§3 Case Study
= Collision Accident =

Japan Transport Safety Board Report MA2019-6-02
Japan Transport Safety Board Report
http://www.mlit.go.jp/jtsb/ship/rep-acci/2019/MA2019-6-2_2018tk0004.pdf

The collision accident of the outgoing large size container which occurred off the port of Kobe on XX May, 2018 is to be analysed.

3−1 Accident summary (See Attachment 8)

Date and time (See Figure 22)

XX May, 2018 at approximately 07:02:49 (JST)

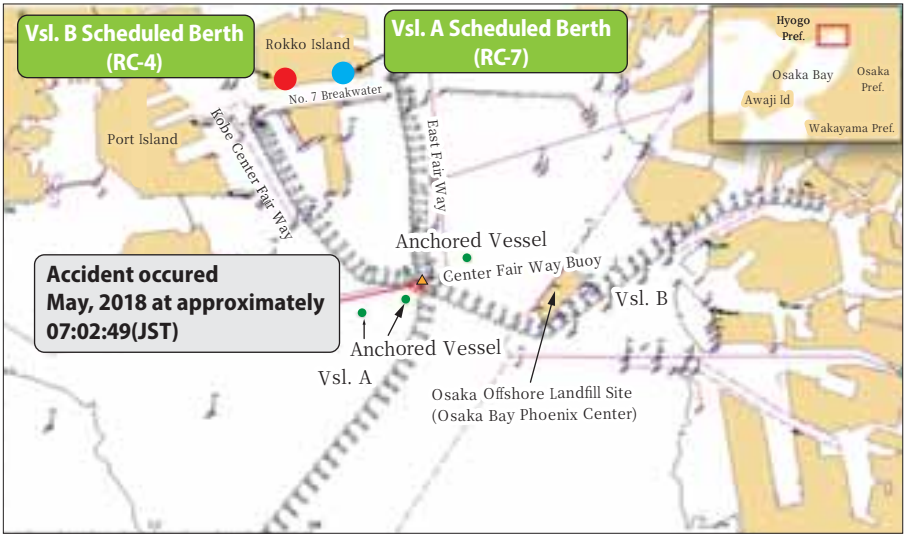


Fig. 22

Point of Occurrence

Near Kobe Rokko Island East Fairway Central FW Buoy

Movement of Both Vessels

Pilot A boards at Tomogashima Channel, and when navigating northeast of Osaka Bay toward RC-7 (Kobe Rokko Island) for mooring, he was trying to head for south of Kobe Rokko Island East Waterway and steered to port side while reducing speed（ship speed: 11.3 knots (approx.).

Vessel B departed Osaka bound for Kobe RC-4 (Kobe Rokko Island) via Kobe Central Fairway. While navigating northwestward and westward, at 13 knots of speed, S/B Full, the starboard bow of Vessel A collided with the accommodation space near the astern port side of Vessel B. (See Figure 23）

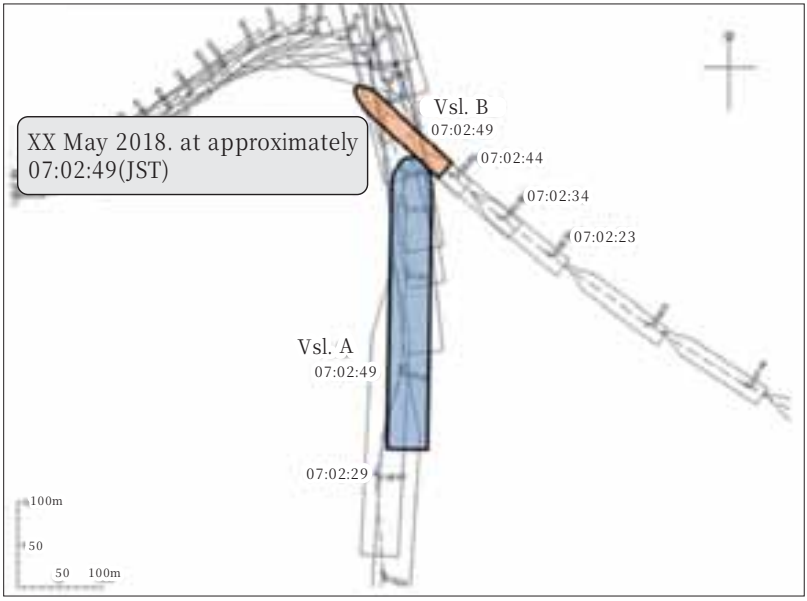


Fig. 23

The weather and sea conditions and visibility at that time were as follows, and did not contribute to the cause of the accident.

05:06　Fine SW ～ WSW 3.8 ～ 4.1m/s (wind force 2 ～ 3) Visibility 30km or more (more than 16 nautical miles)

Container Vessel A Summary

Photograph 24

Gross tonnage	:	97,825GT
L×B×D (Length) (Breadth) (Depth)	:	338m×46m×25m
Port of origin	:	Singapore
Port of destination	:	Kobe RC-7
Cargo	:	20FT CTNR×1,360 40FT CTNR×2,441
Draft	:	12.85m Aft 13.35m
Crew arrangement	:	3 Croatian, 2 Russian, 16 Filipino, 2 Indian, 1 Romanian and 2 Chinese Subtotal 26 crewmembers + 3 accompanying passengers (Indian) and 1 Pilot Total of 30 crewmembers on board
Ship's Bridge on duty personnel at the time of the accident	:	Master A, Pilot A, 3/O A, AB A and Cadet A
Master A	:	Croatian nationality at the age of 54 : Captain since 2003, boarded the vessel on March 2018 and had 8 times experience of entering Hanshin Port of Kobe as Master
Pilot A	:	Japanese nationality at the age of 70 has been an active Pilot since 2002 (15 times per month)
3/O A	:	Filipino nationality at the age of 24
Cadet A	:	Chinese nationality at the age of 25

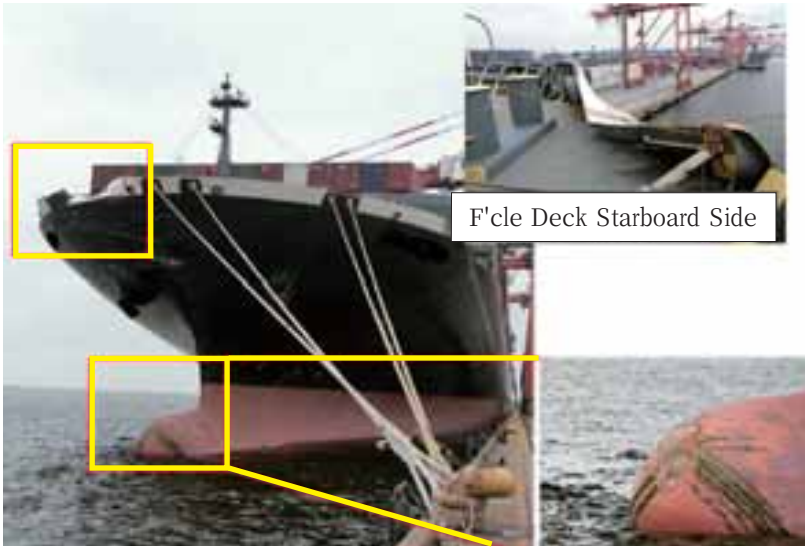
Container Vessel B Summary

Photograph 25

Gross tonnage	:	9,566GT
L×B×D (Length) (Breadth) (Depth)	:	141m×23m×12m
Port of origin	:	Osaka
Port of destination	:	Kobe RC-4
Cargo	:	20FT CTNR×197 40FT CTNR×208
Draft :	:	Fore 5.19m Aft 7.05m
Crew arrangement	:	Master and 17 other crew members, all Chinese nationals
Ship's Bridge on duty personnel at the time of the accident	:	Master B, Navigation Officer B and AB B
Master B	:	Master B was at the age of 45 with experience as Master since 2002. He boarded the Vessel on November 2017 and had more than 100 times experience as Master of calling at Hanshin Port in the Kobe area.

