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The Japan Ship Owners Mutual Protection & Indemnity Association Loss Prevention and Ship Inspection Department

CASE STUDY

Collision

Engine Trouble

Oil Spill Accident

Contents

Introduction

There are many kinds of maritime accidents such as collisions, groundings, fires, sinkings, damage to harbour facilities, oil spills and engine troubles. However, about 90% of the causes of these maritime accidents are said to be due to human error. In this bulletin, we will introduce case studies which are based on real incidents that incurred collisions, engine troubles and oil spills. Along with these, 'Preventive Measures' will be analyzed from the viewpoint of human error.

§1 What is Safety?

§1-1 What is Safety?

On May 2015, we held a seminar entitled 'Thinking Safety' which was issued in the P&I Loss Prevention Bulletin Vol.35. Before introducing the actual incident cases, we would first like to review 'what safety is'. (Please refer to the above P&I Loss Prevention Bulletin Vol.35.)

Seafarers are always expected to operate their vessel in a safe condition, which never causes any accidents.
Expressions such as 'Safe Operation' and 'we pray for your safe voyage' are used frequently, however the meaning of 'Safety' is somewhat unclear.

Fig. 1 San Francisco Golden Gate Bridge

We found an interesting 'definition of Safety', according to the English psychologist Reason:

Safety : Having resistance to danger to which an organization is constantly exposed.

More specifically, postulating that this world is exposed to threat, Reason defines `Safety` as the ability of an individual or the capacity of an organization to confront the threat.

> Also Helen Adams Keller said:
>
> Security is mostly a superstition. It does not exist in nature, nor do the children of men as a whole experience it. Avoiding danger is no safer in the long run than outright exposure to danger.

That is to say 'safety' is simply the result of danger avoidance. Therefore, I believe that it is correct to assume that 'there is no such thing as safety' in the world.

§1-2 Safety and Technicians

If we consider safety from the point of view that, not only the captain and chief engineer, but also the entire crew, comprise a collection of technicians, there are many who view safety as being at the leading edge of technology, and an extension of technology itself. In other words, many are of the opinion that as 'vessel technology' and 'skill of the crew members' are improved, it automatically maintains safety'.

It must be simply stated that this way of thinking is incorrect and dangerous. Japanese psychologist Professor Isao Kuroda, Japan Human Factor Institute, emphasized ' Safety must be thought of as being a social value beyond technology, a dimension beyond technology'. On the other hand, from the view point of technology based on moving things, including vessels, it is specific to various fields, for example, technology employed in a vessel, railway and vehicle operation: each is simply a means by which our lives are more enriched.
Thus, it is necessary to consider that, unless the crew at the frontline of safety in operating the vessel separate safety and technology, unless they have a different dimension to safety, safety cannot be maintained.

However, when an accident occurs, the focus is on preventing a reoccurrence, and there is a strong tendency to analyze it from a technical perspective. Thus, measures developed against reoccurrence are taken from a technical perspective.
For example, a Maritime Accident Inquiry is held following a collision accident, and the vessel is found to be in breach of Clause XX of the Maritime Collision Prevention Act. Consequently, the accident is the responsibility of the person in contravention of the legislation, and that person is then subject to suspension of his/her license for a specified number of days. In other words, the focus is commonly on 'who was responsible', and the person in question is punished, and everyone moves on. (The Maritime Accident Inquiry Law was revised in 2008 and the objective of the law is for disciplinary action to be taken against the designated marine officer who caused a maritime accident, whilst Japan Transport Safety Board is in charge of analyzing preventive measures, also.)

However, this approach 'does not investigate and analyze in practical detail', when focusing on 'the cause of the accident'. For example, in the event of a collision caused by crossing vessels, all watch-keepers at brigde, who hold a license and whom do not remember the clause completely, should know that 'the vessel which has the other on her

own starboard side shall keep out of the way'.
However, if we do not investigate and analyze in practical detail as to 'why the marine officers did not or could not take action to avoid the collision despite having knowledge of these regulations', without consideration of the human factors, 'the measures developed to prevent reoccurrence', simply become a patch on the problem, and a similar kind of accident is likely to reoccur as a result.
Professor Kuroda referred to this as the 'grave-post type' of safety measure, i.e. a safety measure which commemorates the accident, calls an end to it, and moves on, without any connection to preventing reoccurrence.

Fig. 2　SMS Manual (Japanese only)

In fact, what we should really consider are social considerations, for example, ensuring that no lives are lost, or that no pollution occurs. It is necessary to consider safety from the point of view of preventative measures to ensure that the accident does not reoccur. Professor Kuroda referred to this as the 'preventative type' of safety measure.

When we consider operation of a vessel, we focus on existing dangers for example, the danger of collision, the danger of a cargo accident, the danger of damage to harbor facilities, and the danger of engine failure. We therefore see 'how to avoid these dangers' as being associated with safety. As human beings, we face these dangers, and engage in activities to avoid them.

According to the above, 'safety' can be defined as:
'a conclusion or evaluation of the results on avoidance of these dangers'.

§1-3　Safety and Culture

Considerable energy is required to activate the system developed within safety management such as SMS manual (Safety Management System manual). This energy must be seen and derived from the safety culture. When we consider this culture, we must see it in terms of the following three components. (See Fig. 3)

1 Science

While this goes without saying, a theoretical knowledge (e.g. physics) is necessary in the world of ships. For example, why does a ship, which is made of iron, float (Archimedes ' principle), or when stopping the vessel by astern engine, an understanding of acceleration is necessary to understand how far the vessel will move ahead with a given horsepower applied, and how many minutes it will take. Also, dynamics on how to load cargo through weight distribution, so as not to break the hull, are involved.

2 Skill

Skill is the ability to use scientific theory. Skill differs with the manner in which it is used. Skill is a methodology for effective use for the benefit of society, and a means of taking scientific principles to society. Similar to nuclear power, for instance, the technology we end up utilizing depends on how we utilize the science: it can be an atomic bomb or a nuclear power plant, or a reactor powered vessel, even though the principles are same.

3 Technicians

Technicians are persons making the best use of the skills with a methodology derived from the technology. Persons who operate the safety management system are also considered technicians.

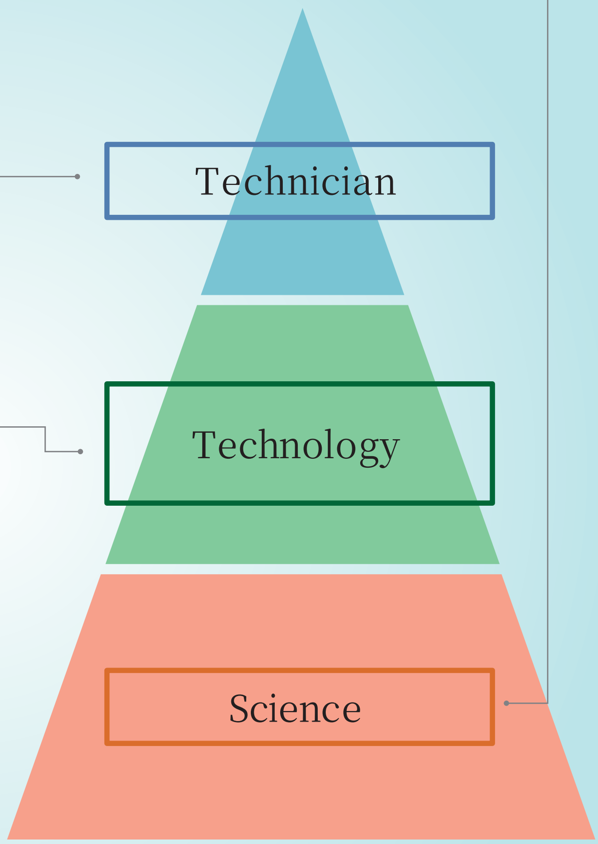

Fig. 3 Pyramid of Science, Technology (Engineering) and Technician (Maritime Officer)

Electronic Chart Display and Information Systems (ECDIS), GPS, AIS, Automatic Radar Plotting Aid (ARPA) and unmanned engine room operation (M0 operation) have been introduced at a rate hitherto unimaginable, and provide a much greater volume of information than in previous visual format. In addition, sounding alarms are also installed in these devices to notify the bridge of vessels which are at risk of collision.

Fig. 4 Integrated Bridge System

At the same time, technicians are responsible for setting the point at which alarms are set, and for the decision as to whether or not to use the various forms of information displayed.These devices do not automatically allow the vessel to avoid dangers in navigation. Until the development or the robotic vessel (unmanned vessel) of the future, the captain and officers as technicians, will conduct an overall evaluation of the provided information and operate the vessel accordingly. In addition, vessels employing M0 operation are increasing in the engine room, and a considerable proportion of operation is now automated. However, even if operation of individual engines can be automated, chief engineer and engineers as technicians view the entire engine room as a plant that operates using the five senses to prevent problems, are still necessary. Also maintaining ‘Safety’ (avoidance of danger) should be done by humans (technicians).

Technicians are therefore required to acquire knowledge and skills for safe operation of the vessel and machinery to ensure safety, and obtain a seamen’s license as evidence of having such knowledge and skills. In other words, because safe operation of the vessel and machinery is extremely complex and difficult, ‘the scope of individual discretion’ naturally becomes wider as a result of carrying out such activities.

Fig. 5　Seaman's License (Japanese)

It is, therefore, natural to consider a seaman’s license a qualification that authorizes the holder to carry out the above duties. However, there seem to be many officers and engineers that tend to believe that ‘they are not required to undergo further training, because they graduated’, once they succeeded in passing examinations and obtaining their licenses. But it must be simply stated that this way of thinking is incorrect. As described above, crew having boarded the vessel after obtaining their licenses as first time officers and/or engineers, will have much technical experience to learn, more than what the examination covers and will continue to improve their skills by themselves. Therefore we have to consider them ‘not as graduates but simply as those who just started their seafaring life’.

‘Safe operation of the vessel, machinery and maintenance of the vessel’s schedule’ is the subject of much expectation from the wider society, but once they have trouble and fail to keep the vessel on schedule, there is not only economic loss but credibility lost, also. For example, in the case that a container vessel sailing from Los Angeles, USA, with a large load of grapefruits in the reefer containers, sustained engine trouble en route in the Pacific Ocean and finally could not arrive at Tokyo, Japan on schedule, there would be no grapefruits available at the market place in Tokyo. While this was occurring, consumers that went to a supermarket to buy a grapefruit would discover that the supermarket had sold out. Then the consumer would instead visit a department store to find a grapefruit. However, the price of the grapefruit would be USD 30/pc. Finally the consumer would give up on purchasing one. Then, the consumer will be disappointed because he/she cannot eat a grapefruit. On finding out through the newspapers that the reason why grapefruits are not available in the market was the result of a container vessel’s engine trouble, he/she may lose faith in the shipping company.

This is an extreme example, but we can understand that the ‘safe operation of the ship and its machinery’ is the subject of much expectation from the wider society, and from this point of view, the following are required in Figs. 6 and 7:

Mission of a Technician

◉ Lifelong Learning
◉ Calm evaluation of one's own personality

Reform of sense

Fig. 6 Mission of a Technician

Once a technical framework has been established, think about what is most important when it comes to using the framework in practice.

Be conscious about prevention and prediction all of the time
in order to not cause an accident.

Concept of "5W1H+2F"

Fig. 7 Prevention and Prediction

In order to be more aware of prevention and prediction, it is required that '5W1H+2F' are considered. 5W1H refers to Fig. 8 below:

5W1H	When ?	Who ?	What ?
	Where ?	Why ?	How ?

Fig. 8 5W1H

Recently, adding 2F (Fig. 9) is favored:

2 F	For Whom ?	For What ?

Fig. 9 +2F

In case of an accident occurring, the person in breach of the legislation is punished and the case is closed. But it is required that 'For Whom' is not only 'for the person in contravention' but also 'for the company' and also 'for society', and 'For What' is 'for no more accidents concerning 5W1H'.

