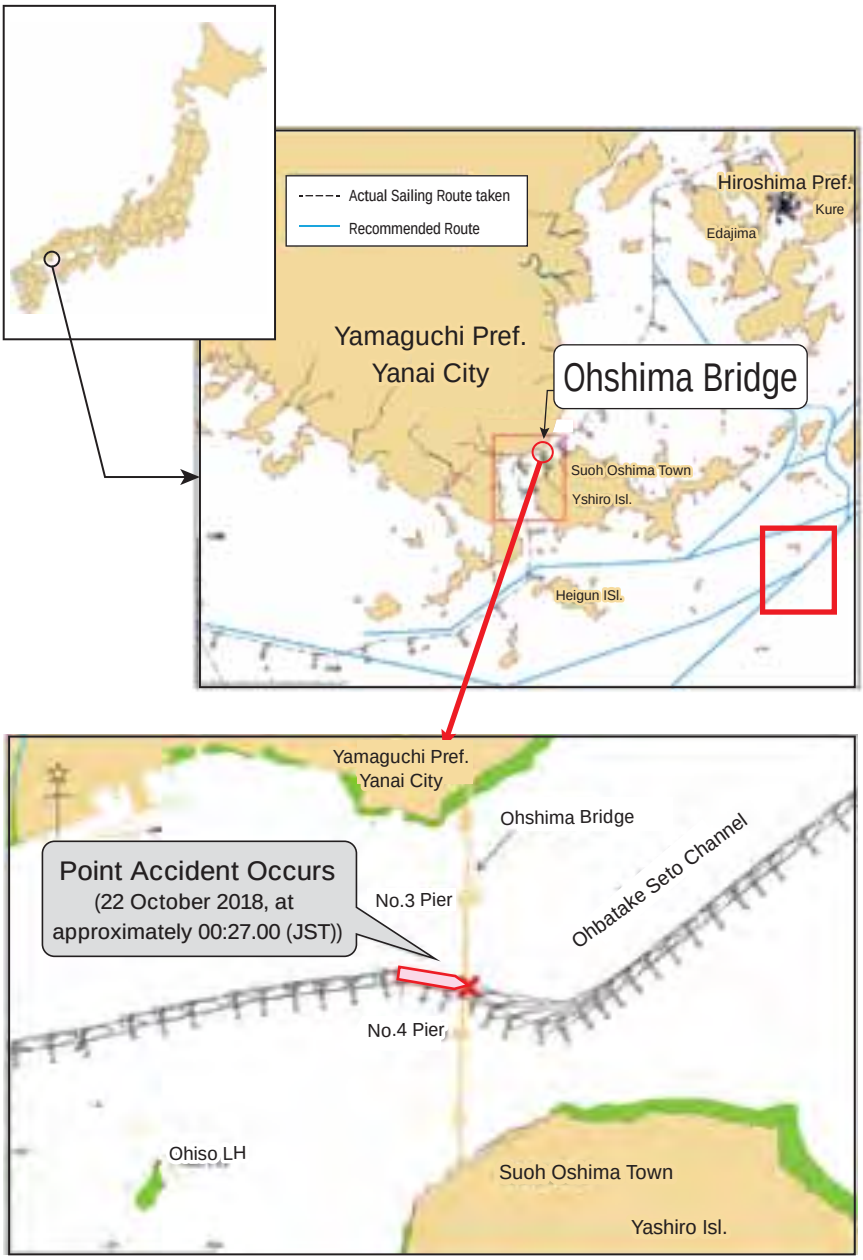

Actual Sailing Route taken
Recommended Route
Hiroshima Pref.
Kure
Edajima
Yamaguchi Pref.
Yanai City
Ohshima Bridge
Suoh Oshima Town
Yshiro Isl.
Heigun ISl.
Yamaguchi Pref.
Yanai City
Ohshima Bridge
Point Accident Occurs
(22 October 2018, at
approximately 00:27.00 (JST))
No.3 Pier
Ohbatake Seto Channel
No.4 Pier
Ohiso LH
Suoh Oshima Town
Yashiro Isl.

Fig. 36

5－2　Summary and Damage Sustained to a Vessel (Cargo ship E)

Photograph 37

Gross tonnage	:	25,431 G/T
L×B×D (Length) (Breadth) (Depth)	:	180m×30m×15m
Port of origin	:	The port of Onsan (Korea) on October 19, departed at 08:30
Port of destination	:	Etajima, Hiroshima Prefecture Private berth
Cargo	:	Oxidized aluminium Approximately 6,300KT
Draft	:	Fore 5.95m Aft 6.97m
Crew arrangement	:	Total number of 21 (12 Indonesian, 4 Filipino, 2 Russian, 1 Turkish, 1 Indian and 1 Ghanaian)
Ship's Bridge on duty personnel at the time of the accident.	:	Master E, 2/O and AB E
Master E	:	Indonesian national at the age of 44 joined as crew in 1998 and became Master in 2016 with a crew change at Qingdao (port before last) on October 16. He had a great deal of experience manoeuvring in the Seto Inland Sea area as a Master, but it was his first time to manoeuvre in the Obatake-Seto channel.
2/O E	:	Indonesian national at the age of 26 joined as crew in 2012 and boarded Vessel E from July, 2018. It was his first time to serve on board as 2/O.

