding about portable fire extinguisher; (2) The fire drills were not seriously carried out; (3) The portable fire extinguishers were in bad condition due to the absence of periodic and regular maintenance. In order to overcome the problem, training and guidance for the crews about the various types of portable fire extinguisher and their uses are highly needed; fire drills need to be performed seriously. Moreover, regular maintenance to the fire-fighting equipment also needs to be carried out.

Keywords: Capability, Portable Fire Extinguisher, Crew, Fire Drill, FTA, USG

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1. Introduction

Since fire is something we could easily find on board, for working purposes, fire prevention is a must. Preventive actions include keeping any flammable materials away from the working space and providing adequate fire extinguishers. Fire prevention is needed since fire can possibly cause danger. An initial action to extinguish the fire, especially a small fire, is so important (unless the fire is caused by an explosion).

The initial response must be done immediately and accurately because any delays or mistakes can lead to fatality. In order to do so, knowledge and skills on how to prevent and overcome fire hazards are needed.

When a fire breaks out on board, the crews are responsible to perform responsive firefighting since any help and assistance would not be present immediately. Therefore, in order to train the crews, a fire drill should be performed at least once a month. During the fire drill, the crews can possibly acknowledge and be more familiar with the equipment of fire extinguishing devices. The crews are also able to improve their capability in using the fire extinguisher to support fire safety on board.

Fire extinguishers are devices used to minimize and eliminate the uncontrolled fire. Fire extinguishers are divided into two types: (1) fixed fire extinguisher and (2) portable fire extinguisher. These fire extinguishers are used as a fire prevention device on board as regulated by SOLAS Consolidated 2014 Chapter II-2.

During the implementation of the fire drill held on June 9th, 2018, a class C fire scenario (a fire which involves electrical equipment) was performed. Based on the drill, it was found that the crews used a portable foam fire extinguisher in order to extinguish the fire. This action, unfortunately, increased the fire hazard since the electric current would flow into the foam. Thus, based on the drill, it was also found that the crews' capability in using portable fire extinguisher was low. Therefore, this research entitled Crew's Capability Assessment in Using Portable Fire Extinguisher in the Fire Drill Implementation on MV. Vinca was held.

2. Literature Review

2.1. Literature Review

In this research, a number of supporting theories were used to support the research as follows:

1. Definition of Fire

   According to the National Fire Protection Association (NFPA), fire is defined as a rapid oxidation process, a chemical reaction, resulting in the evolution of light and heat in varying intensities. Fire is a chemical process between fuel, oxygen, and heat. It is known as a fire triangle. According to this theory, a fire occurs as the three elements of fire are present and combined.

2. Causes of Fire

Fire can be sometimes beyond human control and it can lead to a fire hazard. Fire itself, as stated before, occurs as the result of the fire triangle: heat, fuel, and oxygen. Thus, in order to extinguish it, we need to eliminate one of these elements. The elements can be illustrated as follows:

Figure 1: Fire Triangle.

The reaction above is a chain reaction which runs in balance. In this case, if the reaction balance is interrupted, the reaction will stop. In other words, the fire will go out. The basic method of extinguishing the fire is actually by destroying the balance of the fire reaction. Fire, itself, is caused by various factors as follows:

(a) Human factors

Human factors include: (a) human's carelessness about safety and fire hazards, (b) flammable object arrangement with no consideration of the norms of fire prevention, (c) overcapacity of power and electricity, (d) lack of responsibility and discipline, and (e) intentional factors.

(b) Technical factors

Fires can also be caused by technical factors, especially in unsafe and dangerous conditions as follows:

- Physical/ mechanical process

  An important factor which becomes a role in this process is the emergence of heat due to rising temperatures or the emergence of sparks. Any activities such as repair works by using a welding machine can also lead to fires. Moreover, the poor condition of electrical installation can also cause a fire.
- Chemical Process

  Fire can occur when some hazardous chemicals are transported, stored, and handled without considering the proper instructions.
- Natural Factors

One factor which causes fires and explosions is a natural factor. This factor includes lightning and volcanic eruptions which can cause extensive wildfire and a house fire. This fire is carried out by volcanic lava (Sagala, 2008).

3. Fire Classification

(a) Class A

Class A is the most common type of fire. This fire occurs due to the burning solid objects such as wood, cloth, rubber, plastic, etc. To extinguish this type of fire, a portable fire extinguisher with dry powder or CO2 is needed.

(b) Class B

Class B fire is caused by flammable liquid or gas. The use of portable fire extinguisher which contains water-based ingredients is not allowed to extinguish this type of fire since it can spread the fuel as well as the fire. This type of fire can be extinguished by using dry chemicals powder.