On the other hand, the question arises as to why a technician holding a ship officer's license (Certificate of Competency: COC) causes the same types of accidents. It is because many technicians still believe that improved technology leads to improved safety, that safety is a result of technological advances. As already described before, ‘safety must be thought of as a social entity that extends beyond the realm of technology’.

The ‘human factor’ and ‘human error’ must be introduced into the counter measure, so as for there ‘never to be a reoccurrence of the same type of accident’, in the analysis. Rather, preventative type of safety measures are necessary where we ask questions as to why the accident occurred, about the surrounding circumstances of the accident, and consider the best means to prevent reoccurrence.

When formulating a countermeasure to prevent reoccurence, consider

Human Characteristcs

and analyse as to why such an action that led to an accident was taken.

Fig. 10 Human Characteristics

§1-4 Human Characteristics and BTM (Bridge Team Management) /ETM (Engine Room Team Management)

If we assume that ‘humans are error-prone, including experts’, preventing human error is a matter of BTM and ETM which have been designed to achieve safe vessel operation by raising awareness of bridge and engine room teams. Before an explanation of BTM and ETM, let’s consider ‘Human Characteristics’.

(Human Characteristics)

The following are the “Human Characteristics” that can hinder appropriate procedures and judgment. (from Nihon VM centte “Anzen no Komado” No.18 30/6/2002)

Twelve human characteristics

- ❶ Human beings sometimes make mistakes
- ❷ Human beings are sometimes careless
- ❸ Human beings sometimes forget
- ❹ Human beings sometimes do not notice
- ❺ Human beings have moments of inattention
- ❻ Human beings are sometimes only able to see or think about one thing at a time
- ❼ Human beings are sometimes in a hurry
- ❽ Human beings sometimes become emotional
- ❾ Human beings sometimes make assumptions
- 傓 Human beings are sometimes lazy
- 傔 Human beings sometimes panic
- 傔 Human beings sometimes transgress when no one is looking

If we consider the above, it appears that human beings are nothing but a collection of defects and shortcomings, and it also even seems that human behaviour is in danger of re-occurrence. However, from another point of view, these defects can be seen as ‘wonderful abilities of human beings’. The ‘human behaviour characteristic’ can consist of advantages and disadvantages, as follows.

❶	Attention dispersal model	⇔	Simultaneously perform multiple tasks effectively
❷	Evaluate and act on assumptions	⇔	Able to make overall decisions
❸	Make decisions on limited information	⇔	Able to make decisions efficiently
❹	Haphazard behavior	⇔	Able to make flexible responses to suit the conditions

However, human beings have a wide range of information input systems, along with a single system capable of processing and judging. This system is easily interrupted, and the focus easily switched.

Furthermore, human beings tend to seek the comfortable option, to have real intentions and stated reasons, to be sleepy in time zones, and to find work harder as they become older. These problems are controlled with 'attentiveness' and 'awareness' as information processing sources, however they are limited and become causes of an inability to avoid errors. For example, an investigation of the time zones in which vessel collisions occur show that they are most common between 2am and 6am, and 2pm and 4pm, which means collisions are likely due to these factors.

§1-5 BTM・ETM : From Grave-post Type to Preventative Type Analysis/Counter Measure

The basic concept of BTM is the same as ETM. This configuration is shown by the M-SHELL Model as follows.
As shown in Fig. 11, the person at the center (L: person responsible for the accident) is surrounded by those resources such as: 'H: Hardware', 'S: Software', 'E: Environment', and 'L: Persons other than the person responsible for the accident.' Each resource is always in a state of change. This situation can be shown in terms of quivering rectangles. Here, if communication and cooperation between the person 'L' and those resources are insufficient, 'L' is unable to have sufficient contact with others and human error occurs; in consequence, safety is no longer assured. To ensure that an error by a single individual does not create a hazardous situation, it is necessary to spot the error quickly and work as a team to support one another and correct it. This is the basic concept of BTM and ETM.

As described above, all resources are never static. All resources function to ensure good mutual communication, eliminate causes leading to the 12 characteristics of human beings or change point of view to achieve wonderful ability, and suppress the occurrence of errors. Even if L (You) and other resources generate human error, it is possible to manage them in order to prevent errors in the communication gap of the entire team when it is being managed by BTM or ETM.

Fig.11　M-SHELL Model

(Why are BTM and ETM not well-known?)

Despite 20 years having elapsed since the introduction of BRM, neither BRM nor ERM have become popular. Possible causes are given below.

Root causes that are not well-known

1) If technical skills are at a high level, it is assumed that ' safety is guaranteed'.

2) Management is not seen as a skill, and the traditional idea of separate deck and engineering sections remains strongly entrenched.

3) Crew training is primarily OJT, where responsibility is left to the site.

A revolution in awareness is required in light of this way of thinking, 'the way of thinking of safety', 'the question of what management is', and 'the reconsideration of OJT'.

The captain, chief engineer, and the company are required to develop ‘an atmosphere in which subordinates (i.e. team members) are able to speak up on matters of safety operation’. This is the foundation of effective use of BTM and ETM.

In comparison with the shipping industry, CRM (Crew Resource Management) appears to be running smoothly in the airline industry. When we compare the two, it appears the difference lies in the level of technology. In an aircraft, the difference in level of skill between the captain and the co-pilot appears to be less than that between a ship’s captain and chief officer, or between a chief engineer and engineer.

For example, if the captain of an aircraft were incapacitated in flight at an altitude 30,000 feet, the co-pilot should be capable of landing.

On the other hand, can a third officer operate his vessel safely to its destination? There is a major difference between ships and aircrafts in terms of the methodology of crew training, including up-skilling. Therefore, we can think that training of inexperienced officers also is an important element when utilizing BTM and ETM.

Furthermore, ‘threats’ are sources of errors. With BRM and ERM, if threats are considered as elements which increase the possibility of errors, the following can be noted.

Elements which increase the possibility of human errors

1) A large volume of work (i.e. not enough personnel available to do the work)

2) Time pressure (when the leader is in a rush and this is picked up by team members, it will leave everybody unsettled)

3) Pressure from superior (in particular, regularly shouting at subordinates, scaring them into silence, and inhibiting operation of BRM and ERM)

4) Fatigue and stress (attention is distracted when fatigued, and external stress is a cause of deterioration in abilities)

In other words, unless BRM and ERM can operate properly, not only will errors occur, but stress will develop between the leader and team members, giving rise to a vicious cycle.

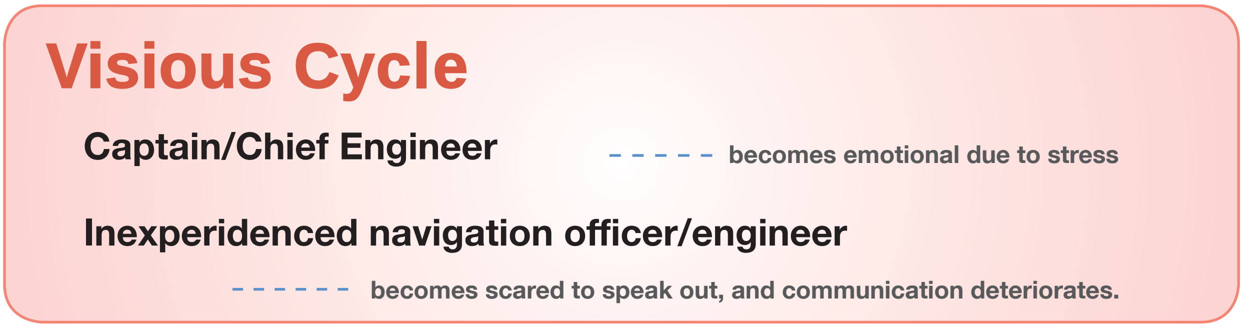

Fig. 12 Vicious Cycle

(From Grave-post type to Preventative type analysis/counter measure)

As described before, in case of a risk of collision by a crossing situation, all watch-keepers at brigde, who have a license and who do not remember the COLREGs clause completely, know COLREGs clause 15 ‘the vessel which has the other on her own starboard side shall keep out of the way’, and also knows clause 5 ‘Look-out’ is one of the most important clauses. However, although they know these clauses, sometimes they neglect the Look-out, ‘Why did they not take action to avoid the collision’, and finally why did they cause a collision accident?

By considering ‘Human Characteristics’, it is necessary to analyze as to why they took dangerous action and establish preventative type countermeasures based on the background information of the accident and consider the best means to prevent reoccurrence. Thus it is necessary to change the analysis and countermeasure from the Grave post type to the Preventative type, shown in Figs. 13 and 14;

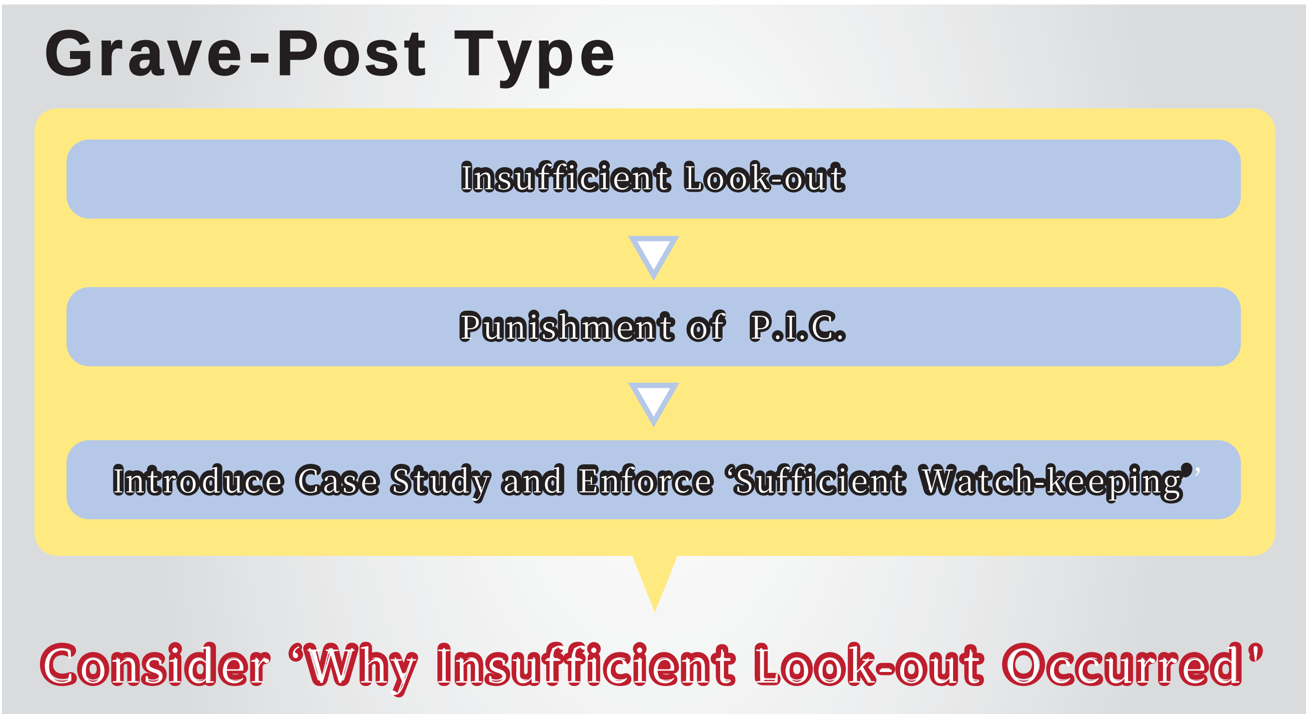

Fig. 13 Grave - Post Type

Preventative Type

Cause of Insufficient Look-out

Paperwork during duty watch

Falling asleep

▶

Check necessity of individual documents

Check amount of work that triggers falling asleep

Collapse of BTM

Non compliance with observance of COLREGs

▶

Although duty officers understand COLREGs and the concept of BTM, analyse as to 'why the duty officers failed to take necessary action'.