Air Draft（Fig. 38）and Damage（Photograph 39）

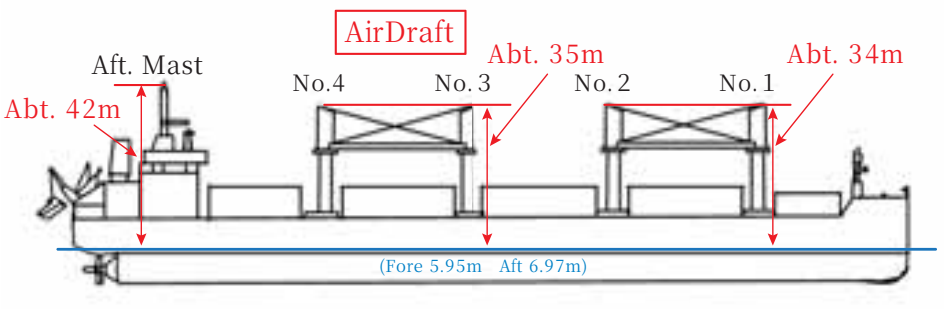
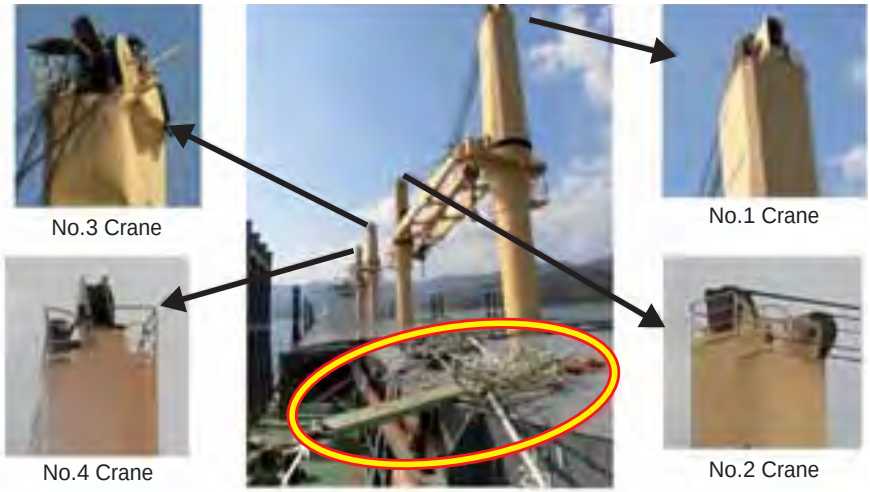


Fig. 38

No.1, No.2, No.3 cranes and the aft mast sustained damage. Air Draft（height from the water surface) is as shown in Figure 38.

Figure 39 illustrates damage sustained.



Photograph 39

5－3　Summary of Ōshima Bridge (Figure 40) and the Damage Sustained (Photograph 41)

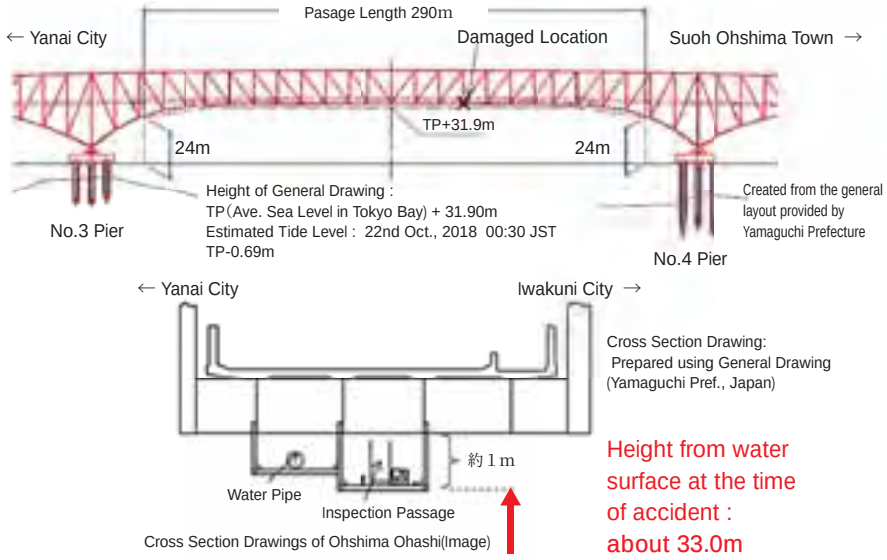


Fig. 40

Ōshima Bridge Damage

Bridge sustained cracks and depressions in the bridge girders, and an inspection corridor which was situated under the girders dropped down damaging a water mains pipe, power and communications cables etc.