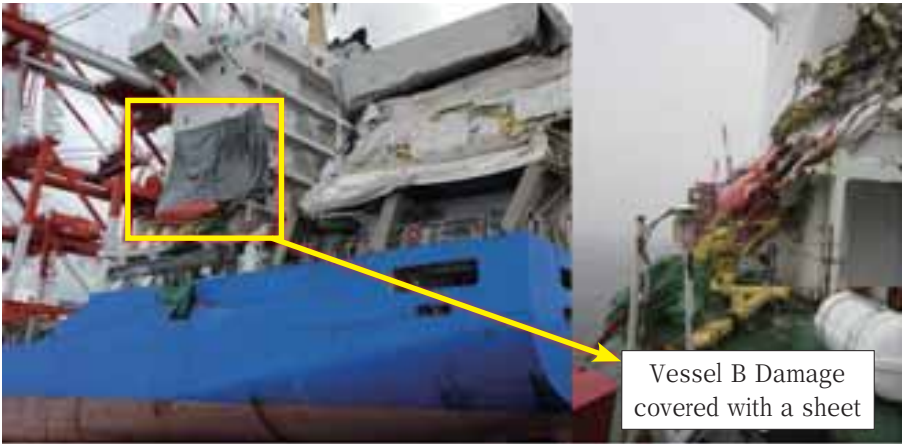
Damage

■ Vessel A was damaged due to a bent and dented bulwark at the starboard bow with scratched shell plating and concave loss on the bulbous bow. (Photograph 26)



Photograph 26

■As for Vessel B, her accommodation spaces at the astern of port side and the shell plating on the port side was cracked.（Photograph 27）



Photograph 27

3－2　Events that Led to the Accident (See Attachments 8 and 9)

In the table of events leading up to the accident (Attachment 9), items related to the accident cause are shown in red.

Ship handling to be applied

Although the conclusion is not yet known, as the decision of the Marine Accident Inquiry is still currently being deliberated (while the author is writing this Guidebook), relative position which seems to be applicable to a Crossing Situation (Rule 15 of Act for Preventing Collisions at Sea) would appear to be the case. However, considering the fact that both Vessel A and B frequently changed headings, increased or decreased speed, etc., and given the outcome of similar accidents, there is a high possibility that "Article 39 of the same law: Liability for negligence of caution, etc. (Managing officer of a seafarer)" will be applied. For reference, a crossing situation, actions by the give-way vessel and stand-on vessel, text regarding Crew responsibilities related to Act for Preventing Collisions at Sea and Marine Accidents Inquiry Law Article 1 (Purpose) will be shown below:

Reference: Extracts from the Act on Preventing Collisions at Sea and the Marine Accidents Inquiry Law

-Sea and the Marine Accidents Inquiry Law

■ (Crossing Situation)

Rule 15

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 this case, the vessel that must avoid the course of the other vessel shall not cross the bow of the other vessel unless it is unavoidable (Provisional translation).

■ (Action by give-way vessel)

Rule 16

In accordance with the provisions of this Act, every vessel which is directed to keep out of the way of another vessel (stand-on vessel defined in the following article) shall, as far as possible, take early and substantial action to keep well clear.

■ (Action by stand-on vessel)

Rule 17

(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（hereinafter, “stand-on vessel” in this Rule）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 the best possible cooperative action to avoid a collision.

■ (Neglect of duties: Crew responsibilities)

Article 39

This article stipulates that in the event of any consequences resulting from neglect of any of the following listed below, neither the vessel structure or materials, or vessel owner, or Master, or crew will be exempt from responsibility: appropriate navigation, observance of any lights or shapes displayed, the sending of signals, or any of the duties of the crew, be they either routine or those required in special circumstances.

Marine Accidents Inquiry Law

Article 1 (Purpose)

This article stipulates that in the event of any marine accidents caused either in the course of duties or through negligence, disciplinary proceedings against either maritime officers, or small vessel operators, or pilots, shall be determined at a maritime tribunal established by the Ministry of Land, Infrastructure, Transport and Tourism. The main purpose of which will be to help prevent further accidents from happening again.

3－3　Causes behind Maritime Accidents

By extracting the accident causes from the Japan Transport Safety Board Report (MA2019-6-02), the parts considered as the accident cause are highlighted in red. (See Attachment 9)

Container Vessel A

▶ 05:00 (approx.)　Pilot A

Boarded Vessel A at Tomogashima pilot station. After conducting the information exchange about Vessel A and its port entry work with Master A, he started his pilotage of Vessel A. Through his pilotage on various vessels, he felt that the crew of Vessel A had received thorough training in BRM and assumed them to be trustworthy. Also, he assumed that Master A had a shared understanding of the navigation plan.

▶ 06:44 (approx.)　Pilot A

Informed port radio via VHF No. 2 in Japanese as follows:

- He had arrived outside Hanshin Port of Kobe area, and
- planned to pass through the breakwater to RC-7 of Hanshin Port Kobe at approximately 07:20

The Pilot also heard that a vessel would pass Vessel A's bow from port radio; that " Vessel B would enter Kobe Central Fairway at approximately 07:15. " The Pilot visually confirmed Vessel B, but did not inform the Master.

▶ 06:53 (approx.)　Master A

After visually confirming Vessel B on starboard bow at a distance of approximately 3.0 nautical miles, he also confirmed Closest Point of Approach (CPA) (hereinafter, DCPA) with Vessel B via No.1 Electronic Chart Display and Information System at 0.84 nautical miles (approx. 1,556 meters). Because Vessel B was heading in a southwest direction, and his Vessel was going to steer to port, the Master thought he could pass starboard to starboard with ample distance.

But, he did not mention the movement of Vessel B to Pilot A. Also, because

Pilot A did not mention the movement of Vessel B as well, near the sea chart table, he started discussing port entry work with C/O A.