Exclusion of Root Cause

Too much paperwork ▷ Review the volume of paperwork ▷ Reduce work load

- Abolish unnecessary and non-urgent documents
- Review SMS Manual
- Prohibit doing of Paper Work during duty watch and control work and rest hours (including falling asleep countermeasures)
- Set priority for various kinds of paperwork

Collapse of BTM

Non compliance with observance of COLREGs

▷ Pertinent:' Human beings sometimes forget ' in Human Characteristics ▷ Remind

- Re-education
- Supervise continuously (Brief before boarding)

Fig. 14 Preventative Type

§1-6 Training of Inexperienced Officers and Engineers with Low Skill Levels

To prevent errors, inexperienced officers and engineers with low skill levels must individually and objectively evaluate and understand the skills with which they are deficient, and endeavor to reach the level of an experienced captain/officer or chief engineer/engineer as soon as possible. OJT and training on shore are methods used in training these officers and engineers. However, the awareness and motivation of the trainee is important. If we consider the level to which skills can be raised with OJT and shore training, Student Oriented (in Fig. 15 below) provides guidelines.

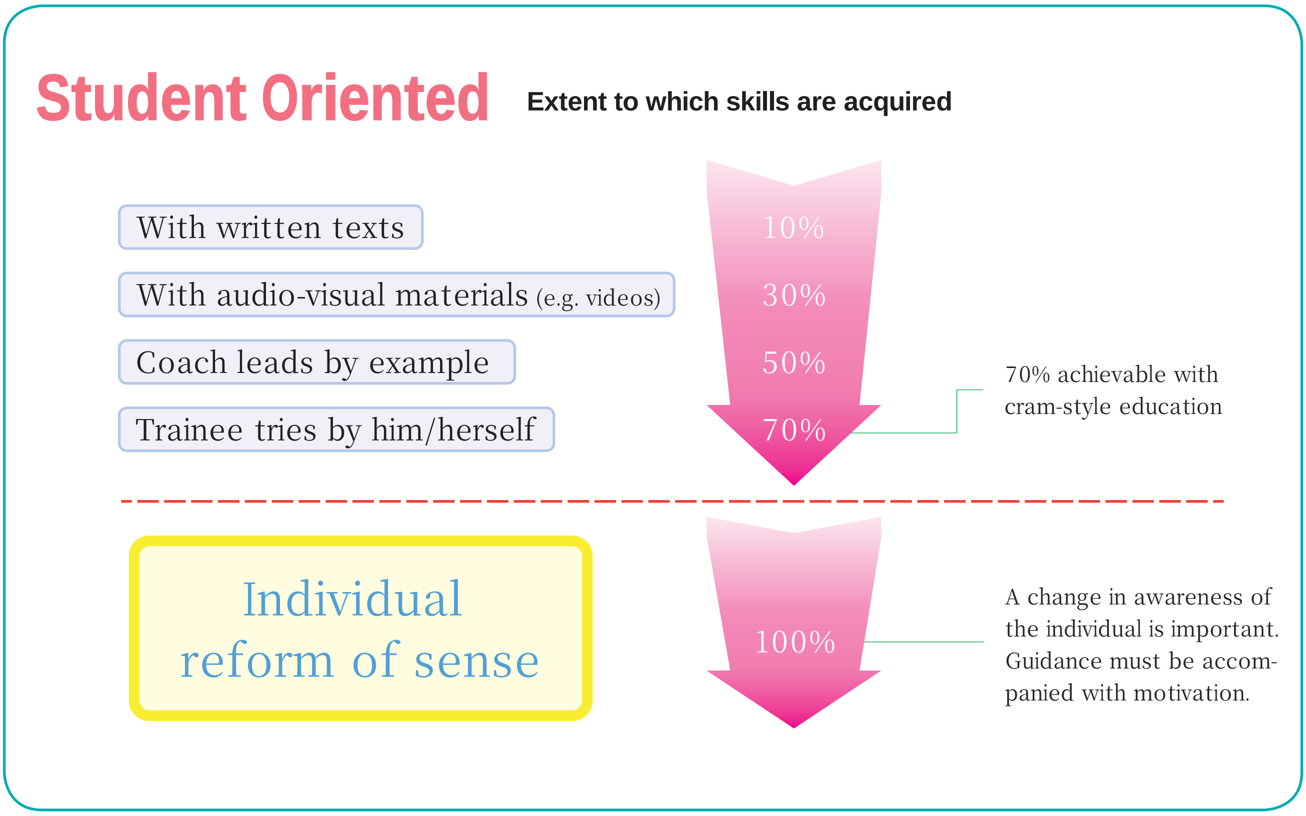

Fig.15 Student Oriented

Approximately 10% of skills are considered to be learned in classroom lessons using written texts. These skills consist primarily of fundamental theory and knowledge.

Use of videos, PCs, and the Internet as 'audio-visual materials' are considered to raise the skill level to approximately 30%. Think of a merchant ship school as being the last step before actually doing the real thing on board a vessel.

Subsequent practice and OJT in which the coach demonstrates is considered to increase the skill level to 50%. Further use of simulators and OJT after having entered the company to provide the student with experience is considered to increase the skill level to 70%. In summary, pushing the student is effective to a certain degree, however the attainment of 100% skill is required on-site.

Increasing the remaining 30% skill level is fundamentally a matter of 'individual reform of sense'. Education at this stage is primarily focused on OJT, and coaching is required to raise the motivation of the student. Also, again, it is necessary to understand the fundamental idea behind '5W1H + 2F'. '2F' is especially important in the training field. And, as mentioned above, it is important to be aware of the fact that behavioral characteristics of people deemed to be defects could be turned into wonderful abilities.

For example, the author had the following experience while aboard a vessel as Master. I feel embarrassed just remembering the event.

> On one occasion, the mooring winch on the Forecastle broke down. Immediately, repair work needed to be carried out and I (Master) requested that the chief engineer, the chief officer and the boatswain repair it. I was also required to attend the repair work. In order to repair it, first of all we had to remove the nut that attached the cover, but the chief officer provided only spanners of the wrong sizes .
> I was aware of ' Human Characteristics No. ⑨ Human beings sometimes make assumptions ' and smoked down the chief officer ' Why did you not bring various size spanners well in advance? ' without realizing ' No. ⑧ Human beings sometimes become emotional ' myself.
> Even after completion of the repair work, the chief officer was disappointed for a while. However, if the spanner that he prepared for repairing was of the correct size and he had commenced the work without trouble, it would have been possible to observe that he was able to make overall decisions manifesting wonderful ability, contrary to No. ⑨ Human beings sometimes make assumptions. Remembering this story, I still feel regret towards him, even though more than 10 years had passed.

Considering 'What is safety' and 'Human Characteristics' (described above), let's study the counter measures in order to prevent recurrence through the following three accident case studies.

§2 Collision

§2-1 Summary of Accident

Date and time of occurrence:

On an unspecified day of October 2013, approximately 21: 01 Japan time (JST)

Accident site:

Southwest area of Kii Suido (Strait), north-northeastern area of I-shima

Vessels concerned:

Container Vessel A (50,686 G/T, Loa 292m)

- During navigation from Kobe Port to the Port of Busan in South Korea on the southern routes along Shikoku
- Crew members (21 members on board)

South Africa	×5 (including Master)	India	×2
Ukraine	×3	Romania	×1
U.K.	×1	The Philippines	×8
Russia	×1		

- The third officer keeping watch was present at the collision accident at that time.
  Bridge Watch personnel constituted one A/B and one cadet respectively. The Master was handling paperwork in his cabin.
  The Master, age 52, was assigned to Master in 1994. Following shore duty as marine superintendent and designated person ashore, the Master came aboard the current vessel. The Master had, on four occasions, navigating experience of this area of sea.
  It was the third officer's (Officer of the Watch, age 27, South African) second vessel as navigation officer. As third officer, the officer had, on five occasions, navigating experience in this area of sea.
- Cargo and draft: 2,500 loaded containers with a Draft Even Keel of 11.39m.

Cargo ship B (4,594 G/T, Loa 110m)

- Bound for Mikawa Port from South Korea via Naruto Strait of the Seto Inland Sea

- Crew members (13 members on board)

Korea	×3 (including Master)	Indonesia	×3
The Philippines	×4	China	×1
Burma	×2		

- The third officer and one A/B watch-keeper were present at the collision accident at that time. The Master was taking a rest in his cabin. The Master, age 50, had 10 years of experience as an officer and 5 years of experience as a master. The Master had extensive experience of navigating between China/Korea and Japan. The third officer, (Officer of the Watch, age 24, Filipino) had been on board both a Filipino coaster vessel in Japan and an ocean-going vessel for 16 months. It was his first time to board as third officer. As a cadet, the officer had, on ten occasions, navigating experience in this area of sea.
- Cargo and draft: 5,350 K/T loaded with steel. Draft Fore 5.60m, Aft 6.85m

(Summary of Accident)

The accident occurred at night off the north-northeastern sea coast of I-shima on the Kii Suido (Strait) while Vessel A was sailing southward on a course of <190>, after pilot disembarkation, having just passed Tomogashima Strait, when cargo ship B was navigating southeast on a course of <140> towards Kii Hinomisaki coast having passed the Naruto Strait. In addition, as for the state of the surrounding environment at that time, there were no other ships in the vicinity, which would have affected either vessel's operations, and there was good visibility.

There were no other vessels concerned which may have affected navigation, as long as one could see the information on the AIS and reports from the related party.

Fig. 16 Surrounding Environment

When both vessels approached cutting across each other's courses, the third officer of Vessel A noticed that there was a risk of collision with Vessel B due to the approach alarm sounded by the ARPA and informed that she (Vessel A) would pass the astern of Vessel B via VHF. However, he continued to navigate on the same course and speed, with the exception of altering course to starboard 6 degrees. Also, after the third officer of Vessel B noticed the Closest Point of Approach (CPA) which indicated zero on the ARPA, he altered course to starboard 5 degrees, but still sailed continuing on the same course and speed.

As a result, both vessels kept closing head-on to each other. Although it steered immediately to avoid collision immediately before the collision, the starboard side bow of Vessel A collided with the port side astern of Vessel B.
Both vessels sustained damage to the hull, however, there were personal injuries. Please see Figs. 17, 18 and 19 and Table 20 for collision details and the actions that were taken by both Vessels.