In almost all parts of Suo-Oshima Town, 9,046 houses and 4,590 residents and local industry suffered approximately 40 days without water. In addition, in a part of Suo-Oshima Town, there were problems such as a temporary power outage, interruption of Internet connections and mobile phones, and electrical equipment such as bridge lights and so on.

Photograph provided : Yamaguchi Civil Engineering Office

Photograph 41

5－4 Events and Sailing Route that Led to the Accident

Timelines and sailing route that led to the accident are summarised in Figure 42 and Table 43.

- The passage plan was created just 1 week before the accident by the 2/O E.
- On the day of the accident, at around 22:00 on October 21, Master E ascended the bridge in the vicinity of Figure 42 ① in preparation for navigating the Obatake-Seto channel, and commenced ship handling command.
- At 00:00 on October 22, the duty was taken over by 2/O E at the point of 1 nautical mile south of Kasasa-jima.
- As Master E felt uneasy about the height of the Ōshima Bridge, he ordered 2/O E to confirm it. But he continued navigating. 2/O E tried in vain to ascertain information, regarding the height of the bridge beam using pilot directions and the ECDIS.
- 10:27 (approx.) On Octorber 27, the Vessel collided with Ōshima Bridge. Master E tried to make a call to the agency but no one answered at all. Master E kept navigating because it seemed that there was no appropriate point of anchor in the vicinity and at 04:00 (approx.) he finally anchored off the Port of Kure.

Fig. 42

Date・Time		No.	Occurrence of Events According to an Interview and Questionnaire
9/24 ～ 10/19		—	9/24 Departed Kwinana Quay (Australia) and arrived at the port of Onsan (Korea)via Isabela (Philippines) and Qingdao (China) on 10/19.
10/13 Approx.		—	2/O E made the Voyage Plan for Onsan - Etajima.
10/16			Master E took over from previous Master at Qingdao.
10/20			Master E and 2/O E confirmed the Passage Plan between Onsan and Etajima.
10/21	08：30		Departed the port of Onsan.

Date・Time		No.	Occurrence of Events According to an Interview and Questionnaire
10/21	22：00 Approx.	❶	In preparation for navigating the narrow channel the Master manned the bridge (Master, 3/O E and A/B E).
10/22	00：00	❷	Duty Officer 3/O E was relieved by 2/O E. As Master E felt uneasy about the height of the bridge, he ordered 2/O E to confirm it. 2/O E tried in vain to ascertain information regarding the height of the bridge beam using BA edition sailing directions.
	00：09	❸	Although 2/O E tried to check the height of the bridge beam operating the ECDIS, he did not notice how high the bridge was.
	Steered to starboard to the west of Kasasa-jima.	❹	Ship's Bridge on duty checked for bridge lights, but were unable to see them due to it being too dark. Master E worried about being pressed by the westerly current.
	00：26	❺	2/O E instructed hard to starboard and A/B E responded to the order.
	00：27		Shortly after Master E ordered midships, the No.1, No.2 and No.3 cranes and the aft mast collided with the bridge in succession.
	00：36	❻	Although Master E made a call to the agency requesting them to report this to the Japan Coast Guard, the person in charge at the agency could not hear what was being explained well, thus it did not get reported. Master E kept navigating because it seemed that there was no appropriate point of anchor in the vicinity and it would be safe to continue to the destination.
	04：00	❼	Anchored off the Port of Kure.

Table 43

5－5 Accident Causes

2/O E made the Voyage Plan with ECDIS and it was signed by the previous Master and Master E. Excerpts from the Japan Transport Safety Board Report (MA2019-10-

2), summarise statements in Table 44 (2/O E) and Table 45 (Master E), so that we may compare their respective statements with the ship management company's procedure manual (SMS manual).

Passage Plan of 2/O E

Actual Passage Plan made by 2/O E	Ship Management Co. E Procedures (SMS Manual: ISM Code)
2/O E did not confirm the information regarding Obatake-Seto using Sailing Directions. ⇒ According to the Sailing Directions published by the Japan Coast Guard, the height of the bridge over the narrowest point of the Obatake-Seto is said to be 24 to 30 meters. ⇒ It is shown as 24 meters in the Sailing Directions of the BA edition.	Both the Master and duty officer(s) shall carefully review Sailing Directions anytime prior to and during the voyage, especially when operating ocean-going vessels.
When making the route plan from Onsan to Etajima, 2/O of E used software installed in the PC on board in order to operate the electronic chart and to place orders. At this point the route, from Onsan to Etajima via Obatake-Seto, that the software had automatically created was copied to the ECDIS to be used.	For small, medium and large scale electronic charts, the route is to be refined in stages.
2/O E used the route check function and noticed that there were several warnings, including shallows on this particular route, but, he missed the warning for Ōshima Bridge. ⇒ The registered height in the ECDIS was 24 meters. As the vessel's draft and air draft had not been input, when using the route check function, it showed up as "Unidentified". Later on, when inputting the draft and air draft, it had been verified as "Not Passed".	The duty navigation officer and the Master are to visually check the route that has been input into the ECDIS and must very carefully check this during the entire sailing route on the electronic chart using the appropriate scale. This is to be then reconfirmed using the route check function of the ECDIS.