▶ 06:55 (approx.) Pilot A

Because Master A appeared to be keeping lookout via radar, Pilot A kept a visual lookout for Vessel B's movements. At approximately 06:55, although he felt that there was no change of bearing between Vessel A and Vessel B, he assumed that the crew of Vessel A were paying attention to the movement of Vessel B, because Master A and 3/O A were watching the radar (ARPA) and ECDIS. Also, because he visually pointed to Vessel B. Then he instructed the vessel to steer to port side in order to head for Kobe Rokko Island East Waterway (hereinafter East Fairway).

▶ 06: 57 (approx.) Pilot A

Cadet A reported to Pilot A, Master A and 3/O A, because he was worried about a risk of collision with Vessel B.

Although he could not predict where Vessel B was heading immediately after she steered to starboard, he visually confirmed Vessel B's relative position. Vessel B would pass the bow of Vessel A, and he continued to steer to port side while reducing speed. Therefore, he kept manoeuvring, believing that his instruction regarding navigation in preparation for port entry work had been approved by Master A. In addition, Cadet A confirmed the risk of collision with Vessel B via radar and reported it to Pilot A (by saying "Closer!! Closer!!"), but the Pilot did not notice Cadet A's report.

▶ 06:57 (approx.) Master A and 3/O A

Did not notice the Cadet reporting. * Cocktail-party effect

Note: Cocktail-party effect (psychology terminology)

Please imagine a situation such as being at a job-well-done party or wedding after party. An example of this would be the way in which a person at a lively party is able to filter out all of the surrounding background noise and still hear their own conversation. They will even notice if their name is called out from across the room, because they can focus on the talk that interests them most. Thus, it is thought that humans have the ability to segregate different sounds and re-arrange them in order of priority. In psychology, this is known as the "cocktail-party effect". It may be that he did not pay attention to Cadet A's reporting on a routain basis.

▶ 07:02 (approx.) Pilot A, Master A and 3/O A

Did not respond to Vessel B's VHF call. He might have got into a panic as the Vessel was about to collide.

Container Vessel B

▶ 06:50 (approx.) Master B

Confirmed Vessel A (at bow and distance of approximately 4.0 nautical miles) and started lookout both via radar and visually. Then, at 06:52 (approx.), he steered to starboard heading for Kobe Central Fairway.

▶ 06:54 (approx.) Master B

Recognized crossing point with Vessel A and that Vessel B was the stand-on vessel. He was concerned about the decreasing DCPA of approximately 06:57, but assumed that vessel B could pass the bow of Vessel A without trouble, according to Vessel's A predicted course on the radar (ARPA). Also, if the speed had been increased to Nav. Full, he assumed that the vessel would reach port too quickly.

3－4 Accident Causes

Taking the above 9 factors into account, the Japan Transport Safety Board summarised the accident causes as follows:

Container Vessel A

Headed for the entrance of Kobe Rokko Island East Waterway and started steering to port side while reducing speed, Pilot A thought that Vessel A could pass the bow of Vessel B, which became the direct cause.

Although Pilot A continued to steer to port side along with reducing speed gradually in preparation for port entry, he assumed his vessel could pass the bow in relation to Vessel B which was visually confirmed, but apparently he did not realize there was a risk of collision with Vessel B.

Furthermore, Master A visually confirmed Vessel B at the point of 3.5 nautical miles in the distance, without confirming the movement of Vessel B with Pilot A. Judging by his vessel's relative position, before Vessel B steered to starboard side (had already passed Vessel B's bow), there is the possibility that he assumed that Vessel B would pass starboard to starboard and that there would be no risk of collision.

Container Vessel B

While heading for the entrance of Kobe Central Fairway, he continued manoeuvring believing that he could pass the bow (front) of Vessel A, which we consider to be the direct cause.

From Vessel A's sailing route and predicted course via radar (ARPA data), Master B assumed that Vessel A would follow her original course. (In fact, Vessel A started steering to port side).

He confirmed the ARPA data via radar (vector diagram and DCPA and TCPA digital display), but there is a possibility that he believed that Vessel B was to be the stand-

on vessel at the crossing point with Vessel A. This is why he completely believed that Vessel B could pass the bow of Vessel A without the need to confirm visually.

Information exchange via VHF

Another cause behind the accident could be that neither communicated one another's sailing route at an early stage using VHF.

Although Vessel A obtained the other vessel's information from port radio, neither paid attention to each other's Vessel's movements. Mutual communication might have prevented the accident.

3－5　Transport Safety Board Report ＝Recurrence Preventive Measures＝

The Japan Transport Safety Board Report (MA2019-6-02) summarises preventive measures to be taken as follows:

Pilot

- A constant watch must be kept both visually, and by means of radar and ECDIS navigation instruments.
- When another ship is passing in close proximity, the risk of collision must be considered. VHF contact should be made to the other vessel with a request for their co-operation to avoid such an outcome.
- The respective officers of the watch of the two vessels should verbally clarify each other's manoeuvres and headings.
- Communication should be in the local language (Japanese), and the contents relayed to the Ship's Master.

Photograph 28 courtesy of the Japan Captains ' Association, DVD

Master A and Master B: Common characteristics of both vessels

- Together with the pilot, the respective officers of the watch should verbally clarify each others ' manoeuvres and headings.
- Even when there is a pilot on board, both the crew and the Master himself must be aware that navigation is ultimately the responsibility of the Master and that constant surveillance must be maintained.
- When coming into close proximity to another vessel, both the Master and the Pilot must be aware that the " distance of closest approach " (DCPA), which is based on the location of each vessel's GPS antenna, does not take into account the length and width of either vessel. Sufficient separation must be maintained for both vessels to safely pass each other.
- To safeguard the storage of objective data in the event of any accident, the Master must ensure that the crew are fully competent with operating the VDR.

Vessel A switched off its VDR immediately after the accident in order to preserve the data, however the vessel set off on its next voyage before the data could be extracted (Kobe to Nagoya). The VDR was again switched on and the previous data overwritten and deleted.

Photograph 29

§4 4M4(5)E Analysis of a Case Study ＝ Collision Accident ＝

4－1 Summary of Related Facts (See Attachment 10)

Related facts from the previous chapter “3-2 Events That Led to the Accident were summarised in the “Maritime Accident Summary of Related Facts.” This brings us to the following:

- **There is nothing applicable to Unsafe conditions.**
- **Rather a number of unsafe behaviours of Pilot A are examined. Bias and assumptions are particularly noticeable.**