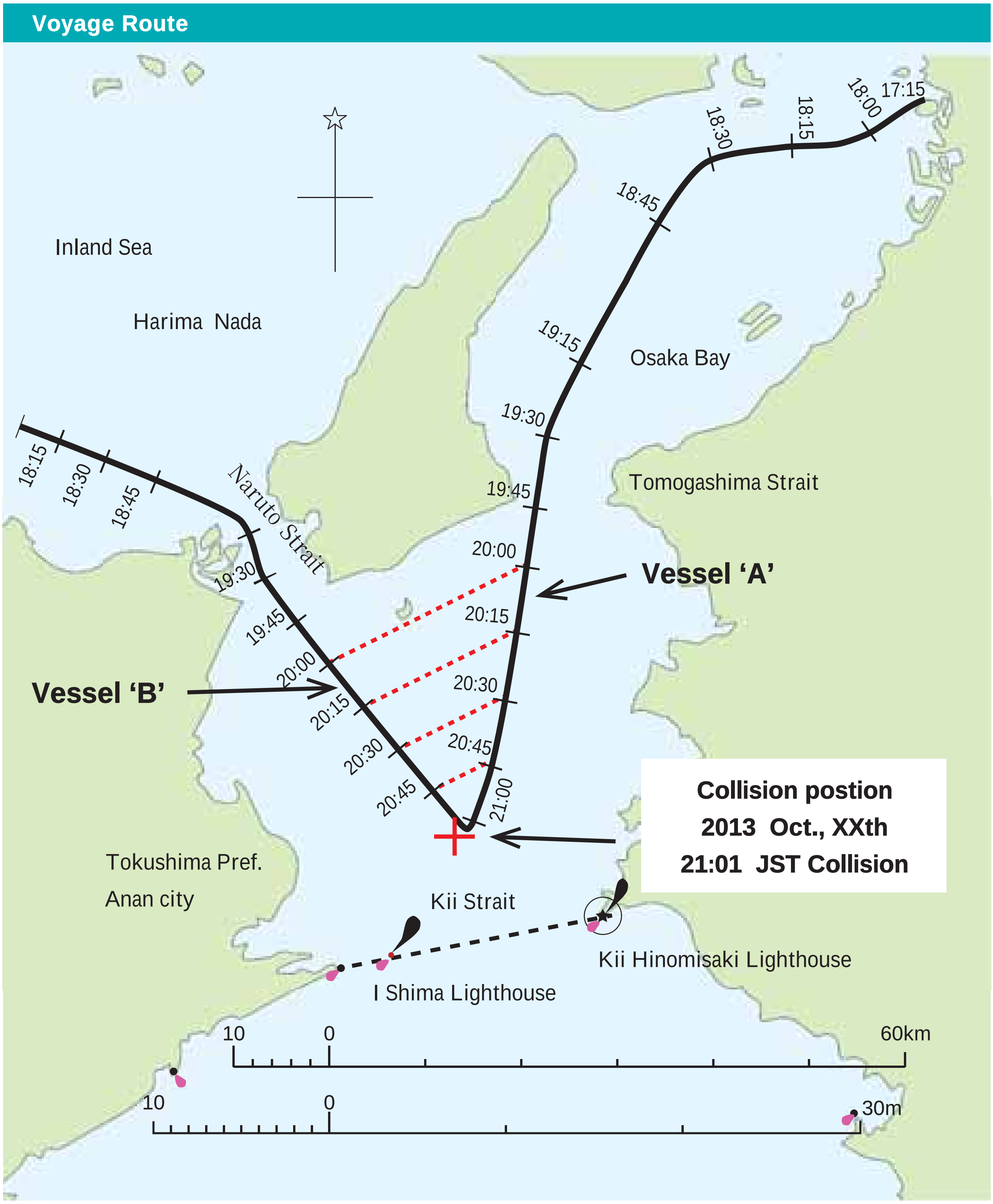

Fig. 17 Voyage Route

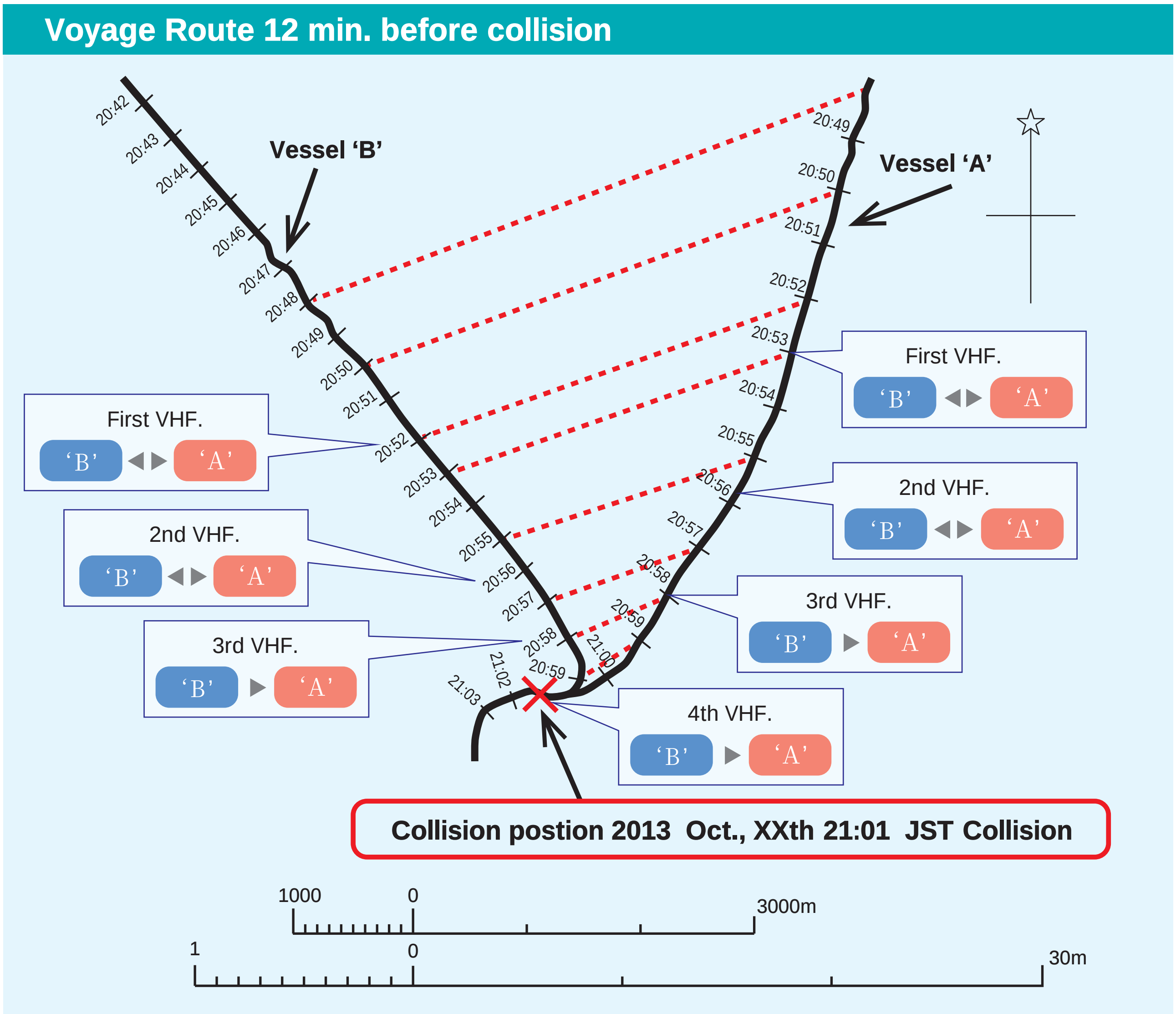

Fig. 18 Details of Voyage Route

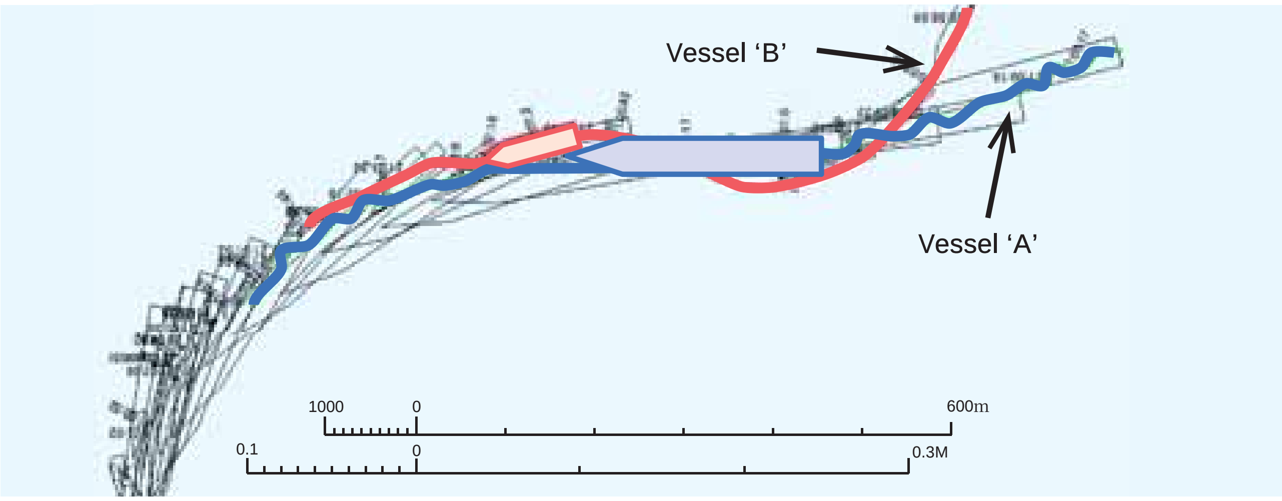

Fig. 19 Details of Voyage Route

Weather and sea conditions Weather：fine, NW wind, wind force 1, visibility: approximately ten(10) nautical miles

	Vessel 'A' (Container vessel)	Vessel 'B' (Cargo ship)
Watch arrangemet at the collision accident at that time	Three in total: the third officer (South African), a Cadet and an AB.	Two in total: the third officer (Filipino) and an AB.
19:54	The Chief Officer took over the watch from the Master.	At around 19:50, the Chief Officer took over the watch from the Master.
	Course <190>, speed 16.0 kts.	Course <140>, speed 12.5 kts.
20:00	The third officer together with other two crew members started watch-keeping.	The third officer together with another crew member started watch-keeping. After verifying the state of the surrounding environment, the Master left the bridge.
20:10	Two radars were in use: Automatic Radar Plotting Aid (ARPA: off-centre) and ECDIS.	Two radars were in use: Automatic Radar Plotting Aid (ARPA: off-centre) and ECDIS.
	One radar used a range of 6 nautical miles and the other a range of 12 nautical miles.	One radar used a range of 6 nautical miles and the other a range of 12 nautical miles.
	The Master left the bridge having commanded his crew to be on alert during the watch.	–
20:25 (approximately)	Vessel B was observed at 7.5 nautical miles. 51 degrees with bearing of <245> off of its starboard bow. Supplemented at 5 nautical miles with ARPA. Verified with the screen that indicated a course of <135> and a speed of 13.0 kts.	–
	At the same time, Vessel B's white, white and red lights were visibly confirmed	–
20:47 (approximately)	CPA alarm sounded at a distance of 3.0 nautical miles (the alarm setting was unknown).	–
20:50 (approximately)	Vessel B was observed at 52 degrees with a bearing of <248> on her starboard bow at 2.3 nautical miles via ARPA.	Vessel A was captured on the monitor at 70 degrees on her port side at approximately 3.0 nautical miles via AIS (superimposed in ECDIS). Visibly confirmed as the CPA indicated it at 0.2 nautical miles. Recognized white, white and green lights of Vessel A.
	Responded to a call from Vessel B via VHF and communicated that Vessel A would pass the stern of Vessel B. Altered course to starboard 6 degrees. Set the new course <196>.	Contacted Vessel A via VHF and confirmed she was going to pass the stern of Vessel B. Vessel B believed Vessel A was heading toward the stern.
20:53 (approximately)	Confirmed Vessel B at 54 degrees with a bearing of <250> on her starboard bow at 1.7 nautical miles via ARPA.	Confirmed Vessel A at 70 degrees with a bearing of <070> on her starboard bow at 1.7 nautical miles via AIS.
	Course <196>, speed 15.0 kts.	Course <140>, speed 12.0 kts.
20:56 (approximately)	Furthermore, officer B requested that Vessel A alter course to starboard via VHF. Gradually started altering course to starboard, the distance was 1 nautical mile.	As the AIS data disappeared, officer B requested that Vessel A alter her course further to starboard side via VHF.
20:57 (approximately)	Confirmed Vessel B at a bearing of <252> at 0.8 nautical miles via ARPA. Steered hard to starboard.	Started altering course steering hard to starboard.
21:01	Collision at 14.6 knots, when bow direction was at <266>.	Collision at 8.6 knots, when bow direction was at <250>.