(c) Class C

Class C fire is a fire caused by an electrical short circuit. In this case, a short circuit occurs and produces sparks which ignite the nearby objects and cause a fire. This C class fire can be very dangerous. To extinguish the fire, fire extinguisher with carbon dioxide (CO2) or dry chemicals is needed. In case of emergency, baking soda can also be used.

(d) Class D

Fire class D is a fire caused by combustible metal objects. In order to extinguish this fire, high-level fire extinguishers which can only be provided by trained firefighters are needed. It is due to the fact that class D fire has strong burning ability.

(e) Class K

Class K fire is a fire found in kitchen or cooking space. This fire is caused by either excessive warming/ human error. It is usually a result of the burning of oil and other cooking ingredients which contain oil. Once the fire exists, it will possibly burn other furniture nearby. The classification of class K is different from class B since even though it may cause a fire, its burning ability is lower. Thus, in order to put it out, a portable fire extinguisher with dry chemical powder is needed.

4. Type of Portable Fire Extinguisher

(a) Water

It is a type of portable fire extinguisher which uses high-pressure water. Among other types of fire extinguisher, it is the cheapest. This fire extinguisher can be used to extinguish fires on non-metal solid materials such as paper, fabric, rubber, plastic, etc.

(b) Dry Chemical Powder

Chemical dry powder is composed of a combination of mono-ammonium and ammonium sulfate. When released, the chemical dry powder will wrap the burning material so that the oxygen, one of the three elements of a fire triangle, will be separated. The portable fire extinguisher with dry chemical powder is multipurpose for its effectiveness to extinguish most classes of fires.

(c) Foam

It is a type of portable fire extinguisher consisting of some chemicals which are able to form foam. AFFF (Aqueous Film Forming Foam) foam which is sprayed out will cover the burning material so that the oxygen will be separated from the firing process. This type of portable fire extinguisher is effective to extinguish fires caused by both non-metallic solid materials such as paper, cloth, rubber and flammable liquid materials such as oil, alcohol, etc.

(d) Carbon Dioxides / CO2

”It is a type of portable fire extinguisher which uses Carbon Dioxide (CO_2) as the extinguishing agent. This type of fire extinguisher is suitable for Class B fire (flammable liquid materials) and Class C fire (voltage electrical installations).

2.2. Research Framework

3. Methods

3.1. Research Methods

In this research, a descriptive method was applied; based on the analysis, the data were described and explained in detail based on the facts. The purpose of descriptive research is to make a systematic, factual, and accurate description of facts and relationships between the phenomena investigated. The report of the research would contain data citations in order to give an overview of the report presentation. The data were taken from interview scripts, field notes, photographs, and personal documents. Thus,

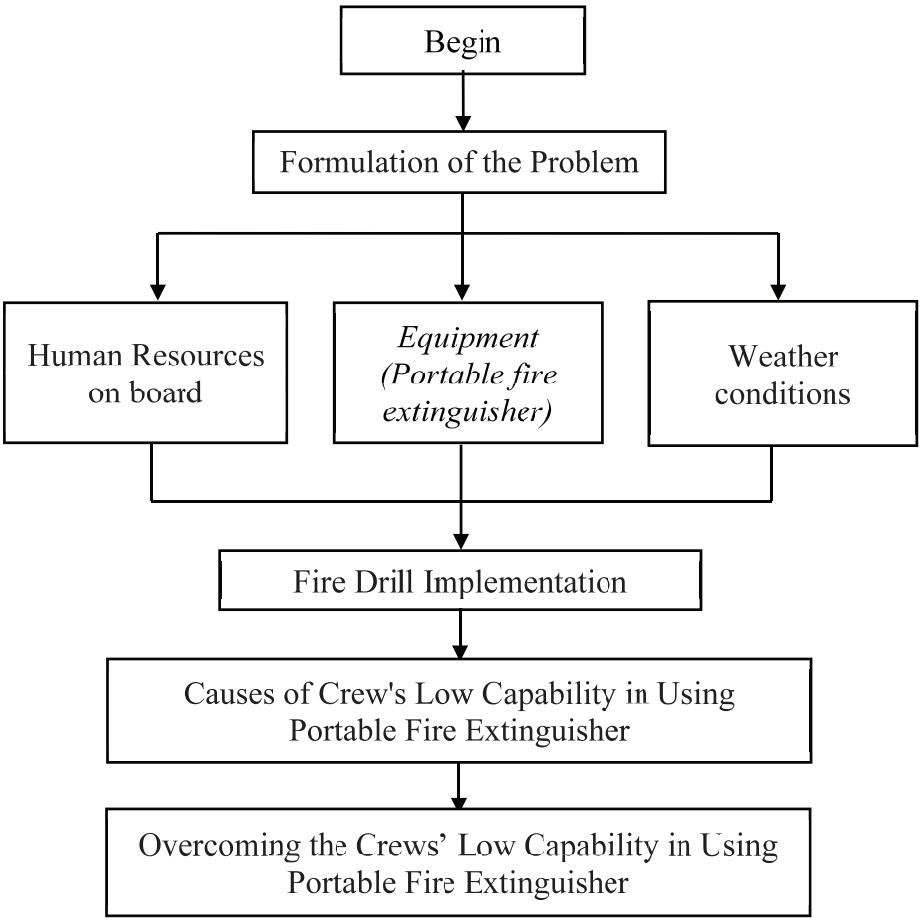

Figure 2: Research Framework.

in the discussion of the problem, the results of all studies and research obtained during the implementation of marine practices were presented.