Table 44

2/O E created the Passage Plan one week before the accident occurred. However, the following deviations from the procedure manual were identified:

- 2/O E did not confirm the information regarding Obatake-Seto using pilot directions.
- According to the SMS procedure manual for creating Passage Plans, it is specified that it be created by confirming each item of data before inputting it into the electronic chart. However, he created the Passage Plan using nautical chart ordering software and copied the data over to the ECDIS.
- When creating a Passage Plan, it is necessary to input the draft, safety isobaths and air draft information of the vessel to begin with, but he neglected to do this. As a result, he could not use the route check function of ECDIS successfully.

Master E

Checks carried out by Master E	Ship Management Co. E Procedures (SMS Manual: ISM Code)
The previous Master had checked and signed Passage Plan document for Qingdao. The Master was relieved by another master at Qingdao. (Checked only the summary and did not sign for it)	The Master is to confirm the Passage Plan first-hand by himself/herself in order to ensure that there are no errors. When the Master signs a Passage Plan document this means that it has been officially approved.
Master E believed that the former Master had confirmed this because the Passage Plan had already been made when he boarded on 16 October.	
Master E checked the Passage Plan to Etajima with 2/O E using the ECDIS when staying at the port of Onsan. However, this was not carried out in detail. Master E's signature was found dated 20 October (one day before departure) on the Voyage Plan for Onsan - Etajima.	

Table 45

The following deviations from the procedures are also found for both Master E and Management Company E.

- Master E boarded at Qingdao on 16 October (which was 5 days before the accident occurred). As the previous Master mentioned to Master E that the Voyage Plan for Onsan - Etajima had been created, Master E assumed that the previous Master had checked and confirmed the plan, meaning that Master E did not check it himself.
- The Master checked the Voyage Plan to Etajima with 2/O E using the ECDIS when mooring at the port of Onsan. However, this was not carried out in detail.
- Master E and 2/O E were not used to using the check-bridge-height function on the ECDIS.
- Ship Management Company E would not usually intervene during the creation of a Passage Plan which are created on board each vessel. At the time of the accident, they had no information about any of the Passage Plans, including the Passage Plan from Onsan to Etajima, in advance.

§6 4M4(5)E Analysis of Bridge Collision ＝ Accident ＝

6－1 Human characteristics (Human error) and Psychological factors (See Attachment 16)

Before starting a specific 4M4(5)E Analysis, let's look at the relationship between human characteristics (human error) and psychological factors.

In the same manner as the previous chapter, Attachment 16 was summarized with the results used in "(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 Causes behind Human Error in "P.4 1-2 As a Mechanism behind Maritime Accidents Caused by Human Error" and "(3) Psychological Factors".

Attachment 16 Vessel E Ōshima Bridge Collision Accident: Human Characteristics, Human Error and Psychology

Date and time	Movement	Who?	Behaviour	Human characteristics	Psychology
13 Oct. approx.	Navigating en route to Qingdao.	2/O E	Created Passage Plan: Onsan - Etajima		
			・2/O E did not confirm information regarding Obatake-Seto (including bridge beam height) using pilot directions	③ Human beings sometimes forget: Forgot the procedures of the Safety Management Code	
				⑩ Human beings are sometimes lazy: Knew the procedure, but cut corners	Normalcy bias Human beings have the characteristic to underestimate or ignore information regarding him or herself.
			・Worked according to the following procedure when creating a Passage Plan		
			1) Created using software for ordering charts h	① Human beings sometimes make mistakes: The software was not for creating Passage Plans	Peer pressure ・Human beings are prone to make a judgement or decision influenced by somebody else's ideas and thoughts.
			Copied the data over to the ECDIS	⑩ Human beings are sometimes lazy: Knew the procedure, but cut corners	
			3) Did not input Draft and Air Draft data into the ECDIS	② Human beings are sometimes careless, ③ Human beings sometimes forget	
			As a result, although some warnings were detected by the route check function of ECDIS, as the vessel's Draft and Air Draft had not been input, the warning for Ōshima Bridge showed up as "Unconfirmed" and was thus overlooked.	While it may be easy to use convenient software for ordering charts, if ECDIS is not used correctly then it will return incorrect results	・When normalcy bias and peer pressure are combined, a deviation from what was the standard occurs. Then, as a result, and in no time at all, this then becomes the new standard.
16 Oct. approx	When moored at Qingdao	Master E	The next Master E took over from the previous Master		Normalcy bias Human beings have the characteristic to underestimate or ignore information regarding him or herself.
			・The previous Master had checked and signed the Passage Plan document for Qingdao under his command. He only checked a summary of the Passage Plan between Qingdao-Onsan, and Onsan-Etajima, and did not sign for it.	⑩ Human beings are sometimes lazy: Neglected to take over properly	
			・Master E believed that the previous Master had confirmed this because the Passage Plan had already been created.	⑨ Human beings sometimes make assumptions: It was assumed that the previous Master had approved the Passage Plan up until completion of voyage discharge	Social loafing There is the psychological tendency to cut corners in the belief that someone else will take care of it
20 Oct. approx	When moored at the port of Onsan	Master E	The Master E checked the Passage Plan between Onsan-Etajima with 2/O E using the ECDIS. However, this was not carried out in detail.	⑨ Human beings sometimes make assumptions: Based on the above, he assumed that the Passage Plan had been entered into the ECDIS correctly	
				⑩ Human beings are sometimes lazy: Knew the procedure, but cut corners	
21 Oct.					
08:30	Departed the port of Onsan.			No specific problem	No specific problem
22:00	The west of Heigun Island	Master E	Manned the bridge in preparation for navigating the narrow channel		
22 Oct.					