Table 20 Sequence of Events

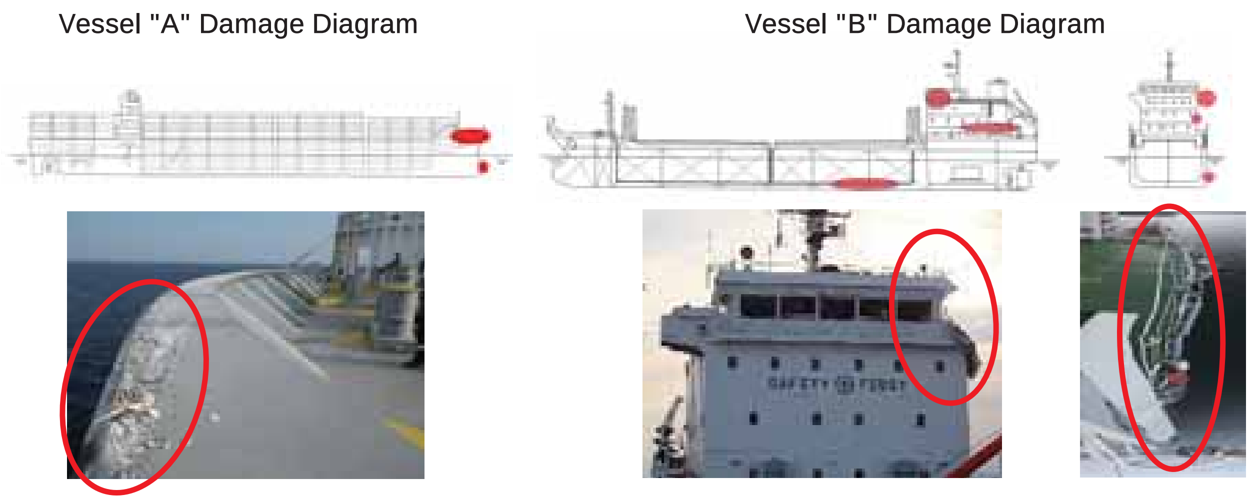

Fig. 21　Damage Diagram

= Communications via VHF =

At around 20:50 (approximately 11 minutes before the collision), the VHF communication (VDR information of Vessel B) transmitted the following (The information of Vessel A was not available from the VDR):

At 20:51:47, Vessel B contacted Vessel A and inquired her intention.
’Vessel A, What is your intention?’

At 20:52:28, After Vessel B confirmed A’s intention, Vessel B answered back that she also changed her course to starboard side.
’Vessel A, Pass my stern? OK, Thank you. You are going to my stern.’
‘Vessel A, I will going to alter course to starboard side also, Thank you.’

Both sides of the conversation are unknown, because the communication history from Vessel A is not available. Although Vessel A was supposed to have replied that it would change its course to starboard side and navigate in order to pass the astern of Vessel B, the question still remains as to why Vessel B replied that she (Vessel B) also would alter her course to starboard side.

§2-2　Analysis of Accident Cause by Japan Transport Safety Board (Marine Sub-committees)

§2-2-1　Applicable Navigation Act

Japan Transport Safety Board determined Rule 15 (Crossing Situation) COLREGs to be the appropriate navigation act.

> **Rule 15：Crossing Situation on International Regulations for Preventing Collisions at Sea (COLREGs)**
>
> When two power-driven vessels are crossing so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way and shall, if the circumstances of the case admit, avoid crossing ahead of the other vessel.

In addition, Rule 16 (Give-way Vessel) of COLREGs was applied to Vessel A and Rule 17 (Stand-on Vessel) was applied to Vessel B.

> **Rule 16: Action by Give-way Vessel**
>
> Every vessel which is directed to keep out of the way of another vessel shall, so far as possible, take early and substantial action to keep well clear.

> **Rule 17: Action by Stand-on Vessel**
>
> (i) Where one of two vessels is to keep out of the way the other shall keep her course and speed.
>
> (ii) The latter vessel may however take action to avoid collision by her manoeuvre alone, as soon as it becomes apparent to her that the vessel required to keep out of the way is not taking appropriate action in compliance with these Rules. In this case, if the requirements of Rule 15.1 apply to these vessels, the stand-on vessel shall turn to port unless impossible.
>
> (iii) When, from any cause, the vessel required to keep her course and speed finds herself so close that collision cannot be avoided by the action of the give-way vessel alone, she shall take such action as will best aid to avoid collision.

§ 2-2-2　Analysis of Accident by Japan Transport Safety Board

Japan Transport Safety Board analyses the accident as follows.

(1) Vessel A

Vessel A	
①	(approx.) 20:25 local time on a unspecified day of October. Vessel A was heading southbound on a course of <190>, at a speed of 16.0 kts. In the vicinity of 16.5 nautical miles on a course of <022> from I-shima Lighthouse, a third officer detected Vessel B on radar at a distance of 8 nautical miles, 55.0 degrees with bearing of <245> on her starboard bow. It is probable that the officer visually confirmed each of the two white mast lights and one red light (port side).
②	(approx.) 20:47, the third officer (Vessel A) noticed there was a ‘ risk of collision ’ with Vessel B in response to the ARPA alarm. 3 minutes after, the third officer responded to a call from Vessel B via VHF. The third officer communicated that Vessel A would pass the astern of Vessel B and hung up the receiver after confirming. The third officer then, set the new course <196> by altering course starboard to 6 degrees, and navigated continuing on the same course and speed for approximately 4 minutes. It is probable that despite the change of course, the change of relative bearing to Vessel B was only within 2 degrees turning to starboard side. It is thought that the third officer of Vessel A, according to his understanding of the communication received from Vessel B, assumed that Vessel B was turning to starboard, and therefore kept Vessel A maintaining on the same course and at the same speed. Vessel A steered hard to starboard immediately prior to the collision, however, it was too late.

(2) Vessel B

	Vessel B
③	(approx.) 20:50. Vessel B was navigating on a southeast course of <140> towards the Kii Suido, Kii Hinomisaki western offshore, at a speed of about 12.0 kts. In the vicinity of 8.8 nautical miles on a course of <017> from I-shima Lighthouse, Vessel A was noted to be navigating south on a course of <068> about 3 nautical miles from Vessel B at 70 ° on her starboard bow, according to the AIS, which was captured on ARPA, the third officer recognized two mast lights and one green (starboard light) of Vessel A. Because the CPA of Vessel A was indicated at 0.2 nautical miles on the ARPA screen, third officer judged that there would be a risk of collision and confirmed the name of Vessel A via the AIS.
④	The third officer contacted Vessel A on VHF and inquired her intention. As Vessel A replied with her intention to ' pass the astern of Vessel B', the third officer repeated the conversation and agreed. Moreover, the third officer finished communication with Vessel A's final confirmation and navigated continuing on the same course and speed.
⑤	Later, the third officer noticed that CPA read zero, which was indicated on the ARPA. He then altered his course to starboard by approximately 5 degrees using auto pilot and set the new course to <145>. Then, he sailed continuing on the same course and speed, however, at about 20:55, thinking that the two vessels were in serious danger of colliding, he communicated via VHF with Vessel A once again. When the third officer requested that Vessel A change course to starboard, Vessel A respond to confirm. However, while waiting for Vessel A to change course to starboard side, the third officer realized that the risk of collision was imminent, and although he steered hard a starboard, it appears that a collision was unavoidable.

§ 2-2-3 Analysis of Accident Cause by Japan Transport Safety Board (Marine Sub-committees)

Japan Transport Safety Board analysed the cause of the accident and issued the following five reasons.

①	Vessel A contacted Vessel B via VHF and informed of her intention to navigate in order to pass the astern of Vessel B. However, after only altering course to starboard 6 degrees, the third officer assumed that Vessel B had altered course to starboard side and navigated continuing on the same course and speed.
②	After cadet A of Vessel A listened to the communication via VHF about the change of course to starboard side by both Vessels A and B, he could not see if Vessel B had altered course to starboard side on the ARPA monitor. Also, he considered it not sufficient enough to change heading course, and although he knew that the third officer had altered course to starboard by approximately 6 degrees, he did not advise and report this to the third officer (although, this was not the direct cause of the accident).
③	The reason why Vessel A continued on the same course ＜ 196 ＞ and speed was, presumably, because, through communication with Vessel B via VHF, Vessel A understood that Vessel B was going to alter course to starboard, even if only slightly.
④	After Vessel B discovered that the CPA was zero, indicated on ARPA, she altered course to starboard 5 degrees and set a new course to ＜ 145 ＞, however, she sailed continuing on the same course and speed. That is to say, it is probable that the third officer may have been waiting for Vessel A to take action by giving way, which meant that Vessel A intended to navigate passing the astern of Vessel B mutually communicating with Vessel A via VHF.
⑤	For both Vessels A and B, they did not adopt either warning signals or manoeuvring signals using whistles or flashing caution signal lights.

§ 2-2-4　Preventive Measures by Japan Transport Safety Board

Japan Transport Safety Board proposed the following preventive measures to avoid a recurrence of the incident.

(1) Vessel A

Vessel A	
①	After the other vessel is first detected, in the event that both vessels approach cutting across each other's courses,/or in the event that both vessels are on a course to cross each other, regardless of whether communication via VHF is maintained, /or regardless of whether VHF communication takes place, at first, it is naturally expected that quick recognition of the possibility of a collision with the other vessel is ascertained. Then, according to the Rule of the Maritime Collisions Prevention Act (COLREGs), avoidance action should be taken in ample time and, at the same time, dynamically so as to be easily recognised by the other vessel.
②	In the case of noticing that there is a risk of collision, in accordance with the Rule of Maritime Collisions Prevention Act (COLREGs), the necessary action is to be taken immediately and recognition that it is not necessary to communicate mutually by VHF.
③	The watch-keeper who felt uneasy and warned about the movement of the other vessel is obliged to immediately report it to the Officer of the Watch (OOW).

(2) Vessel B

Vessel B	
④	Look-out is to be adequately performed and in the event of the other vessel being detected, the course of the other vessel is to be accurately determined.
⑤	In the event that the stand-on vessel, which is vessel B in this case, does not understand the give-way vessel's intention or action, warning signals are to be sent without hesitation. And, in the case of feeling uneasy about the movement of the other vessel, the Master is to be immediately requested to come up to the bridge.
⑥	In the case that it is obvious that the give-way vessel is not following appropriate actions in accordance with the Rules of Maritime Collisions Prevention Act (COLREGs), action to avoid a collision is to be immediately taken and recognition that it is unnecessary to communicate via VHF accordingly.
⑦	In the case of observing the give-way vessel's course and accurately determining whether it is possible to avoid a collision with the give-way vessel on her present course, and in the event that it is recognised that a collision is unavoidable, take the best course of action to avoid a collision

§ 2-3　Analysis Combining Human Characteristics and Preventive Measures

§ 2-3-1　Analysis of Accident Causes

As explained in §1-5, similar accidents are likely to reoccur without the ‘establishment of preventative safety measures’ according to an analysis of the accident causes that include Human Characteristics, focusing on the aspects of ‘why the accident occurred’ and ‘why the person involved took such unsafe measures’.

In other words, it is necessary to consider safety from a ‘preventative type’ perspective in order to safeguard society against the occurrence of an accident. In this section, we are going to determine the measures necessary in order to prevent recurrence, from the viewpoint of preventive measures, of this kind of collision accident.

Firstly, let’s apply the behaviour that the third officer of Vessel A took according Human Characteristics respectively. Table 22 shows a summary of this. We are indicating ◯ for applicable and × for not applicable.