3.2. Time and Place

The research was conducted during the marine practices on MV. Vinca.

3.3. Data Sources

In this research, various kinds of qualitative data were used. The data were both in spoken and written forms. The types of data sources used were as follows:

1. Primary Data

   According to Purwanto and Sulistyastuti (2007: 20), primary data are data collected directly from the research field. Based on the definition above, it can be concluded that primary data are data taken from the first-hand source such as surveys,

interviews, etc. Direct observations on how to use a portable fire extinguisher were done during a fire drill on MV. Vinca (both knowledge and capability). The research subjects were those who participated in the fire drill including deck officers, boatswain, able seaman, ordinary seaman, and engine crew.

2. Secondary data

   According to Purwanto and Sulistyastuti (2007: 20), secondary data are data obtained through prior research conducted by other parties. In this research, the secondary data were obtained through reference books, textbooks, IMO publications, and other books related to the research topic. The secondary data were taken from the ship's documents, documents provided by the deck officer to the officer, SOLAS 1974, and other references.

3.4. Method of Data Collection

According to Jonatan Sarwono in his book Quantitative and Qualitative Research Methods (2006: 222), it is stated that the method of data collection is a method carried out through direct involvement of the research objects. In this research, these following methods were used to obtain the data:

1. Literature

   According to Sukardi, in his book Educational Research Methodology (2008: 33), literature study focuses on tracing and looking for theories or other researches which are closely related to the problem of research. The theories are not only taken from one source but also various sources which were then arranged in a separate chapter. The data were taken from reading, researching, recording, and studying books and documents on board. Literature studies were also carried out on the use of portable fire extinguisher in the fire drills on MV. Vinca.

2. Observation

   According to Sutrisno Hadi, in his book Research Methodology (2000: 136), observation can be interpreted as observing and recording some systematic phenomena. In this case, direct observations of the fire drills were carried out. Digital cameras were used to take the necessary pictures during the fire drills.

3. Interview

   According to S. Nasution in his book Method Research (2009: 113), interview is a form of verbal communication. It is a kind of conversation aimed to obtain research

data. In this research, interviews were done to deck officers, boat swain, able seaman, ordinary seaman and engine crew on MV. Vinca.

3.5. Data Analysis Technique

According to Lexy J. Moleong (2004: 103), data analysis is defined as a process to formally attempt to find research theme and formulate the hypotheses (ideas) as suggested by the data. It is also an attempt to provide assistance on the theme and hypothesis. The data analysis methods of this research were as follows:

1. Case Study Method

   Case study method is a data analysis technique where the researcher directly observes the object of the research closely to see the participants' activities. Basically, observation techniques are used to see and observe the phenomena changes which are developing based on which can be made changes to the assessment. In this research, this method was used to analyse the first research problem on crew's capability to use portable fire extinguisher during fire drills on MV. Vinca. This method was carried out since the researcher would like to directly experience the fire drill. Interviews were also done to the ship's crews via e-mail. The interviews were aimed to find out their knowledge and understanding about portable fire extinguisher.

2. Fault Tree Analysis (FTA)

   In this research, Fault Tree Analysis was also used. Fault Tree Analysis (FTA) is an analytical tool which graphically translates the combinations of errors which cause system failure. This technique is useful for describing and assessing events within the system. Fault Tree Analysis uses two main symbols: events and gates (Foster, 2004). By using the Fault Tree Analysis, the factors which caused the crews' low capability in using portable fire extinguisher during fire drills on MV Vinca were analysed.

3. USG (Urgency, Seriousness, Growth)

   In order to determine the priority of the problem, ultrasound method (Urgency, Seriousness, Growth) was applied. Within organizational activities, plan plays an important role. One of the planning aspects is to determine the problem priority. Determining the priority of the problem becomes an important part in formulating the problem. There are several methods in determining the problem priority presented as follows:

(a) Urgency

It is the gravity level of the problem and related to the urgency of the time needed to resolve the problem.

(b) Seriousness

It is the seriousness level of a problem and related to the impact of the problem to the organization.

(c) Growth

It is related to the growth of problems. The faster the problem develops, the higher the growth rate will be.