Table 46 (Attachment P. 124)

2/O E's Creation of the Passage Plan

While he may be versed in the Safety Management System (SMS)'s procedure manual, he was unable demonstrate this. When applying this with human characteristics, the following emerge. (Numbered Figure 5 on P. 6)

❶ Human beings sometimes make mistakes and
❿ Human beings are sometimes lazy

Created Passage Plan using nautical chart ordering software and copied the data over to the ECDIS as is.

❷ Human beings are sometimes careless and
❸ Human beings sometimes forget

Before inputting specific data of sailing route, it is a requirement that basic information such as Draft, Air Draft、Safety isobaths of the vessel, be input. This was neglected.
In addition, as for psychological factors, overlaps of Normalcy Bias which is to ignore information that is inconvenient（e.g. following the procedure manual in the Safety Management System (SMS）is time consuming, etc.,) and Peer pressure such as the copying of data into the ECDIS from the Passage Plan using software for ordering charts by superiors and predecessors contributed to the above mentioned actions.

Master E

We can conclude that the following human characteristics invited human error.

❾ Human beings sometimes make assumptions

The previous Master checked and signed the Passage Plan up until Qingdao Port where the takeover Master boarded. The Master assumed that the Passage Plan created for Qingdao-Onsan-Kure (Etajima) was complete and that the previous Master had checked and signed it.

❿ Human beings are sometimes lazy

The Safety Management System (SMS）specifies that the Master is to check the details

of the Passage Plan and sign for it. However, he neglected this duty because of his assumption.

The following psychological factors underlay the root cause behind these human characteristics.

- Normalcy bias : Similarly for 2/O E, he conveniently interprets the burdensome task at hand.
- Social loafing : Simply assuming that someone (in this case, the previous Master) was supposed to do it.

As Master E felt uneasy about the height of the bridge, he ordered 2/O E who just ascended the bridge to confirm it. But, it must be said that this was in vain, because it was too late. Let's proceed to the following 4M4(5)E analysis, while considering these underlying root causes.

6－2 Summary of Related Facts (See Attachment 17)

It is possible to list up the following related facts from the main accident causes summarised in 5-5.

Creation of Passage Plan by 2/O E

- Did not research the waterway enough.
- Did not input basic information such as draft, Air draft and safety isobaths of the Vessel into the ECDIS.
- Saved to the ECDIS only by copying the Passage Plan data which was created using nautical chart ordering software.

Attachment 17 Maritime Accident Summary of Related Facts (Collision with Ōshima Bridge)

Reference No.	Identified problems from survey findings				Direct cause		Accident cause evaluation	Re-examination necessity
					Unsafe behaviour	Unsafe conditions		
	Date	Time	Caused by	Check facts and problem areas				
1	13 Oct. approx.		2/O E	Created Passage Plan: Onsan - Etajima without checking the bridge beam height of Ōshima Bridge. Abort Point procedure was unclear	○		1	○
				Did not input Draft, Air Draft and Safety isobaths data into the ECDIS				
				Created Passage Plan using nautical chart ordering software and copied the data over to the ECDIS as is				
2	16 Oct.		Master E	Believed that the previous Master had checked and signed the Passage Plan both between Qingdao-Onsan and between Onsan-Etajima.	○		5	
3	20 Oct.		Master E and 2/O E	Passage Plan between Onsan-Etajima were not confirmed in detail on the ECDIS.	○		2	
4	22 Oct.	00:00	Master E	As Master E felt uneasy about the height of the Ōshima Bridge, he ordered his 2/O E to confirm it.	○		4	
5	22 Oct.	00:00	2/O E	2/O E did not confirm bridge beam height using pilot directions and the ECDIS	○		3	
6	22 Oct.	00:11	Master E	Continued navigating without confirming the height of the bridge beam	○		6	
7			Ship management company E	No intervention was taken into account whatsoever, regarding the vessel's Passage Plan	○		6	

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

Table 47 (Attachment P. 126)

Master E

- Believed that the previous Master had checked and signed the Passage Plan from Qingdao-Onsan-Kure (Etajima).

Passage Plan confirmation between Master E and 2/O E

- Both did not do a final check of the passage plan before departing the port of Onsan.
- Immediately before the accident, Master E ordered his 2/O E to confirm the height of the Ōshima bridge, but 2/O E could not confirm this with pilot directions and the ECDIS.
- Continued navigating without confirming the height of the Ōshima Bridge.