Vessel ‘A’ 3rd Officer				
Human Characteristics			Behaviour	Reason
①	Human beings sometimes make mistakes	×	–	Detected Vessel B via radar at a distance of 8 nautical miles.
②	Human beings are sometimes careless	×	–	Same as above
③	Human beings sometimes forget	◯	give-way vessel's heading course change was six (6) degrees.	Forgot Rule 16 (give-way vessel) of Maritime Collisions Prevention Act (COLREGs).
④	Human beings sometimes do not notice	×	–	Paid attention to the other vessel's movement.
⑤	Human beings have moments of inattention	◯	Carried out inadequate look out.	Relied solely on ARPA information.
⑥	Human beings sometimes are only able to see or think about one thing at a time	◯	Relied solely on ARPA information.	Negligent with verifying visually.
⑦	Human beings are sometimes in a hurry	×	–	There was no testimony attaining to anything be conducted in haste.
⑧	Human beings sometimes become emotional	×	–	Was not particularly emotional
⑨	Human beings sometimes make assumptions	◯	Thought that all was normal, because avoidance action was taken. Assumed that Vessel“ B ”would also alter its course starboard side.	Cadet considered that the change of heading course degrees were not sufficient enough. (Collapse of BTM)
⑩	Human beings are sometimes lazy	◯	Not verified visually.	Did not verify the other vessel's constant watchkeep and confirmation of change relative bearing.
⑪	Human beings sometimes panic	◯	Continued altering course between starboard and port sides immediately before the collision.	Even forgot about maneuvering characteristics.
⑫	Human beings sometimes transgress when no one is looking	◯	Did not carry out Master's standing order (sharp look-out).	Neglected in spite of having been directed to be cautious of crossing vessel.

Table 22 Vessel ‘A’ 3rd Officer Human Characteristics

Similarly, we are going to analyse the third officer of vessel B as well.

Vessel 'B' 3rd Officer				
	Human Characteristics		Behaviour	Reason
①	Human beings sometimes make mistakes	×	–	There was a delay in visually verifying the other vessel, but it was verified.
②	Human beings are sometimes careless	×	–	Same as above
③	Human beings sometimes forget	○	No joint action in accordance with Maritime Collisions Prevention Act (COLREGs) (Rule 17: Action taken by Stand-on Vessel)	Regarding the relationship between large vessels, when they are approaching at 3 nautical miles, they are to take joint action.
④	Human beings sometimes do not notice	○	Did not notice until Vessel A was 3 nautical miles away.	Negligent with look-out.
⑤	Human beings have moments of inattention	○	Was negligent during look-out.	Relied solely on ARPA information.
⑥	Human beings sometimes are only able to see or think about one thing at a time	○	Relied solely on ARPA information.	Negligent with verifying visually.
⑦	Human beings are sometimes in a hurry	×	–	There was no description applicable.
⑧	Human beings sometimes become emotional	×	–	Same as above
⑨	Human beings sometimes make assumptions	○	Thought that Vessel A was going to give-way because she changed her heading course to 20-30 degrees.	Assumed Vessel A would pass the stern via VHF.
⑩	Human beings are sometimes lazy	○	Neglected to keep watching the other vessel's movement constantly. Not verified visually.	Did not verify the other vessel's constant look-out or confirm change of relative bearing.
⑪	Human beings sometimes panic	○	Contacted unilaterally via VHF. Did not confirm the other vessel's reply.	Only contacted unilaterally via VHF.
⑫	Human beings sometimes transgress when no one is looking	○	Transgression of master's standing order (not reported).	Master's standing order: to report when a dangerous ship is visually confirmed.

Table 23 Vessel 'B' 3rd Officer Human Characteristics

For the third officer of Vessel A, seven (7) out of the twelve (12) Human Characteristics items are applicable, whereas, eight (8) of the Human Characteristics are applicable to the third officer of Vessel B. An analysis using the M-SHELL model as to why such behaviour was taken in relation to these characteristics is shown in Fig. 24.
To begin with, we consider the root cause to be 'Exclusive Node'. In spite of insufficient avoidance action (third officer communicated that Vessel A would pass the astern of Vessel B), however in reality, Vessel A altered course to starboard 6 degrees only (in general, Vessel A should alter her heading course to starboard 60 degrees).
Meanwhile, vessel B did not notice vessel A until she approached at a distance of 3.0 nautical miles.

If you were to take a snapshot of each manoeuvre and lay them all out on a table in card form, it would be possible to trace as to why such action was taken and find out what caused the accident.

On analysing as to why the third officer of Vessel A caused the accident, firstly we can say that there was a lack ability in recognizing the importance of look-out. Further, this was not only down to the fact that work was not prioritised appropriately, but that there was also an insufficient understanding of the Maritime Collisions Prevention Act (COLREGs). In addition, it is clear that there were other causes, such as impatience, a lack of caution and non compliance with the Master’s standing order.

On the other hand, when analysing the third officer of Vessel B similarly, we can conclude that the accident causes are the same for the third officer of Vessel A. We understand that the cause was not only down to the fact that there was a lack ability in recognizing the importance of look-out, but in addition, work was not prioritised appropriately. Moreover there was insufficient understanding regarding the Maritime Collisions Prevention Act (COLREGs). It is also clear that there were other causes, such as impatience, a lack of caution and non compliance with the Master’s standing order.

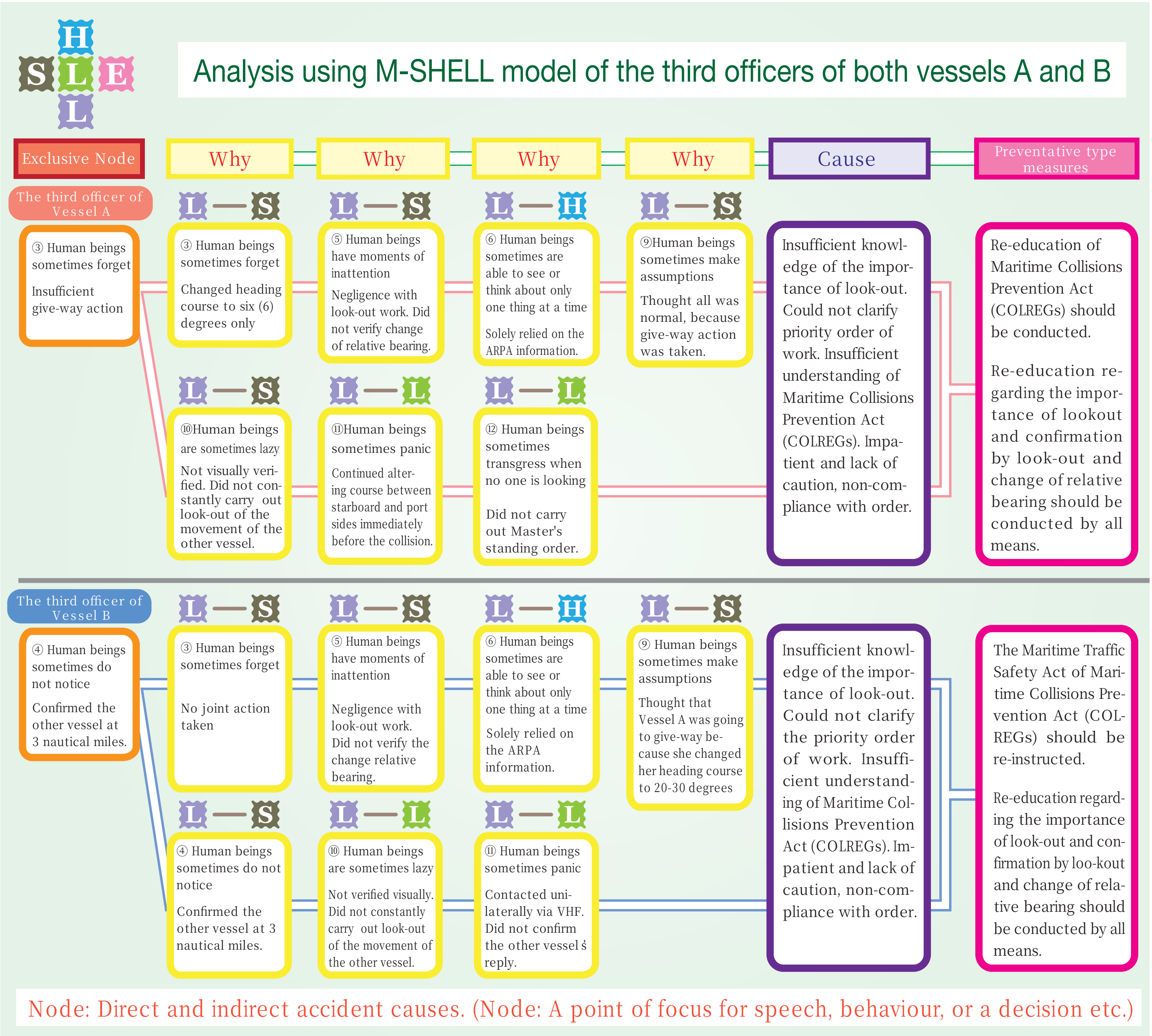

Fig. 24 Why-why? Model

§ 2-3-2 Analysis of Accident Causes which can be Commonly Seen Regarding the Third Officers of Vessel A and B

There are several common points regarding the accident causes of the third officers of vessels A and B. We are going to analyse this focusing on the ‘Why?’ of Human Characteristics. A summary of the common points regarding the third officers of both vessels is as follows:

（1） They relied solely on ARPA information regarding the risk of collision, and did not verify the changes in compass bearing that the other vessel continued on (③ , ⑤ and ⑥).

> Human Characteristics：
>
> ❸ Human beings sometimes forget
> ❺ Human beings have moments of inattention
> ❻ Human beings sometimes are only able to see or think about one thing at a time

The testimony of the third officer of Vessel A is as follows:

‘At approximately 20:25 (approx.36 minutes before the collsion), along with detecting Vessel B’s starboard bow at a distance of 8 nautical miles on radar, I visually confirmed her two white mast lights for the first time. Then I also visually confirmed one red light, and recognized that Vessel B was navigating on a course of approximately ＜135＞ at a speed of about 13.0 kts. I continued to look out visually using the radar, while assigning a cadet to watch the radar and the Able Seaman to look out visually. (Approx.) 20:47, which was approximately 14 minutes before the collision, the third officer of Vessel A noticed that there was a risk of collision with Vessel B following the ARPA alert’.

The testimony given by the third officer of Vessel B is as follows:

‘At Approximately 20:50 (approx. 11 minutes before the collision), I caught Vessel A on the AIS and recognized two white lights and one green light. Vessel A, which was heading southbound was overtaking our vessel, at approx. 25° on her port side abeam aft, about 3 nautical miles away from our vessel. Then, I thought there was a risk of collision, because the CPA was indicated at 0.2 nautical miles via ARPA. I obtained the information that Vessel A was navigating to pass the stern of Vessel B via VHF, and confirmed the vessel name via AIS’.

The course, speed and approaching information of both vessels according to the AIS data analysis are shown in Table 25.