By using Urgency, Seriousness, and Growth (USG), this research attempted to find some effective ways to overcome the crews' low capability in using portable fire extinguisher on MV. Vinca. In this research, this ultrasound method was applied by comparing one factor to another. As the result, the highest priority of the problem would be obtained and methods to overcome the crews' low capability in using of portable fire extinguisher on the MV. Vinca would also be found.

4. Result and Discussions

4.1. General Description of Research Objects

In this research, the objects were taken from marine practices in the MV. Vinca. The ship's particular is as follows:

- Ship's Name / Call Sign: MV. Vinca / 3EEV2
- Official No. / IMO No.: 31487-06 A / 929855
- M.M.S.I.: 37182100
- INMAR-F: Tel:870773157925
- Inmar-C: Tlx:43718211
- E-mail: vinca@orcajpn.co.jp
- Port Of Registry: Panam
- Owner: Osaka Asahi Kaiun. Co. Lt
- Charterer: Kawasaki Kisen Kaisha. Lt
- LOA / LBP: 189.99 M / 182.0
- Breadth / Depth: 32.26 M / 17.0 M

- Displacement: 56,994 MT
- Deadweight: 48,669 MT
- Kind Of Vessel: Bulk Carrier (5 Holds)

4.2. Problem Analysis

In the process of data analysis, three methods were used: (1) the case study observation method, (2) Fault Tree Analysis (FTA), and (3) Urgency, Seriousness, Growth (USG). Case study method was used to find out the crews' capability in using portable fire extinguisher during fire drill implementation. On the other hand, Fault Tree Analysis (FTA) was applied to determine the causes of the crews' low capability in using portable fire extinguisher during the fire drill whereas Urgency method, Seriousness, Growth (USG) was used to find solution to overcome the crews' low capability in using portable fire extinguisher.

The knowledge of how to properly use the fire extinguishers is a basic capability which must be acknowledged by all crews on board. Fire extinguishers can save lives, property, and the environment. Small fire needs to be put out immediately since fires can be out of control. Thus, if the crews have no knowledge on how to correctly use the fire extinguishers, the fire would make a greater danger. For example, they need to know what type of fire extinguishers they need to use in order to extinguish class C fire. At this case, a lot of crews would use foam fire extinguisher which is so dangerous since the foam will let the electricity flow. Most crews also cannot distinguish various types of portable fire extinguishers and how to use them. These data were obtained through questionnaires given to the crews by using the following criteria:

Table 1: Table of Assessment Criteria.

Percentage	Criteria
> 90 %	Capable
70 % - 89%	Fairly Capable
50% - 69%	Less Capable
< 50 %	Unable

Based on the analysis, the results were found as follows:

Based on the percentage, it can be concluded that most crews had low capability in using portable fire extinguisher. The result indicated that the crews were less capable (percentage value of 55%).

Table 2: Questionnaire Findings.

No.	Name of Respondent	Rank	Percentage	Result
1	Respondent I	Boatswain	75 %	Fairly capable
2	Respondent II	Able Seaman	50 %	Less capable
3	Respondent III	Ordinary Seaman	50 %	Less capable
4	Respondent IV	Oiler	58 %	Less capable
5	Respondent V	Chief Cook	42 %	Unable
	Final Result		55 %	Less capable

In determining the factors of the low ability of the crews, FTA was used. These factors were obtained through observations and interviews to the Chief Officer, Second Officer and First Engineer. The FTA diagram was as follows:

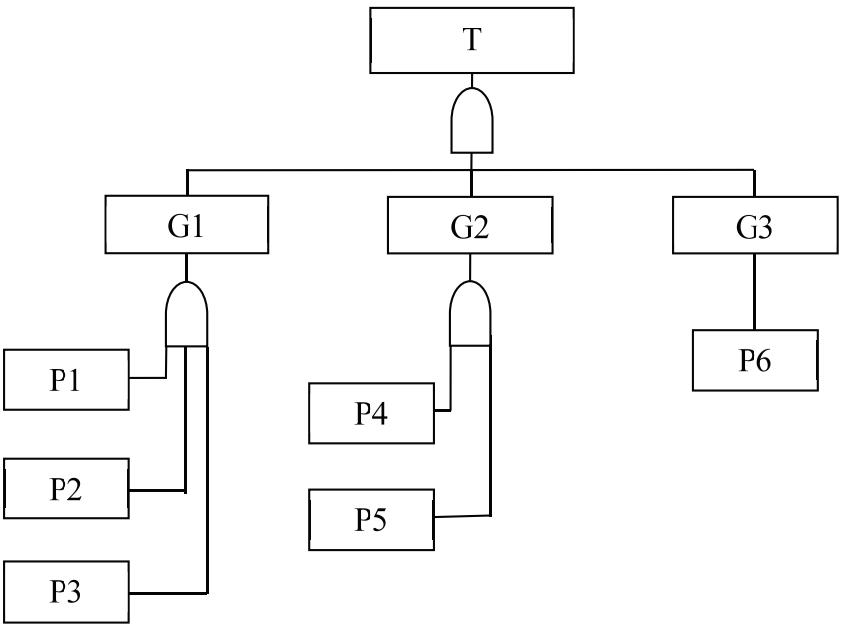

Figure 3: Fault Tree Analysis Diagram.