We can understand that the accident occurred, because the chain of human errors was not broken.

Ship Management Company E

- No intervention was taken regarding the creation and confirmation of the management of the vessel's Passage Plan

6－3 “Analysis Related to Unsafe Behaviour”for Master E and 2/O E (See Attachment 18)

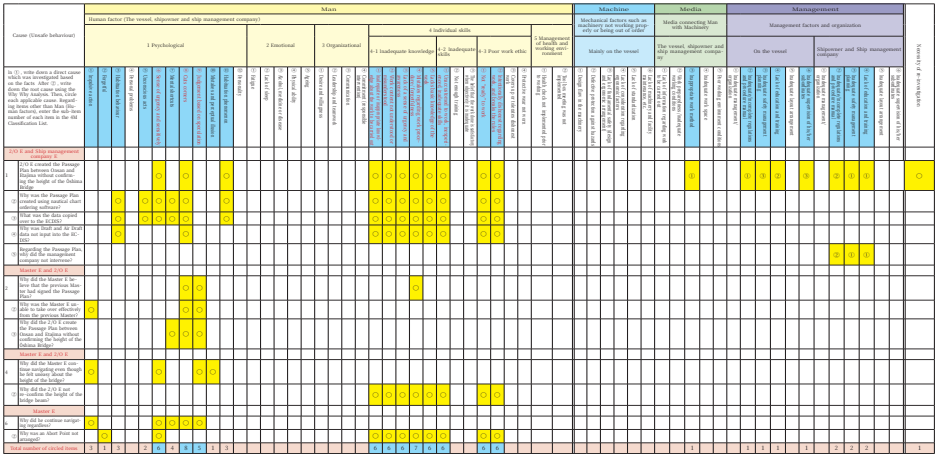


Table 48 (Attachment P. 127)

There is a tendency that causes are from “1 Psychological factors” and “4 Individual skill factors” in Human Factor (Man) of 4M.

Psychological Factors

Among the psychological factors, ⑥ Sense of urgency and sensitivity, ⑧ Cutting corners and ⑨ Judgement based on speculation, are the main causes.

- Created a Passage Plan using nautical chart ordering software and copied the data over to the ECDIS as is. ⑧ Cutting corners is applicable.
- Did not input Draft, Air Draft and Safety isobaths data into the ECDIS ⑧ Cutting corners is applicable.

- Before departing the Port of Onsan, Master E and 2/O E confirmed the final Passage Plan, but without checking the details. In addition, as a planned Abort Point had not been identified, it was also not input into the ECDIS. ⑥ Sense of urgency and sensitivity and to ⑧" Cut corners "are applicable.

Ship Management Company E

The Safety Management System (SMS) specifies the creation procedure manual of the Passage Plan, and there was no problem with this in itself. However, regarding management at the office on land, it is clear that they were not involved in the Vessel including any other vessels. "2 Inadequate/incomplete regulations and procedure manual", "3 Inadequate safety management planning" and "4 Lack of education and training" are applicable. As the problem lies in that of the operational method, we have designated this as Re-examination necessary.

6－4 Countermeasures for" Unsafe Behaviour "for Master E, 2/O E and Ship Management Company E (See Attachment 19)

Attachment 19 Maritime Accident Analysis using 4M5E and Countermeasure List (Unsafe behaviour) Collision with Oshima Bridge

	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. 2/O E created the Passage Plan between Onsan and Etajima without confirming the bridge beam height of the Hakata -Oshima Bridge (1- ③ and ⑤～⑪) 2. Regarding the Passage Plan between Onsan - Etajima, Master E did not receive details from the previous Master. (1- ①, ⑧ and ⑨) 6. Continued navigating while feeling uneasy about the height of the bridge. (1- ①, ⑥, ⑨ and ⑩) 1. Abort Point: Was there a clear plan if the Passage Plan got interrupted or if there were non-returnable points? (Re-examination necessary) (1- ①, ② and ⑥～⑨)		1. Vague setting method of ECDIS (input-ting basic da-ta) (1- ①, ⑤～⑧ and ⑪)	3. Vague procedure for confirming and approving the Passage Plan (1- ① and ⑦～⑨) 2. What the Master did receive from the previous Master was vague (1- ①, ⑧ and ⑨)	7. No intervention was taken into account whatsoever regarding the vessel's Passage Plan (Management 2- ②, 3- ① and 4- ①)
Education Education and training Knowledge, skils, consciousness, being given information, etc.	・Re-training for the personnel in charge of creating the Passage Plan (2/O E) ・Re-training regarding handing of Abort Point procedure ・Re-training on how to handle feeling uneasiness regarding navigation ・Re-training for Master E regarding Safety Management Code				・Formulation of continued training and education for Crew
Engineering Technology and engineering Technological countermeasures					

	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
Enforcement Thorough guidance and enforcement Standardization, proceduralization, alerting, reward and punishment KYT, campagnes etc.	・Re-training for taking over from previous Master ・In particular, procedure manual compliance regarding the approval procedure of Passage Plans. ・Formulation of handling method (procedure) regarding the route check function of ECDIS		・Creation of Passage Plans using ECDIS and a procedure manual on how to utilize the route function	・Thorough compliance with the revised procedure manual	・Review of SMS procedure manual regarding creation, confirmation and approval of Passage Plans. (To include basic setting method of ECDIS) ・Guidance and completeness of revised procedure manual for all ships under management ・Enforcement of internal auditing
Examples Case studies, countermeasures and rules Lead by example, experience of success, introduce model cases, "Hiyari -Hatto" (near misses), etc.					
Environment Working environment, office internal management, on-board organization, etc.					