Time (about)	Distance bewtween vessels (Nautical Miles)	Vessel 'A'					Vessel 'B'				
		Heading	Speed	Bearing Vsl.' B '	Relative Bearing to Vsl.' B '		Heading	Speed	Bearing Vsl.`A'	Relative Bearing to Vsl.' A '	
20:25:00	7.5 nm	<190>	16.0kts	<245>	Starb.	55Deg.	<139>	12.4kts	<065>	Port	74Deg.
		Noticed Vessel ' B ' by ARPA and Radar									
20:30:00	6.5 nm	<190>	16.0kts	<245>	Starb.	55Deg.	<139>	12.3kts	<065>	Port	74Deg.
20:34:59	5.5 nm	<190>	15.8kts	<245>	Starb.	55Deg.	<140>	12.4kts	<065>	Port	75Deg.
20:40:00	4.5 nm	<190>	15.9kts	<246>	Starb.	56Deg.	<140>	12.2kts	<066>	Port	74Deg.
		ARPA Alarm. Changed Co. 6 deg. To Starb'd									
20:45:00	3.4 nm	<196>	16.1kts	<248>	Starb.	52Deg.	<140>	12.1kts	<068>	Port	72Deg.
							Noticed Vessel ' A ' by AIS and ARPA				
20:50:00	2.3 nm	<196>	16.1kts	<248>	Starb.	52Deg.	<139>	12.0kts	<068>	Port	71Deg.
20:52:00	2.0 nm	<196>	16.2kts	<250>	Starb.	54Deg.	<140>	12.2kts	<070>	Port	70Deg.
20:53:00	1.7 nm	<196>	16.2kts	<250>	Starb.	54Deg.	<139>	12.4kts	<070>	Port	69Deg.
							Steered Hard Starb'd				
20:55:00	1.3 nm	<208>	16.2kts	<251>	Starb.	43Deg.	<145>	12.5kts	<071>	Port	74Deg.
20:57:00	0.8 nm	<212>	16.0kts	<252>	Starb.	40Deg.	<151>	11.9kts	<072>	Port	79Deg.
		One shot to steered port and then Hard Starb'd									
20:58:00	0.5 nm	<210>	15.8kts	<250>	Starb.	40Deg.	<151>	11.8kts	<070>	Port	81Deg.
20:59:00	0.4 nm	<223>	15.9kts	<247>	Starb.	24Deg.	<206>	10.1kts	<067>	Port	139Deg.
21:00:00	0.3 nm	<248>	15.2kts	<239>	Port	9Deg.	<273>	8.4kts	<059>	Port	214Deg.
21:00:30	0.2 nm	<257>	14.7kts	<245>	Port	12Deg.	<278>	8.1kts	<065>	Port	213Deg.
21:01:00	0.2 nm	<266>	14.6kts	<270>	Starb.	4Deg.	<250>	8.6kts	<090>	Port	160Deg.
		Collision!									

Table 25 AIS Information

There was almost no change in relative bearing from approximately 20:25, when the third officer of Vessel A noted the other vessel, until to approximately 20:40, when the approach alarm of ARPA sounded. Although Vessel A altered course to starboard at around 20:40 when the distance from Vessel B was 4.5 nautical miles, she (Vessel A) set a new course to <196> and altered course to starboard 6 degrees only. In addition, the change of relative bearing after change of heading course was slightly astern (starboard), which shows there was no effect on the give-way vessel at this point.

Thus, we can ascertain that the behaviour of third officer of Vessel A led to the following errors:

(1)	Relied solely on ARPA infromation.	Human Characteristics ⑤ Human beings have moments of inattention
(2)	There was a change in heading course to give-way, but the change in bearing was not verified. (The effectiveness of the give-way action was not confirmed)	Human Characteristics ⑥ Human beings sometimes are only able to see or think about one thing at a time

(3)	Although the vessel confirmed that it was navigating to pass the stern of the other vessel via VHF, the other vessel felt uneasy due to such a slight veering, Under normal circumstances, the appropriate give-way vessel is to widely change heading course to <248> to the astern of the other vessel	Human Characteristics ③ Human beings sometimes forget

This is in violation of Rule 16 of the Maritime Collisions Prevention Act (COLREGs) (Action by Give-way Vessel) that defines: Every vessel which is directed to keep out of the way of another vessel shall, so far as possible, take early and substantial action to keep well clear. (See §2-2-1 Applicable Navigation Act)

Also, the following are behaviour errors regarding the third officer of vessel B.

(1)	He first only recognized vessel A on the radar when it was at a distance of 3 nautical miles away	Human Characteristics ⑤ Human beings have moments of inattention
(2)	Relied solely on the ARPA information	Human Characteristics ⑤ Human beings have moments of inattention
(3)	He over relied on the VHF information of the other vessel.	Human Characteristics ⑥ Human beings sometimes are only able to see or think about one thing at a time
(4)	If there is a distance of 3.0 nautical miles between large vessels and TCPA is estimated at 12-13 minutes, it is reasonable timing to start joint action.	Human Characteristics ③ Human beings sometimes forget

'The most appropriate joint action should be taken to avoid collision with another power-driven vessel' which is in accordance with the Maritime Collisions Prevention Act Rule 5 (Look-out) and Rule 17 (Action by Stand-on Vessel). (Regarding Rule 17, please see §2-2-1 Navigation Act)

(Maritime Collisions Prevention Act (COLREGs) Rule 5: Look-out)

Rule 5 requires that every vessel shall at all times maintain a proper look-out both visually and aurally as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.

(2) Inhibited communication because of assumptions

Human Characteristics: ⑨ Human beings sometimes make assumptions

Miscommunication via VHF can be one of the reasons for a collision. On account of a breakdown in 'communication with external information' (one of the principles of BTM), there was information breakdown between the officers (both third officers) on both vessels, thus it is thought that human error (making an assumption) was at fault. Namely, we can determine that both third officers of Vessel A and B made the following assumptions.

The third officer of Vessel A: Thought that all was well, because avoidance action was taken. He assumed that Vessel B would also alter her course to starboard side by VHF communication.

The third officer of Vessel B: Assumed that Vessel A had changed her course to starboard side to navigate in order to pass the stern of Vessel B because he confirmed it via VHF.

The dangers of collision avoidance using VHF, have been pointed out in 'CAUTION ON THE USE OF VHF RADIO IN COLLISION AVOIDANCE' issued by The Maritime and Port Authority of Singapore (MPA) dated the 4th of July 2005.

' CAUTION ON THE USE OF VHF RADIO IN COLLISION AVOIDANCE '

①	Many investigations worldwide have revealed that VHF communication is one of the contributing factors in collisions at sea. In many of the so called ' VHF assisted ' collisions, the ' VHF communication ' between the bridges had created misunderstanding among the officers which led to close quarter situations and collisions. We are of the view that compliance with the International Regulations for Preventing Collisions at Sea will be more effective in averting a collision rather than the use of VHF communications (based on scanty and unclear information), to avoid a close quarter situation. A recently concluded investigation showed that both vessels were using VHF communication to agree on action to be taken in order to avoid collision, however, many collisions occurred.
②	' VHF assisted ' collisions, contacts or near misses are not uncommon occurrences at sea. The IMO has taken a serious view of this trend. '
③	Based on our findings and experience in similar occurrences, we believe that such incidents are avoidable. We wish to reinforce this learning among all the masters and navigators serving on Singaporean ships through this circular. We wish to take this opportunity to reiterate the following possible dangers involved in the use of VHF communication as a means of avoiding a collision. Factors to be considered are as follows: a. (omitted) b. Uncertainty over the interpretation of messages received due to language difficulties and an imprecise or ambiguously expressed message; c. Loss of valuable time in trying to establish contact on VHF radio instead of taking concrete action in accordance with the Collision Regulations; and d. The danger of agreeing to a course of action that does not comply with the Collision Regulations resulting in a situation which the action intended avoidance of.
④ and ⑤	(omitted)

Since implementation of the AIS, it is now easier to call on the other vessel via VHF. However, critical time was

wasted when using it take avoidance action, after both vessels approached one another at a distance of 3 nautical miles.
If using VHF, it is necessary to start communicating from a much earlier stage and only use it for reference. Thereafter, it is necessary to observe the other vessel's action utilizing the look-out strictly in accordance with Maritime Collisions Prevention Act (COLREGs). In addition, extra time for it shall be needed.

(3) Both Vessels A and B were in breach of the Masters' standing order.

Human Characteristics: 慊 Human beings sometimes transgress when no one is looking

The procedures of the SMS Manual for Vessel A and the Masters' standing order for both vessels are as follows. The fact that both of the third officers of each vessel did not fulfil this criteria can be regarded as one of the causes of the collision. (The parts in red are considered a violation)

Vessel A: SMS Manual and Master's standing order

= SMS Manual =

- Watch-keeper shall pay attention to any other vessel in sight. Please pay extra attention if there is a sudden change in circumstances while navigating.
- To keep an appropriate distance from the other vessel as always. Not to sail across the path of another vessel within one (1) nautical mile, except when necessary.

= Master's standing order =

- The Officer of the Watch shall proceed with the procedures described in the SMS manual.
- Do not hesitate to call the Master up to the bridge, if in doubt. Even if it is too late to call the Master up to the bridge or it is no deemed longer necessary, by all means be sure to call to the Master to the bridge as soon as possible.
- Before calling the Master up to the bridge as early as possible, for safety reasons change the heading course or stop the engine without hesitation, remembering that it will enable the Master to have extra time for situation assessment.

= Specific orders for the Master to come up to the bridge =

- When in doubt about an action being taken by the approaching vessel
- When recognizing something unusual as a duty officer
- When either of the duty officer or watch person of the bridge has a doubt for whatever reason. Use the public-address system, in the case that you cannot make a telephone call to the Master.

Vessel B: Master's standing order

- The Officer of the Watch is naturally expected to take action to avoid collision promptly if there is a risk of a dangerous situation during navigation. Do not be too cautious when using whistle signals.
- Keep appropriate look-out of the surroundings and immediately report the spotting of dangerous meeting ships.
- Do not think too much when taking actions to a avoid collision.

§ 2-3-3　Analysis According to Human Characteristics for the Masters of Vessel A and B

The Master of Vessel A was handling e-mails in his cabin at the time of the collision accident. Meanwhile, The Master of Vessel B was taking a rest in his cabin.

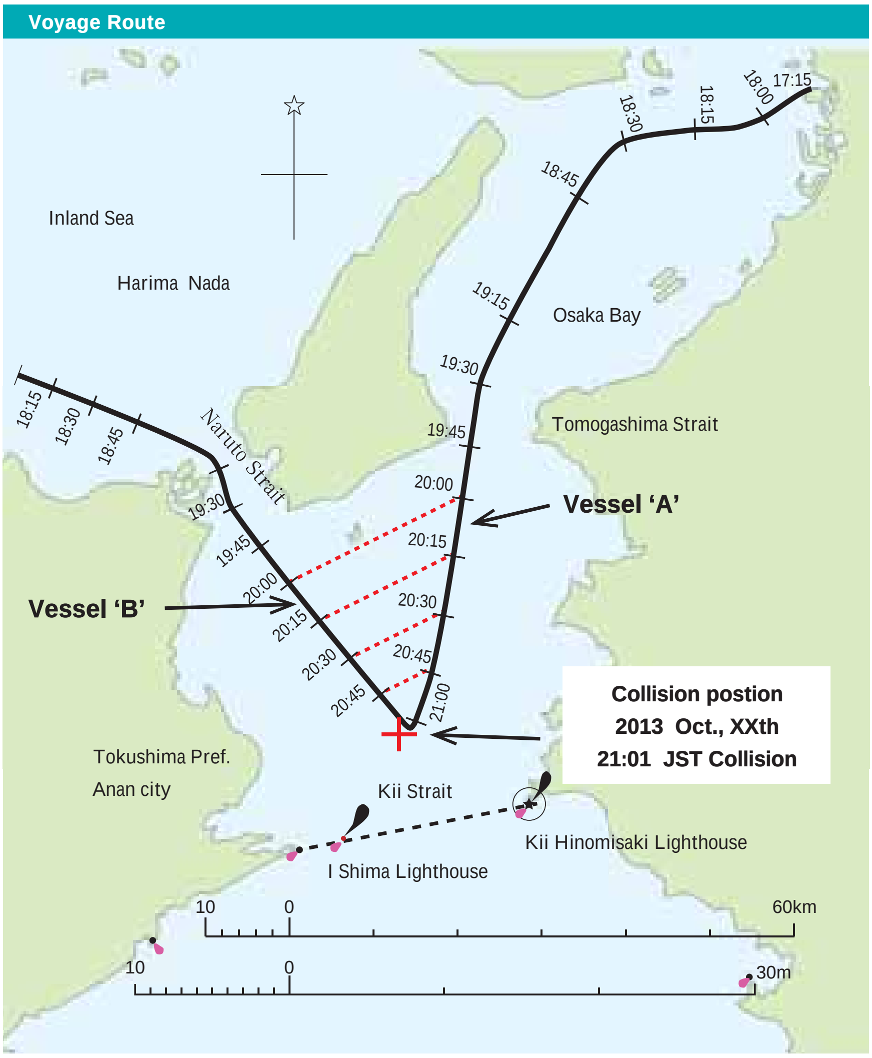

Fig.26　Voyage Route (same as Fig17)

As can be seen in Fig. 26, the traffic system of the Kii Suido (Strait) is a sea area which easily causes a crossing situation because it has a narrow angle for approaching 'vessels between the Naruto Strait and Hinomisaki' and 'those navigating north to south between the Tomogashima Strait and the Kii Hinomisaki coast of I-shima Island'. Also, there are a large number of fishing vessels operating, along with a high volume of marine traffic.