The descriptions of Fault Tree Analysis were as follows:

1. Human Resources on board

   Human resource was one of the main factors of the low crews' capability in using portable fire extinguisher. It could be found when the implementation of fire drill was carried out. Based on the research, it was found that: (a) many of the crews did not take part in the implementation of fire drills; (b) there were many of the crews, especially deck crews and engine crews, who were not able to use portable fire extinguisher even though they had Basic Safety Training (BST) and Advance Fire Fighting (AFF) certificates.

Table 3: Fault Tree Symbol.

No	Symbol	Information
1	T	Reasons for the crews' low capability in using portable fire extinguisher during fire drills
2	G1	Human Resources on board
3	G2	Equipment (Portable fire extinguisher)
4	G3	Weather conditions
5	P1	Crew has standardized seaman certificates
6	P2	Experience working on board
7	P3	Crew's seriousness in carrying out fire drills
8	P4	Availability of portable fire extinguisher
9	P5	Decent portable fire extinguisher
10	P6	Rough sea

The crews' low capability in using portable fire extinguisher in terms of human resources was caused by three factors: (a) the crews' standardized certificate of seaman expertise, (b) their experience of working on board, and (c) the crews' seriousness during the training. These three influenced the crews' low capability in using portable fire extinguisher during fire drills on MV. Vinca. The factors were shown in this following figure:

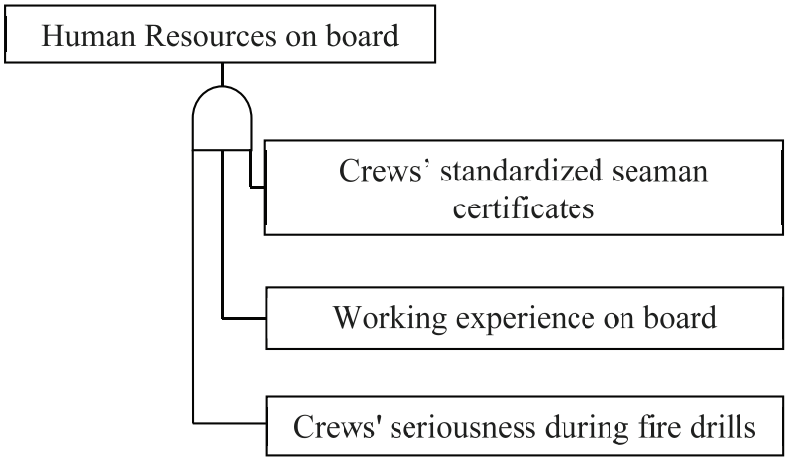

Figure 4: Factors of human resources.

The reasons for the crews' low capability in using portable fire extinguisher regarding human resource factors were as follows:

(a) The crews' standardized seaman certificates

International standardized seafarers certificates is one of the benchmarks of whether the person is able to work on board or not. One of them is the Advanced Fire Fighting (AFF) certificate. In order to obtain the certificate, the participants will be taught about fire suppression procedures on board as well

as the knowledge of various types of fire extinguishers including portable fire extinguisher. Firefighting teams are required to be competent and capable to identify the source of fire and how to prevent the fires.

In this research, it was found that the crews had their Advanced Fire Fighting (AFF) certificate, yet they were not able to extinguish the fire properly. Most of the crews did not acknowledge how to use the portable fire extinguisher correctly. It might due to the fact that when they took the certificates, they did not take the course seriously; they had not realized how dangerous fire suppression could be. During the fire drill, most of them could not perform what they had learned. Thus, the factor was rated 1.

(b) Working experience on board

The working experience on board is very closely related to the crews' performance during fire drill. The more they have experience, the more capable they can be during the fire drill. However, in fact, many of the crews who had experience of working on board unfortunately could not distinguish the types of portable fire extinguishers and how to use them. Thus, their experience of working on board could not be used as a benchmark for their capability in performing the fire drill. However, this factor could be attributed to the third factor, crews' seriousness in performing the fire drill. Thus, the second factor can be used as a benchmark of the assessment. In this case, this factor was rated 1.

(c) Crews' seriousness in carrying out fire drills

This factor was obtained through the interviews with senior officers who were responsible for the deck training. According to the interviews, a numbers of crews did not take the training seriously. They did not pay close attention to what was being explained and instructed. As the result, when it was time for practice, some of the crews were not able to perform. It was also found that when an evaluation was carried out at the end of the fire drill, many of them did not have knowledge of various types of portable fire extinguishers and their uses. Therefore, this factor was rated 0.