Attachment 10 Vessel A and Vessel B Collision Accident Summary of Related Facts

Reference No.	Identified problems from survey findings				Direct cause		Accident cause evaluation	Re-examination necessity
	Date	Time	Caused by	Check facts and problem areas	Unsafe behaviour	Unsafe conditions		
1	XX May	05：00 Approx.	Pilot A	Felt that the crew of Vessel A had received thorough training in BRM and assumed them to be trustworthy. Also, assumed that Master A had a shared understanding of the navigation plan.	○		4	
2	XX May	06：44 Approx.	Pilot A	Visually confirmed Vessel B, but did not inform the Master of port radio information (Vessel B bound for RC-7).	○		3	
3	XX May	06：53 Approx.	Master A	Assumed that Vessel B would keep its distance when passing the starboard side of Vessel A.	○		5	
4	XX May	06：53 Approx.	Master A	Did not mention the movement of Vessel B to Pilot A. Also, as Pilot did not talk to him about Vessel B, he started discussing port entry work near the sea chart table with 1/O A.	○		6	
5	XX May	06：55 Approx.	Pilot A	Although he felt that there was no change of bearing between Vessel A and Vessel B, he assumed crew of Vessel A were paying attention to the movement of Vessel B, because Master A and 3/O A were watching the radar and ECDIS. Pilot A himself confirmed Vessel B visually by pointing.	○		1	
6	XX May	06：57 Approx.	Pilot A	Assumed that Vessel B would pass their bow, and continued to steer to port side.	○		2	
7	XX May	06：57 Approx.	Pilot A	Did not notice the Cadet reporting.	○		7	
8	XX May	06：57 Approx.	Master A and 3/O A	Did not notice the Cadet reporting earlier.	○		8	
9	XX May	07：02 Approx.	Pilot A, Master A and 3/O A	Did not respond to Vessel B's VHF call.	○		9	
10	XX May	06：57 Approx.	Master B	Was concerned about decreasing DCPA, but assumed that vessel B could pass the bow Vessel A, according to the predicted course Vessel A on the radar.	○		10	
11	XX May	06：57 Approx.	Master B	Assumed that the vessel would reach port quicker if speed was increased to Nav. Full.	○		11	
12			Master B and ship management company B	Did not instruct navigation officer to report and lookout thoroughly. (BRM is was not implemented)	○		12	○
13			Pilots' Associations	Were the pilots obliged to take BRM training periodically?	○		13	
14			Master A	Non-compliance with Safety Management Code	○		14	○
15			Ship management company A	Non-compliance with Safety Management Code	○		15	○

Accident cause assessment: Prioritized according to the scale of the cause

Fig. 30 (Attachment P. 112)

Regarding the examined behaviours in the list of related facts, each unsafe behaviour will be summarised while carrying out a Why Why Analysis.

4－2 “Analysis of Unsafe Behaviour”for Pilot A (See Attachment 11)

After carrying out the Why Why Analysis regarding Pilot A’s unsafe behaviour which was extracted from the “Maritime Accident Summary of Related Facts”, we can see that the causes of the unsafe behaviour are mostly associated with “Man” of the 4M. (Figure 31)

In addition, in this situation, Management（Management factors and organization）stipulates that Pilot A, as a member of the BTM structure, should exchange information, but this was not adhered to. Thus, there is a necessity to investigate as to whether the Pilots associations have such policies and operation manuals, and if so, ascertain as to why Pilot A could not follow them.

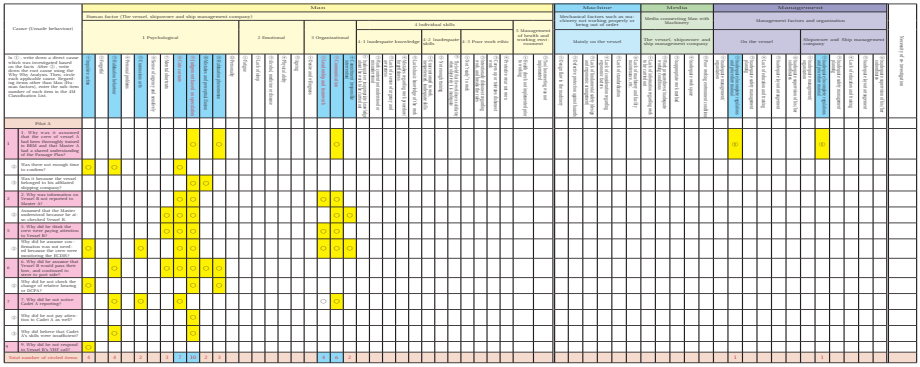


Fig. 31（Attachment P. 113）

Looking at Human factors, it is possible to see that there is a concentration of factors that fall under 1 Psychological Factors ⑧ Cutting corners and ⑨ Judgement based on speculation. In addition, there are many issues related to ② Leadership and teamwork and ③ Communication, in 3 Organizational factors.

It is understandable that it may be difficult to exchange information with other members of the Bridge including the Master of the vessel because of such pilotage conditions in Osaka Bay where traffic is congested. However, ⑪ Habituation phenomenon and ⑤ Unconscious acts and Judgement based on speculation and so on, and each item applicable to the list here all contribute to the chain of human errors.

In addition, Cadet A reported the movement of Vessel B shortly before the collision, but they did not notice. “People are unconsciously prone to believe only what they want to believe” and “information that supports what they believe rather than purposefully seeking information to the contrary” from ③ Psychological factors on “P.6 1-2 As a Mechanism behind Maritime Accidents Caused by Human Error” of which Confirmation bias (psychology terminology) might have contributed as well.

4－3 “Analysis on Unsafe Behaviour”for Master A and Master B (See Attachment 12)

In the same way as Pilot A, the Why Why Analysis will be carried out here regarding the unsafe behaviour of Master A and Master B.

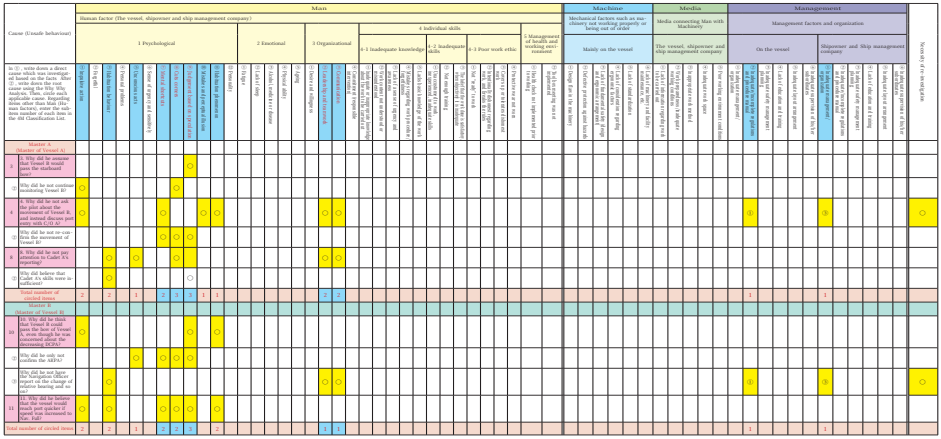


Fig. 32 (Attachment P. 116)

Master A

We can see that the causes of unsafe behaviour are mostly associated with “Man” of the 4M. As shown in Figure 31 and on close examination, we can see that there is a tendency for ⑦ Mental shortcuts, ⑧ Cutting corners and ⑨ Speculation and judgement in 1 Psychological factors. Also, similarly to Pilot A, problems can be identified in ② Leadership and teamwork and ③ Communication in 3 Organizational factors.

Vessel B’s movement was confirmed only once. However, it was before Vessel B changed her direction bound for Kobe RC-4 (Kobe Rokko Island) and, at that point, the stem of the Vessel B was facing a southwesterly direction（Tomogashima Channel direction). This is why he believed Vessel B was an outgoing ship from Osaka Bay and that he could pass starboard to starboard.