Although it depends on the individual circumstances, if the waters are congested and there is a narrow channel, the Master is expected to command by himself in a large ocean-going vessel.

Why did both Masters of the vessels stay in each of their cabins? We are going to analyse the Masters of both vessels, according to the Human Characteristics.

(1) The Master of vessel A was checking his e-mail in his cabin after disembarkation of the pilot.

When analysed according to Human Characteristics, the following two apply:

6 Human beings sometimes are only able to see or think about one thing at a time
7 Human beings are sometimes in a hurry

It is understandable that contact with related parties needs to be made and that incoming information must be checked without delay, having sailed out from Kobe port. However, it should be obvious that safe navigation be top priority, when comparing the processing of e-mails with that of steering a ship through a narrow channel.

（2）The Master of vessel B was taking a rest in his cabin after having passed the Naruto Strait.

> Human Characteristics： 偏 Human beings are sometimes lazy is applicable here.

It is true that the Master would be quite fatigued, because it is easy to imagine that the Master had continuously been in command at the bridge all the way from South Korea via the Naruto Strait of the Seto Inland Sea to Mikawa Port. However, in navigating the approximately 25 nautical mile passage of the Kii Suido Strait (almost two hours at a speed of 12.0 kts.) from Naruto Strait to Hinomisaki, why was the Master not in command of operation on the bridge?

§2-4 Preventive Measures

These preventive measures were formulated from the point of view of preventing a similar accident through drawing up countermeasures applicable to the third officers and Masters of the ships involved, Vessel A and Vessel B, and the managing companies of the respective ships.

§2-4-1 The Third Officers of Vessels A and B

There were similarities in the specific behaviours of the Human Characteristics involved that led to the accident. If these specific behaviours can be eliminated, preventive measures can be formulated. These are summarized as illustrated in Fig. 27 below:

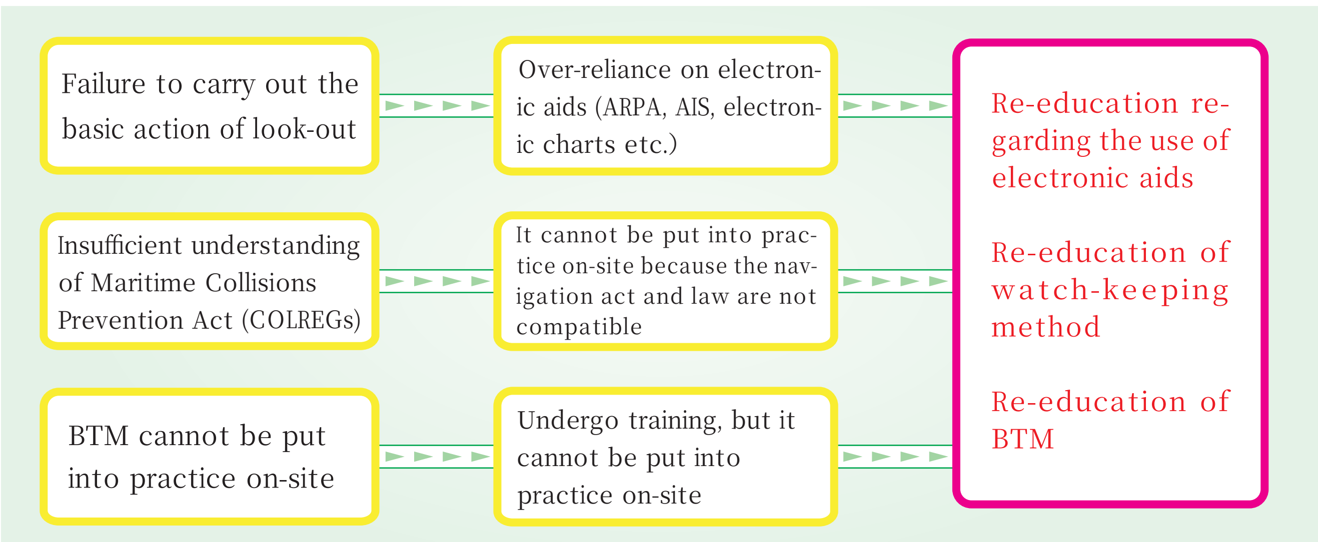

Fig. 27 Preventive Measures for the Third Officers of Vessels A and B

As the analysis in §2-3 shows, the conclusion is that the following are the root causes of the accident.

①	A failure to carry out the basic action of a look-out.
②	A tendency to rely too heavily on ARPA, AIS, electronic charts and other electrical equipment.
③	Although the Maritime Collisions Prevention Act (COLREGs) is understood, it could not be put into practice on-site.
④	There was failure in implementing the BTM despite the presence of the A/B (able seaman) and a cadet on the bridge.

In order to achieve improvements in the above, retraining in all of these areas is necessary. As obvious as it may appear, this is an important measure in order to prevent similar accidents occurring again.

§ 2-4-2　The Masters of Vessels A and B

Despite the fact that the Kii Strait is congested with a narrow channel, the fact that the Masters were not on their respective bridges is one of the reasons for the collision. This is summarized as illustrated in Fig. 28 below.

The reasons behind the fact that the respective Masters left their bridges are as follows: the Master of Vessel A was concerned about dealing with e-mails and other paperwork, and put priority on this rather than steering the ship through the narrow channel.
In addition, it is also a fact that the Master of Vessel B did not give priority to manoeuvring the ship through the narrow channel over taking a break. Therefore, the root cause for the accident can be taken as a lack of awareness regarding the safe operation of the ships.

In the case of both Masters, there were no problems regarding the level of their technical skills or their ability to operate in these waters. Both Masters presumably would have felt enough regret regarding their actions, but they clearly both need retraining in maintaining priorities concerning the safe operation of a ship.

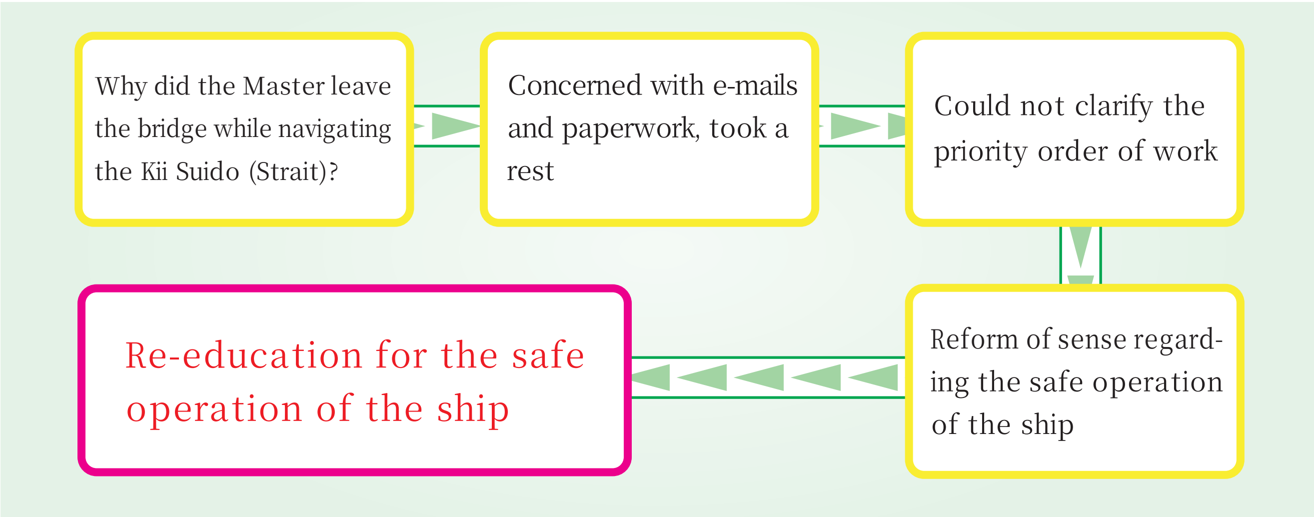

Fig. 28　Preventive Measures for the Masters of Vessels A and B

§ 2-4-3　Management on Shore (Ship Management Company)

The author also understands that the Master of Vessel A went back to his cabin, because he was concerned about e-mail checking and paperwork. However, as a fundamental measure to improve this situation it is important to set up a system where this kind of pressure is avoided.
Because the implementation of the ISM code, SMS, and the use of e-mails have led to advances in communication technology, the amount of paperwork a Master has to deal with has increased enormously. Moreover, there is now great pressure from the organisation for the strict adherence to deadlines for the submission of various reports.
However, in considering priorities of 'what is the most important right now', it is clear that the most important duty of the Master is to command the ship safely through a narrow channel. Therefore, it is of importance that the organisation implements improvement measures in order to reduce pressure on the Master, and does not just leave the situation in the hands of those on the ship.

Moreover, in the case of the Master of Vessel B, he was suffering from accumulated fatigue because he had to command the ship for a long time going from the Kanmon Strait to the Naruto Strait. The summary of this is shown in Fig. 29. There is therefore also a need to implement safety measures, such as the efficient use of inland sea pilots, in order to reduce the amount of time the Master has to spend commanding the ship.

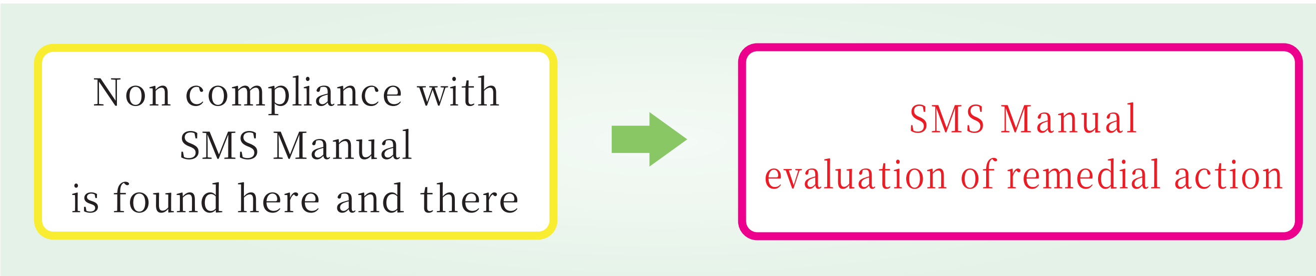

Fig. 29　Preventive Measures for Management on Shore (Ship Management Company) of Vessels A and B

Since the introduction of the ISM code and SMS, although there have been reviews regarding ways of effective implementation, the results of these reviews show that the contents of the SMS manuals have actually increased enormously. The situation would therefore seem to have become one whereby people have to operate within the framework of the SMS, and the basic procedures for the safe operation of the ship are being neglected in the process.

Against this backdrop, and in order to return to the original way of thinking, it should be identified as to what is actually necessary to allow the carrying out of basic operations, and the safe operation of the ship. The time has now come to consider taking the corrective action of simplifying the SMS manuals.