Thus, based on the analysis, the findings in regard to human resources factors were as follows:

Based on the table above, it can be interpreted that the crews had standardized seaman certificate and experience of working on board, but the crews did not take the training seriously. Thus, the human resource factor was 0.

Table 4: Truth Table of Human Resources.

Crews' standardized seaman certificates	Working experiences on board	Crews' seriousness during fire drills	AND
1	1	0	0

2. Equipment (Portable Fire Extinguisher)

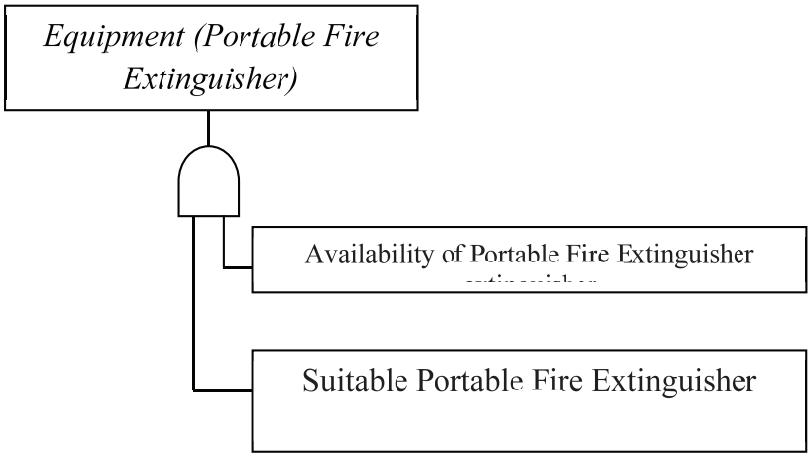

Figure 5: Equipment Factors.

Another reason which caused the crews' low capability in using portable fire extinguisher was equipment factor. The descriptions were as follows:

a. Portable fire extinguisher availability

The existence of a portable fire extinguisher on board is very important as according to the rules, every vessel must have portable fire extinguishers on board. However, there are many domestic vessels which are not equipped with portable fire extinguishers. It means that the crews did not use the real equipment (portable fire extinguishers) during the fire drill implementation. Moreover, the officers who led the implementation could not either show various types of portable fire extinguisher and their uses to the crews.

MV. Vinca had 42 portable fire extinguishers consisting of dry powder chemical (DP) = 17 cylinders, CO2 extinguisher (CO2) = 7 cylinders, foam = 16 cylinders, and foam applicator = 2 units. The availability of portable fire extinguisher on MV Vinca had been in accordance with the existing rules. Therefore, the availability of portable fire extinguisher was scored 1.

b. Decent portable fire extinguisher

Even though the portable fire extinguishers were available on board, there were many of them which were not in a good condition; many of them were not able

to be used. It could be because the equipment maintenance was not regularly performed.

This factor could possibly be affected by the maintenance carried out by officers responsible for the lifesaving appliances and firefighting equipment, Mualim III. Based on the research, it was found that, frequently, Mualim III only filled in the checklist without performing a proper treatment. As the result, the portable fire extinguishers were not in a good condition when they were needed. Thus, the equipment factor was rated 0.

TABLE 5: Truth Table of Fire Fighting Equipment.

Availability of portable fire extinguisher	Decent portable fire extinguishers	AND
1	0	0

Based on the table above, it can be interpreted that MV. Vinca had adequate numbers of portable fire extinguisher as required by the International Regulation. However, some of them were not able to be used. Thus, the equipment factor was 0.

3. Weather conditions

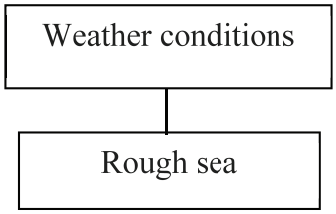

Figure 6: Weather condition factors.

a. Rough sea

Natural factors are variables which cannot be contested. Natural factors came naturally and became the obstacles in the implementation of fire drills. If the weather was bad, the captain would not carry out a fire drill for safety reason. On MV Vinca, during its voyage through Pacific Ocean, typhoon frequently occurred (Japan-Australia, Japan-Kalimantan). Therefore, the implementation was often postponed, or the worst, it was not implemented at all due to the bad weather. This rough sea factor's value was rated 1.