As introduced in “ 4 Human Brain Capacity ” in “P.7　1-2　As a Mechanism behind Maritime Accidents Caused by Human Error”, once he/she may have had a bias, we understand the difficulty in thinking differently about something once it set in one’s mind.

He let Pilot A take care of the manoeuvring, and started discussing port entry work with C/O A. It must be said that he neglected his top priority of keeping lookout, which shows that the prioritizing of work proved to be challenging.

We presume that the importance of BTM is stated in the SMS manual at the ship management company. But as this is still unknown, we circled the column Re-examination necessary regarding: 1. Inadequate management/organization, 2. Inadequate/incomplete regulations and procedure manual, 3. Inadequate safety management planning, and 6. Inadequate supervision of his/her subordinates, in the items under Management.

Master B

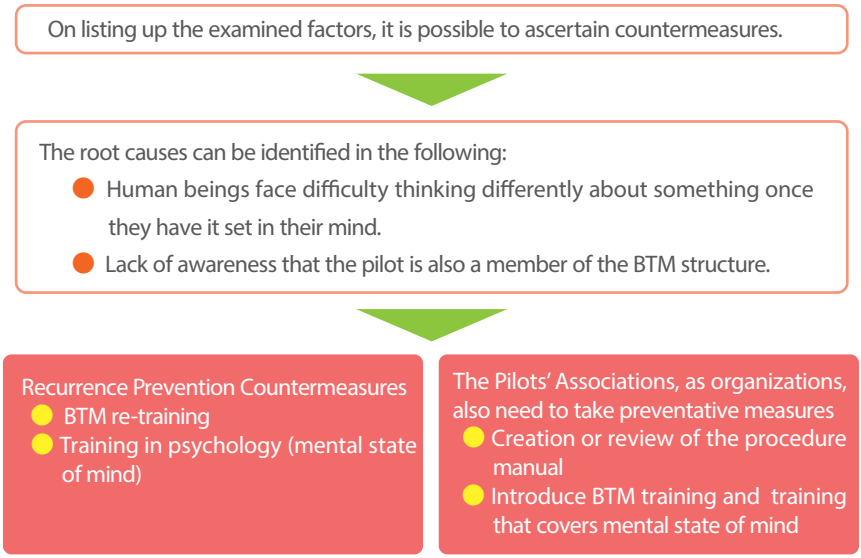
Similarly to Master A, it is possible to see that there is a concentration of factors that fall under Man (Human factors) in 1　Psychological Factors　⑦ Mental shortcuts,

⑧ Cutting corners and ⑨ Judgement based on speculation. In particular, he was distracted in order to not be delayed for the port arrival time which caused him to neglect monitoring Vessel A. Also, another reason as to why he did not pay attention to the movements of Vessel A was because he neglected to confirm visually as a result of solely relying on the ARPA （CPA/TCPA) system.

4－4 Countermeasures for“ Unsafe Behaviour ”for Pilot A (See Attachment 13)

As there were no related facts applicable to unsafe conditions, regarding the unsafe behaviour of Pilot A and the pilots' association, we are going to consider measures with “Analysis using 4M5E and Countermeasure List (Unsafe behaviour)”.

3-4-4 Analysis using 4M5E and Countermeasure List for Pilot Attachment 13



Attachment 13 Vessel A and Vessel B Collision Accident Analysis using 4M5E and Countermeasure List (Unsafe behaviour): Pilot A

	Man	Machine	Media	Management	
	The vessel, shipowner and ship management company	Mainly on the vessel	The vessel, shipowner and ship management company	On the vessel	Shipowner and ship management company
Risk factors (Direct cause and indirect/root cause)	1 Psychological 1. Why was it assumed that the crew of vessel A had been thoroughly trained in BTM and that Master A had a shared understanding of the Passage Plan? (1-①, ③ and ⑧~⑪) 2. Why was information on Vessel B not reported to Master A? (1-⑦~⑨) 5. Why did he think the crew were paying attention to Vessel B? (1-①, ⑤ and ⑦~⑨) 6. Why did he assume that Vessel B would pass their bow, and continued to steer to port side? (1-③, ⑤, ⑧ and ⑨) 7. Why did he not notice Cadet A reporting? (1-③ and ⑨) 9. Why did he not respond to Vessel B's VHF call? (1-①) 3 Organizational Related Facts 1, 2, 5, 5, 7 and 9 ② Why could he not exert leadership as a conning officer? ③ Why could he not communicate with the Master?			13. Incomplete BRM including pilot (2-①)	13. Incomplete BRM including pilot (2-①) 13. Not enough training about psychological factors invites human error (2-①)
Education Education and training Knowledge, skills, consciousness, being given information, etc..	Cause ・Human beings face difficulty thinking differently about something once they have it set in their mind. ・The pilot is also a member of the Bridge. It would have been naive not to have considered him part of the BTM structure. Recurrence Prevention Countermeasures ・BTM re-training ・Training in psychology (mental state of mind)				
Engineering Technology and engineering Engineering countermeasure					
Enforcement Thorough guidance and enforcement Standardization, procedurralization, alerting, reward and punishment KYT, Campagnes etc..					Recurrence Prevention Countermeasures ・Thorough guidance and creation of procedure manual for pilotage regarding BRM (Pilots' associations)
Examples Case studies, countermeasures and rules Lead by example, experience of success, introduce model cases, "Hiyari-Hatto" (near misses), etc.					Recurrence Prevention Countermeasures ・Introduce model cases, BRM training and training that covers mental state of mind(Pilots' associations)
Environment Working environment, office internal management, onboard organization, etc.					

Each item number (bold and red coloured) corresponds to the Summary of Related Facts No. in the Attachment 3
The number applies to the number in Attachment 2-2 (Maritime Accidents 4M Classification List)

Fig. 33 (Attachment P. 119)

After transcribing the results of the analysis in 4-2 "Analysis of Unsafe Behaviour" for Pilot A into the risk factors column (in the column of Direct and indirect/root causes (coloured in pale yellow) of "Analysis using 4M5E and Countermeasure List (Unsafe behaviour)", the Why Why Analysis will be carried out here regarding each risk factor. The root causes can be identified in the following two points:

- **Human beings face difficulty thinking differently about something once they have it set in their mind.**
- **Lack of awareness that the pilot is also a member of the BTM structure.**

The following numbers correspond with each Summary of Related Facts No.

Psychological Factors : Man

1 Pilot A assumed that the crew of vessel A had been thoroughly trained and that Master A had a shared understanding of the manoeuvring.

Although not stated in the report by the Japan Transport Safety Board, Vessel A's operation and ship management were both managed by the shipping company from where Pilot A belonged.

This would partly explain as to why he assumed that the BTM training had been thoroughly carried out.

2 06:45 (approx.) He visually confirmed Vessel B and checked the movement of Vessel B with port radio, but he did not report this to Master A.