Table 49 (Attachment P. 130)

When listing risk factors derived from a direct cause and indirect/root cause, countermeasures for improvement will emerge.

Recurrence Prevention Countermeasures through Education (education and training) for Master E and 2/O E

It is likely that there were no major deficiencies in the procedure manual on how to create the Passage Plan according to the Safety Management System (SMS). The root cause shows that the creator(s) did not have the foundations necessary to plan the Passage Plan according to the manual.

Therefore, it will be important for both Master E and 2/O E to receive re-training on creating a Passage Plan including the utilization of ECDIS.

Also, Master E continued navigating even though he felt uneasy about the height of Ōshima Bridge. Re-training on how to handle feelings of uneasiness while navigating will also be required.

Recurrence Prevention Countermeasures by Ship Management Company E

Regarding the creation of the Passage Plan, the fact that the management company was not directly involved poses a problem, since they relied on related parties only. Confirm if there any problems with regards to the ISM Code or SMS Manual. If there are any deficiencies, they need to be improved. This should include the following:

- A review of the Passage Plans procedure using the ECDIS and procedure manual. This is to include how to utilize the route function.
- This should not stop with work completion and an improved procedure manual, but that ongoing verification be carried out if it is to be practised reliably at sea (PDCA cycle). Namely, it is important to manage the following:
  - Thoroughly introduce accident summary and guidance and completeness of revised procedure manual for all ships under management.
  - Until the management company can confirm that they reliably practice this with

each ship under management, the implementation frequency of internal audits is to be increased.

- Moreover, it is important to evaluate these operation results and, if necessary, review in order to not forget the lessons learned from the accident.

Specific prevention countermeasures will be summarized here by adding the recurrence prevention countermeasures compiled in Japan Transport Safety Board's report (MA2019-10-2).（As the (X) numbered items are recurrence prevention countermeasures which are defined in the Japan Transport Safety Board Report, our recurrence prevention countermeasures with 4M4(5)E analysis are almost identical.)

1 When crew create the passage plan regarding a sea area where they are to navigate for the first time, it is a requirement that they carry out an in-depth investigation throughout the entire route, using nautical charts, sailing information and other oceanographic information in particular.

1 Recurrence Prevention Countermeasures Specific to (1)

When considering why they could not perform their duties, as mentioned above, psychological factors and individual skill factors of Master E and 2/O E underlay the root cause. Another direct cause, which is a result of insufficient knowledge and experience regarding Passage Plan creation by 2/O E（who firstly conducted the duty as 2/O on this vessel）can be identified. Thus, the following two points can be regarded as recurrence prevention countermeasures:

- Re-training for Master E and 2/O E regarding the creation procedure of the Passage Plan.
- Ship Management Company E to systematize crew education and training.

2 When creating the Passage Plan using the ECDIS, crew must not overlook the potential hazards en route. They must (1) confirm the electronic charts and (2) employ the ECDIS function. The contents of any cautions displayed should be thoroughly inspected.

3 It is sometimes the case that crew are not fully aware of the potential hazards

en route when using computer generated voyage plans. When using computer software for navigation, crew should pay attention to the aforementioned two points.

4 In order to prevent oversight of any aerial obstacles, crew should make full use of the ECDIS height check function, if so equipped. It is hoped that the ship owner will actively encourage implementation of this function.

One factor is the fact that both Master E and 2/O E had insufficient skill and knowledge to operate the ECDIS route check function. According to the Japan Transport Safety Board Inquiry, vessel E's ECDIS displayed the height above sea-level of the Oshima Bridge as 24m. However, neither vessel draft or air draft had been input and so cautions regarding the bridge were displayed as "Undefined".

When the route was rechecked following input of the vessel draft, air draft and safety isobath data, the display changed to "Not passed". Before departing Onsan Port, it appears that both Master E and 2/ O E did check the route with the ECDIS, but failed to notice the "Undefined" display.

From this author's history of being on board vessels, it can be said that although the route check function is useful, too many alerts are shown on screen (this could be related to the settings of basic information), and there is a tendency to get desensitized to the meaning of the alerts. Regarding this area, we hope to discuss how to improve this aspect via Machine (out of 4M) in the future. Considering this background information, the following have been identified as recurrence prevention countermeasures:

2～4 Recurrence Prevention Countermeasures Specific to (2) - (4)

- Re-training for obtaining safe isobaths and vessel information via ECDIS for not only the parties involved but also all Masters and navigation officers of contracted ships（including how to deal with draft, Air Draft and so on.）
- It is important to carry out not only temporary re-training, but ongoing and periodic training, also. It is necessary that Ship Management Company E create and review the education and training programme for crew.