The factors were illustrated as follows:

Based on the figure, Boolean equation was obtained as follows:

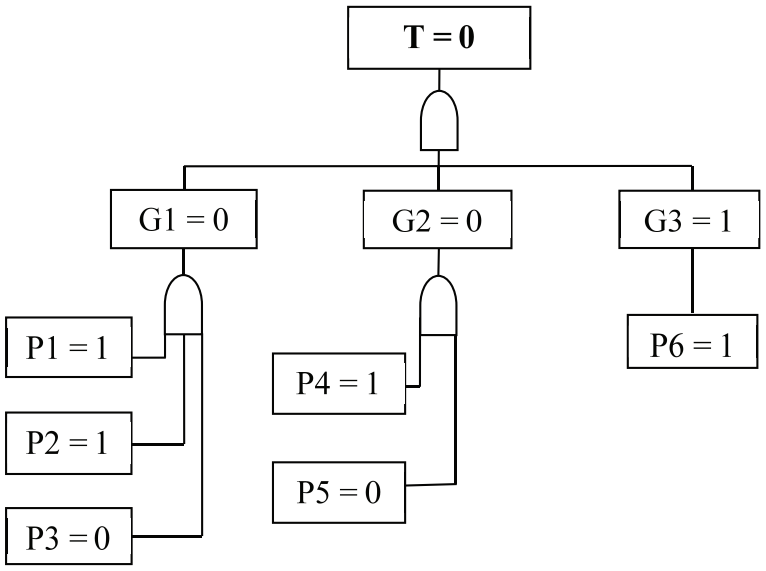

Figure 7: FTA diagram.

- G1= P1 x P2 x P3
  G1=1 x 1 x 0
  G1=0
- G2=P4 x P5
  G2=1 x 0
  G2=0
- G3=P6
  G3=1
- T=G1 x G2 x G3
  T=0 x 0 x 1
  T=0

Based on the fault tree analysis diagram, the truth and formula were established. It was found that there were some reasons for the crews' low capability in using portable fire extinguisher. The reasons included: (a) the crews were no seriously performing the fire drills and (b) portable fire extinguishers were not able to be used due to lack of periodic and regular maintenance. Since the value of T was 0, it could be concluded that the crews had a low capability in using portable fire extinguisher during the fire drill.

Based on the identification above, the factors were analysed by using USG (Urgency, Seriousness, Growth). Thus, based on the analysis, factors which needed to be seriously taken into consideration were found. The table was as follows:

Based on the USG assessment above, the priority of the problems experienced was as follows:

- Crew must seriously implement the fire drills

Based the USG, it was found that crews' seriousness during fire drill implementation was the main factor which influence their low capability to perform firefighting including using portable fire extinguisher and recognizing types of portable fire extinguisher. During the fire drill, most crews did not pay enough attention to what was being explained by the officer. It became the main concern that the crews would possibly

Table 6: Selection of prioritized issues.

NO	PROBLEM	COMPARATIVE ANALYSIS	U	S	G	VALUE				PRIORITY
						U	S	G	T	
A	The crews had proper education and training when taking Advanced Fire Fighting (AFF) certificate	A-B	A	B	A	3	2	3	8	3
		A-C	C	C	C					
		A-D	D	A	D					
		A-E	A	E	A					
		A-F	A	A	A					
B	The crews seriously worked on the vessel, so that the experience could become their future learning	B-C	B	C	C	1	3	3	7	4
		B-D		D	B	B				
		B-E		E	E	B				
		B-F		F	B	B				
C	Crews needed be serious in the implementation of the fire drills	C-D	C	C	C	3	5	4	12	1
		C-E	E	C	E					
		C-F	C	C	C					
D	The company provided complete fire extinguishers including portable fire extinguisher	D-E	D	E	E	4	0	1	5	5
		D-F	D	F	F					
E	Officers were responsible for firefighting equipment and proper maintenance needed to be carried out	E-F	F	E	E	2	4	3	9	2
F	A fire drill needed to be performed when the sea was in a good condition	-	-	-	-	2	1	1	4	6

make mistakes in using portable fire extinguisher which led to serious impact to both the vessels and the crew themselves.

4.3. Discussion

In this research, after analysing the result of USG, a discussion of the problem was also done in order to overcome the crews' low capability using portable fire extinguisher. The discussion was as follows:

1. Based on the comparison analysis

The comparison was as follows:

Table 7: Comparison Result of USG.

No	Problem	Total	Priority
1	Crew must seriously perform the fire drill implementation	12	I
2	Officers were responsible for firefighting equipment and proper maintenance must also be performed	9	II
3	The crews must have proper education and training when taking seafarers' certificates of Advanced Fire Fighting (AFF)	8	III
4	The crews needed to be seriously working on the vessel, so that the experience would be their future learning	7	IV
5	The company provided adequate fire extinguishers including portable fire extinguisher	5	V
6	A fire drill was carried out when the sea was in a good condition	4	VI

Based on the table above, it was found that the highest value on each factor based on FTA (Fault Tree Analysis) chart included:

1. The crews must seriously perform the fire drill implementation.
2. The officers responsible for firefighting equipment must carry out maintenance properly and regularly.