Resource management via communication with" resources surrounding the subject " (P.14 See Figure 12), which is based on the concept of BTM, was not sufficient. This generated a gap between the subject and other people except the subject which is the most important resource where human error would be caused.

Not informing the movement of Vessel B to Master A, 3/O A, Cadet A and A/B A is applicable to the" Hidden area: risk factors which only one knows, that others do not "in the Johari Window (P.13 See Figure 11). Had such information been shared appropriately, this would have been changed to an Open area, which would have allow the ship's bridge on duty personnel of Vessel A to have kept paying attention to the movement of Vessel B and to report it to Pilot A. This exchange of information might have made it possible to make a give-way manoeuvre prior to being in a dangerous situation.

5 He thought that the crew were paying attention to Vessel B.

06:55 (approx.) Assumed crew of Vessel A were paying attention to the movement of Vessel B, because Master A and 1/O A were watching the ECDIS (Electronic Chart Display Information System). They also confirmed Vessel B visually by pointing.

However, Master A and C/O A moved away from the ECDIS just prior to this, and

they started discussing port entry work beside the sea chart table. Lookout was neglected.

6 06:55 (approx.) Headed for the entrance of the East Fairway and continued to steer to port, assuming that Vessel B would pass their bow

He instructed the vessel to reduce speed in preparation for port entry and docking work, but he did not allow the crew to report the actual speed, and did not check it himself. He assumed that the vessel could pass the bow of Vessel B owing to his pilotage experience.

7 Did not notice Cadet A reporting

06:57 (approx.) Cadet A reported“ Closer ”to mean that Vessel B was too close. The timing of the report was a little too late, however, since it was around five minutes prior to the collision, this would have been the crucial moment to have given way. It cannot be denied that not enough attention was paid to the report that was made by the cadet.

9 Did not respond to Vessel B's VHF call

Shortly before the collision, VHF calls were made twice by Vessel B, but non were returned. This presumably was not noticed because a collision was imminent and he panicked.

Workplace Factors: Man and Management

The root causes were (1) both Master A and Pilot A did not adequately perform their leadership duties as conning officers and (2) could not communicate with Vessel A’s bridge on duty personnel. Pilot A well understood the importance of BTM, but it is presumed that he could not carry it out in reality.

Recurrence Prevention Countermeasures

Pilot A felt deeply responsible for causing the accident. However, as mentioned above, the root cause behind the chain of human errors was caused by Psychological factors. Even though there were several chances to break such a chain of errors after having boarded Vessel A until the accident occurred, resource management (the foundation of BTM) was ineffective and the error chain could not be broken as a result, which inevitably lead to the collision accident. Because it was unknown as to what kind of safety measures had been implemented by the Pilots' Associations, we raised the issue that a Re-examination was necessary.

Recurrence Prevention Countermeasures through Education (education and training) in 4(5)E for Pilot A

After removing the above risk factors, the following two preventive measures remain.

- **BTM re-training**
- **Training in psychology (mental state of mind)**

After Pilot A took above mentioned training and lecture, had he have taken actions such as Self-analysis and told other pilots around him about his experiences, this may have been helpful in preventing a recurrence.

Management (Pilots' Associations) : Preventive measures by Management

According to the Japan Transport Safety Board's report, Pilot A took BTM training 3 years prior to the accident (in 2015). We naturally assume that accident prevention activities are appropriately implemented by Pilots' Associations. However, it is still unknown if such accident prevention measures pertaining to Management were sufficient or not, therefore, it would be necessary to review the accident prevention measures through Re-examination. Thus, we have identified Re-examination necessary in the countermeasure list.

4－5　Countermeasures for“ Unsafe Behaviour ”for Masters A and B (See Attachment14)

The root causes can be identified in the following two points:

- Human beings face difficulty thinking differently about something once they have it set in their mind.
- Lack of awareness that pilot is also a member of the BTM structure. Collapse of communication (the foundation of BTM) Master A starts discussing port entry work with C/O
- Mistakes regarding work prioritization.

Recurrence Prevention Countermeasures

- BTM re-training
- Re-training of Safety Management System (SMS)

The Company, as organizations, also need to take preventive measures.

- Reviewand make the work procedure.
- Introduce BTM training and traing that covers mental state of mind.

Attachment 14　Vessel A and B Collision Accident Analysis using 4M5E and Countermeasure List (Unsafe behaviour): Master A and Master B

	Man	Machine	Media	Management	
	The vessel, shipowner and ship management company	Mainly on the vessel	The vessel, shipowner and ship management company	On the vessel	Shipowner and ship management company
	Master A 1. Psychological 3. Why did he assume that Vessel B would pass the starboard bow, without continuously monitoring Vessel B? 4. Why did he start discussing port entry work with C/O A? 8. Why did he not pay attention to Cadet A's reporting? (1-①, ③, ⑤ and ⑦～⑪) 3. Organizational factors (Related Facts No. 3, 4, 8 and 9) ② Why could he not exert leadership as a			Vessel A 14. Why did he not comply with the Safety Management Code? (2-①) 4. Why did he interrupt lookout duty to start discussing port entry work with C/O A in the middle of S/B? (2-①)	Ship management company A 15. Why did he not comply with the Safety Management Code? (1-③) 4. Why did he interrupt lookout duty to start discussing port entry work with C/O A in the middle of S/B?

Fig. 34 (Attachment P. 120)

Let’s take a closer look at the preventive measures for unsafe behaviour of both Master A and Master B. Just as with Pilot A, Analysis using 4M4(5)E and Countermeasure List (Unsafe behaviour) will be used here. It is clear to see that the root cause underlying Psychological factors and Organizational factors has to do with Man on both sides.

Psychological Factors Regarding Master A: Man

The root causes can be identified in the following three points: Each number corresponds with a Summary of Related Facts No.

3 He assumed that Vessel B would pass the starboard bow, without continuously monitoring Vessel B.

06:53 (approx.) Master A visually confirmed Vessel B, but Master A did not watch continuously.

At this moment, Vessel B's bearing was <068> and her distance at approx. 3.4 nautical miles and steering to starboard, but she would have been heading in a southwest direction. Also, the ARPA showed Closest Point of Approach (CPA) to be 0.22 nautical miles on the starboard side and TCPA displayed 6.5 minutes later. Together with those and the vector, Master A assumed that Vessel B was an outgoing vessel from Osaka Bay and completely believed that he could pass starboard to starboard.

However, Pilot A was in contact with port radio via VHF at approx. 06:45 and understood that Vessel B was a shifting ship between Osaka Bay and Kobe RC-4.

Port radio communications with Pilot A was conducted in Japanese and Master A did not understand the contents. But, he would have noticed that Pilot A was using VHF to relay information. At that point, if he had confirmed with Pilot A what he was talking about, the chain of errors could have been broken at this stage.

4 He started discussing port entry work with C/O A.

06:53 (approx.), he let 3/O A man the bridge to take over from 1/O A and started discussing port entry work with C/O A beside the sea chart table. It is important that discussion immediately prior to work be conducted, so it is also known that the most important work to be done during S/B in a

congested area like this is lookout. Errors regarding work prioritization.

8 Did not notice Cadet A reporting

Similarly to Pilot A, it cannot be denied that not enough attention was paid to the report that was made by the cadet. As usual, and not just on this occasion, he did not notice the Cadet reporting.

Workplace Factors Regarding Master A: Man

Even when a Pilot is on board, the Master is ultimately responsible as navigator. But, just as with Pilot A, (1) leadership duties were not adequately performed, (2) communication with the vessel's bridge on duty personnel including Pilot A was insufficient. These underlay the root cause. It is considered that BTM was infeasible.

Risk Factors Regarding Management of Master A and Ship Management company A

The ship management company of A's SMS Manual clarifies the procedures during port entry work. Why was this not adhered to? Also, as mentioned earlier, why did he neglect to carry out important lookout work and management of the ship's bridge on duty personnel to start discussing port entry work with C/O A?

It is apparent that both Master A and the Safety management company are fully aware that compliance with the Safety Management Code is a top priority. However, why were they unable to realize this? As further examination and analysis to clarify the reason is necessary, we have designated this as Re-examination necessary.

Psychological Factors Regarding Master B: Man

The root causes can be identified in the following two points:

10 He thought that Vessel B could pass the bow of Vessel A, even though he was concerned about the decreasing DCPA. In addition, he checked ARPA data only and did not confirm it visually.

Furthermore, whilst Master B did appear to pay attention to the movements of Vessel A, he neglected to make a visual confirmation and believed blindly in the ARPA (CPA/TCPA) data alone. In addition, 3/O B on the bridge did not give the order to monitor the movements of Vessel A. When focusing on ship handling in congested sea areas, it is possible to lose sight of the surrounding circumstances, because it is very difficult for crew to perform 3 or 4 different tasks simultaneously. To deal with this problem, the bridge personnel need to form a team which can exert efficient BTM and raise the level of safety. However, this did not happen on this occasion.

11 Assumed that the vessel would reach port delayed or quicker if speed was decreased or increased

Although he believed that the vessel could have just passed the bow of Vessel A, based on the relative bearing of A, and if the speed was maintained, it would have been problematic to do such a manoeuvre using only ARPA data in such close quarters.

In addition, the Master steered to starboard while increasing speed just prior to the collision. The author understands that DCPA will increase when speed is increased, but it is impossible to rapidly increase speed for a large-sized vessel.

The author believes that Master B did his very best given the somewhat stressful circumstances and understands that he may have used the engine for better rudder effect due to there being more than 1 nautical mile to Kobe Central Fairway, but believes that his testimony regarding his concern as whether speed should have been increased (or decreased) to be questionable.

Recurrence Prevention Countermeasures

Recurrence Prevention Countermeasures through Education (education and training) using 4E for Master A

The Master is expected to handle the ship in congested areas until the Pilot arrives on board. However, there is a tendency due to language difficulties to just hand over responsibility to the pilot upon their arrival.

This author has also experienced entry into Kobe port on many occasions. Typically we would pick up the pilot at 04.00 in the morning, which would require some time rescheduling from around 23.00 the previous night at Cape Muroto or off the coast of Cape Shiono (adjustment of engine speed, change of course etc.). At this point I would take command of the bridge. However, it is said that the average human concentration span is around 40-50 minutes, with 90 minutes being an absolute maximum. Under busy continuous working conditions, that span begins to fade and become even shorter. The tendency to leave it all up to the Pilot when he comes on board is therefore understandable given the level of mental and physical fatigue of the crew.

That said though, the command of ship handling is not something which should be simply handed over to the Pilot. The Master must retain responsibility until safely docked at port. Exercising good BTM, including management of the Pilot, is one of the duties of the Master.

With this in mind, the measures needed to be taken by Master A, to prevent recurrence of this danger, can be summarised in the following two points.

- **BTM re-training**

  When the pilot boards, is enough information exchanged, or would there have been enough information exchanged regarding a head-on situation like this?
  The pilot checked port radio for the movement of Vessel B via VHF.

Although he knew that Vessel B was communicating in Japanese and that he could not understand what was being said, he could see that the pilot was communicating via VHF. At the time once they had finished speaking, he should have proactively asked the pilot if there was any information that needed to be shared with him.

Also, when he started discussing port entry work with C/O A, he let 3/O A take over from 1/O A immediately after he ascended and started manning the bridge. Was he really aware of the surrounding situation when he took over?

Although he took BTM training, he was unable to practise it in reality, which is the root cause behind the accident. Thus, he is required to take BTM re-training.

• Re-training of Safety Management System (SMS)

Details including the importance of BTM regarding duties on departure and entry, congested areas, reduced visibility would be written in the Safety Management System (SMS). Master A had also seemingly received training in the Safety Management System (SMS) several times. Still, it is necessary to analyse as to why he could not practice this on board and to recommend re-training.

Recurrence Prevention Countermeasures through Management (management and organization) Applying 4E to Ship Management Company A

The ship management company proactively provided the crew with BTM training and seminars on the Safety Management System(SMS). We have identified this as Re-examination necessary, because we do not know the contents of the program.

In other words, crew (those who attended lectures and training) vary in levels of competency, and, consequently, may not be able to apply such training to actual circumstances, thus leading to an accident.

This is the reason why there needs to be further investigation as to why the Safety Management System (SMS) was not adhered to and, furthermore, the following

countermeasures need to be examined and implemented if necessary.

Countermeasure through Guidance and Enforcement (Enforcement)

Review, disseminate, and carry out training of Safety Management System (SMS) procedures for Pilot duty when the Pilot is on board. Also, VDR data was overwritten, thus data at the time of the accident is not available. VDR operation skills and a review of the procedure manual may be required.
In addition, for the time being, it will be of value to continuously carry out internal audits and hold collision recurrence prevention campaigns. Moreover, the Master must realize that he is in charge even when a pilot is on board. However, he must also understand that it may be difficult to supervise a pilot as intended. The ship management company should check with the Pilots' Associations for any relevant improvements.

Recurrence Prevention Countermeasures through Education (education and training) Applying 4E to Master B

Similarly to Master A, one of the contributing root causes Psychological factors: Human beings face difficulty thinking differently about something once they have it set in their mind. Another contributing root cause would be the collapse in communication, such as bridge on duty personnel management and the exchange of information externally, which are the foundations of BTM. Therefore, the following have been identified as recurrence prevention countermeasures:

• BTM re-training

Similarly to Master A, although Master B appears to have taken BTM training, he was unable to practise this in reality. BTM re-training is one recurrence prevention countermeasure that could prove to be effective for those not ready to carry it out in practice.

• Re-training of Safety Management System (SMS)

It appears that the vessel was not able to carry out port departure and entry work in accordance with Safety Management System(SMS), and similarly to Master A, re-training will be necessary.

Recurrence Prevention Countermeasures through Management (management and organization) Applying 4E to Ship Management Company B

As in the case of Company A, the following recurrence prevention countermeasures could be considered: (1) to analyse why the Safety Management System(SMS) was not adequately performed at sea, and if necessary, (2) to review the Safety Management Code regarding duties on departure and entry, narrow channels, reduced visibility and so on, and (3) to disseminate and carry out training for improvement.