2. How to overcome the crews' low capability in using the portable fire extinguisher on MV. Vinca.

   Based on the priorities selection, the steps were as follows:

   (a) The ship officers must give more guidance to the crews

   Ship officers must frequently provide guidance to the crews about various types of portable fire extinguishers and how to use them. Thus, the crews would acknowledge and perform better. Knowledge and understanding on portable fire extinguisher is very important because it is used during the implementation of fire drills.

   (b) The crews must seriously take part in the implementation of fire drill

   According to SOLAS 1974 Consolidated 2014: Chapter III: Regulation 19.3.2: pages 243, a fire drill is carried out at least once a month or, if possible, > 25%

of the total number of crews; it must be carried out within 24 hours after the ship leaves the port except it sails on narrow waters, for safety reason. Within a month, the new crews should have performed training on all firefighting equipment. During each drill, the emergency fire pump must be turned on.

The fire drill is aimed to check:

- All detection facilities and alarms work properly
- All fire extinguishers (including portable fire extinguishers) are ready and functioning
- All crews are on standby, alert, and skilful
- All crews are trained for an emergency.

Each crew has his own responsibility during an emergency based on the muster list. Continuous training is needed to ensure the crews remain alert to their duties and responsibilities. Fire drill presents an opportunity for the crews to be able to practice their duties and responsibilities immediately, safely, and efficiently.

One of the factors that led to the implementation of the fire drill was the crew's seriousness level during the fire drill. The crews' seriousness greatly determines their capability in using portable fire extinguisher. When the officer was giving directions on the various types of portable fire extinguisher and their uses, many of the crews did not pay enough attention. As the result, when the fire drill was carried out, the crews could not perform correctly. They need to be more disciplined in implementing fire drills, so that they can understand various types of portable fire extinguisher and their uses.

(c) Officers responsible for firefighting equipment must carry out maintenance properly and regularly

Maintenance needs to be carried out so that the extinguishers work properly. In order to get the maximum performance of portable fire extinguisher, regular checks are needed. Regular maintenance can be performed once a month. Generally, there is a label that records when the fire extinguishers were last checked.

The maintenance processes include checking the entire fire extinguisher starting from the smallest part to the content and the gas pressure. Third, officer should not only fill in the checklist but also check the condition of the portable fire extinguisher. It is done in order to support the crews' capability in using portable fire extinguisher during the fire drill. The availability of portable fire extinguishers is also important that the crews do not only receive the

theory of what to know and what to do but can also acknowledge exactly what and how to use the portable fire extinguisher.

5. Conclusion

In order to extinguish uncontrolled fires on board, some attempts need to be performed. First, after identifying the scale of the fire, the crews perform firefighting by using portable fire extinguisher. However, the main problem was that the crews' capability in using the portable fire extinguishers was rather low. This low capability can possibly cause fire hazard on board. Based on the research, some conclusions were obtained as follows:

1. The crews' capability in using portable fire extinguisher during a fire drill on the MV. Vinca was low (both knowledge and understanding).
2. The low capability was due to crews' less knowledge and understanding about portable fire extinguisher since they did not seriously take part in the fire drill. It was also because the portable fire extinguishers were not in good condition due to lack of periodic and regular maintenance.
3. In order to solve the problems, MV. Vinca needs to give more guidance to the crews about the various types of portable fire extinguishers and their uses. Moreover, the crews need to seriously take part in the fire drills. Maintenance to the firefighting equipment also needs to perform boatswain.

Based on the research, in order to overcome the problems including the crews' low capability in using the fire extinguishers, some suggestions were made as follows:

1. The ship officers should pay more attention to the crews' capability in using portable fire extinguisher during the fire drill. Evaluation is needed at the end of the fire drill to check the crews' understanding.
2. It is important that the fire drills are based on SOLAS 1974 so that the crews' understanding of portable fire extinguishers will hopefully increase and their capability in using the portable fire extinguisher can be improved.
3. To overcome the crews' low capability, the officers must establish good communication and working relationships with all crews. Thus, any shortcoming of the crews' capability in using the fire extinguishers can be detected. It is also suggested that the shipping companies need to perform a pre-test on fire prevention

supposed to check the crews' knowledge and capability. The crews also need to seriously learn during the fire drill. The ship officers can also apply punishment to those who are unable to perform the fire drill and reward to those who are capable to do so. It is hoped that the crews' performance and capability will increase. Punishment needs to be applied, not only for the crews but also for the officers in regard to the maintenance of portable fire extinguisher. Thus, proper and regular maintenance to the fire extinguishers can be performed. Last, MV. Vinca needs to provide adequate numbers of portable fire extinguishers. It is also important to provide some spares and additional portable fire extinguisher. Thus, when damages are found, they can be immediately replaced and fire drills can be properly carried out.

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