4-6 Accident Analysis from the Perspective of Human Factors and Human Error (See Attachment 15)

Attachment 15 **Vessel A and B Collision Accident Human Behavioural Traits and Human Error (Psychological Analysis)**

Time	Movement	Who?	Behaviour	Human characteristics	P sychology
06：10	Vessel A After passing Tomogashima Channel, changed course to the northeast for Kobe Rokko Island Berth.	Pilot A	From past experience as a pilot, he assumed the crew of Vessel A to be trustworthy.	⑨ Human beings sometimes make assumptions	③ Confirmation bias People unconsciously collect information that supports what they believe.
		Pilot A	Assumed that Master A had a shared understanding of the navigation plan.	⑨ Human beings sometimes make assumptions ⑩ Human beings are sometimes lazy.	② Normalcy bias Assumed everything would be fine, because this method had been fine up until now.
				Did not explain procedure sufficiently enough to the Master after boarding.	③ Confirmation bias Only collected information that supported what what he/she believed.
06：45 Approx.		Pilot A	Informed port radio via VHF of the approximate time he	③ Human beings sometimes forget	④ Social loafing
	Vessel B Steered north-westerly heading for the entrance of Kobe Central Fairway	Master B	Concerned about decreasing CPA, but assumed that the vessel could pass the bow, according to the vector indicated on ARPA.	⑨ Human beings sometimes make assumptions ⑤ Human beings have moments of inattention ⑩ Human beings are sometimes lazy. ⑥ Human beings are sometimes only able to see one thing at a time Only confirmed information via ECDIS and ARPA	② Normalcy bias People ignore negative information and underestimate phenomena saying "I'm special, nothing can hurt me!"

Fig. 35 (Attachment P. 122)

Each item number printed in the "Human Characteristics" and "Psychology" in the list corresponds with those numbers of "(2) Human characteristics（Nihon VM (Visual Motivation) Centre Co., Ltd from Anzen-no-komado 18 (Safety Loopholes) dated 30 June, 2002 (Provisional translation）（Figure 5）" which explains what causes human errors in "P.4 1-2 As a Mechanism behind Maritime Accidents Caused by Human Error" and "(3) Psychological Factors".

For example, at 06:10 (approx.) Pilot A thought that he had shared his understanding of manoeuvring with Master A, but they never actually communicated with each other in reality. We can assume that information exchange using the Pilot Card in accordance with the procedure manual was all but a formality. This can be analysed as follows:

Human characteristics

⑨ Human beings sometimes make assumptions, and

⑩ Human beings are sometimes lazy

He did not explain the procedure sufficiently enough to the Master after boarding, as he assumed it would not be necessary, despite the fact that the circumstances at that time were unknown. As a result, he probably simplified his usual explanationtion.

Psychological factors

② Normalcy bias

Psychologically, he assumed that everything would be fine, because this method had been fine up until now.

Did he not underestimate the importance of exchanging information?

Psychological factors

③ Confirmation bias

According to human behavioural characteristics, could it be that when he quickly observed Master A and other bridge personnel, that he may have had the bias that the crewmembers were all conversant in BTM?

Although mentioned earlier above, Master A visually confirmed Vessel B at approximately 25.0 degrees on its starboard bow at approx. 06:53. However, because Master A did not hear from the Pilot that Vessel B would head for Kobe Central Fairway, he assumed that there would be no risk of collision judging by his vessel's relative position with the other ship: that it would be heading in a southwest direction (Outgoing Osaka Bay). He also neglected paying attention to the movement of Vessel B afterwards. This, too, can be applied to human characteristics and psychological factors as follows:

Human Characteristics

⑤ Human beings have moments of inattention,
⑨ Human beings sometimes make assumptions and
⑩ Human beings are sometimes lazy.

Tracing the chain of human errors, it is possible to see that he neglected to keep monitoring the movement of Vessel B.

Psychological factors

② Normalcy bias

People unconsciously collect information that supports what they believe.

Psychological factors

③ Confirmation bias

He only collected information that supported what he believed by thinking everything was fine because she crossed the stem of Vessel B.

Psychological factors

④ Social loafing

Assumed that Pilot A would take care of the entire procedure.

In addition, as for Master B, at 06:52 (approx.), he steered to starboard for Kobe Central Fairway without checking the movement of Vessel A visually. This was also the result of the following human characteristics and psychological factors which contributed to the chain of errors.

Human Characteristics

④ Human beings sometimes do not notice,
⑤ Human beings have moments of inattention,
⑥ Human beings are sometimes only able to see one thing at a time,
⑦ Human beings are sometimes in a hurry.

He understood that the relative position would be risky, if he steered to

starboard, but he was concerned about entering port late if he was to follow the originally scheduled course, and neglected to keep visual confirmation of Vessel A.

Psychological factors

② Normalcy bias

People ignore negative information and underestimate phenomena saying :
" I'm special, nothing can hurt me! "
He simply confirmed the ARPA only.

As compiled in Attachment 15, when looking chronologically at the course of events, it is possible to see how each factor contributes to the chain of human errors. This accident might have been prevented had the chain been broken at some point. It can be said that BTM was not operational.

When analysing other collision accidents, it is possible to observe "accident analysis from the perspective of human factors and human error". These are almost identical to "4M4(5)E Analysis". In other words, the root causes that led to the collision accident can be found in the following Human Characteristics: ⑨ Human beings sometimes make assumptions, ⑤ Human beings have moments of inattention, ⑩ Human beings are sometimes lazy and ⑦ Human beings are sometimes in a hurry. There are also 4 psychological factors that are connected which make it impossible to eradicate human error.

Thus, even if the person "L", who is the centre of the M-Shell Model (P. 14 Figure 12) makes a mistake, the surrounding resources will notice and point it out via communication without hesitation. This is important, because it will break the chain of errors to prevent an accident, namely: practising BTM effectively.

§5 ＝ Case Study ＝ Bridge Collision Accident

Japan Transport Safety Board Report (MA2019-10-2)
Modified from the Japan Transport Safety Board Report:
http://www.mlit.go.jp/jtsb/ship/rep-acci/2019/MA2019-10- 2_2018tk0020.pdf

Let's analyse the Ōshima Bridge Damage in Yamaguchi Prefecture that occurred on October 22, 2018.

5-1 Accident Summary (See Figure 36)

On the 22nd of October 2018, at approximately 00:27 (JST), Cargo ship E (25,431 G/T) collided with Ōshima Bridge while navigating Obatake-Seto channel, heading from the port of Onsan (South Korea) to Etajima of Hiroshima Prefecture (navigating to the east). 3 cranes out of 4 on the vessel sustained damage. On the other hand, Ōshima Bridge sustained cracks and depressions in the bridge girders, and a water mains pipe ruptured as a result of the inspection corridor dropping down on it. Consequently, all areas of Oshima Town suffered approximately 40 days without water, and in addition, power cables and communications cables were also damaged.