5 When crewmembers feel uneasy during navigation, navigation should continue only after confirming satisfactory safety by the taking of necessary steps to change course, reduce speed, stop manoeuvring and so on asap, depending the circumstances.

Master E's continuing to navigate, even while feeling uneasy could be a direct cause. Because of the inadequate planning for an abort point, the information was not displayed on screen. At that time when checking the lights at the Ōshima Bridge, it might be possible to judge if she could keep manoeuvring by stopping navigation at that point, and take into consideration the manoeuvrability of the vessel (minimum stop distance, turning etc.).

5 Recurrence Prevention Countermeasures Specific to (5)

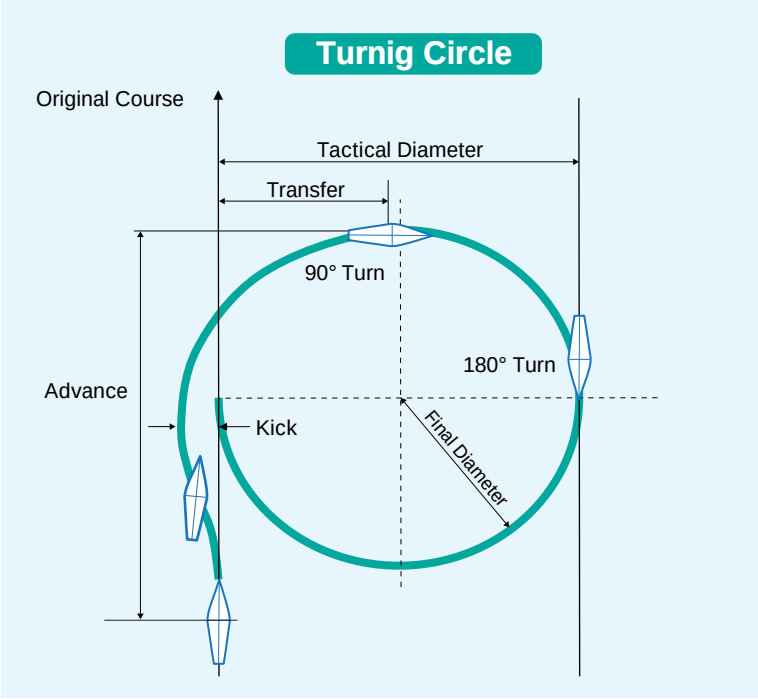
- When approaching port entry and passing narrow channels, it is necessary to clarify the location of an Abort Point and determine whether or not to continue navigation at that point.
- Ship Management Company E is to prepare the procedure manual and set up the Abort Point, and systematise further education and training for Masters and officers.

The ship's Sea Trial Results and the Turning and Stopping performance displayed on the bridge are as follows:

1. Turning performance

	Right (Starboard) Turn (Initial Spd 12.9kts Rudder Angle 35deg.)	Left (Port) Turn (Initial Spd 13.5kts Rudder Angle 35deg.)
90° Turn (Advance) (Req. Time)	about 543m (2 min. 10 sec.)	about 559m (2 min. 02 sec.)
180° Turn Tactical Diameter (Req. Time)	about 441m (4 min. 22 sec.)	about 463m (3 min. 52 sec.)

Table 50



2. Stopping performance

When operating full speed sternway during employing full speed ahead (14.3 knots), the distance forward until stopping the vessel was 2,116 meters and its time taken was 9 minutes and 53 seconds.

At approximately 00:00 (27 miniutes before the accident occurs) on October 21 when Master E felt uneasy about the height of the Ōshima Bridge, he ordered his 2/O E to confirm it; the vessel was at the point of 1 nautical mile south of Kasasa Island (Kasasa-jima). Considering this sea area, it would have been possible both to return by turning or stopping the vessel itself.

In addition, in the case of heading for Kure（Etajima) passing Kanmon Straits, as it is not suitable to navigate Obatake-Seto channel for large ships, for example, those that are more than 180 meters in length, i.e. Vessel E, it is common to pass via Kudako Suido（See Figure 42）instead. In the event of being unfamiliar with this sea area, it would be necessary to have a pilot on board.

§7 Conclusion

As explained in the Chapter 1, almost 90% of the root causes of all maritime accidents are said to be caused by a chain of human errors. In terms of accidents such as collisions, bridge damage and groundings, which were closely examined this time, it is no exaggeration to say that the root causes were down to human errors (100%). BTM/ETM and the 4M4(5)E analysis can break the error chain and prevent future accidents. By utilising the PDCA cycle and by analysing why the parties involved caused the accident and using lessons learned from past accidents to reflect and prevent the same type of accident occurring, it is our hope that these methods may serve to prevent similar accidents from happening in the future.

References

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- The Maritime Human Resource Institute, Japan: Engine room resource management (Provisional translation)
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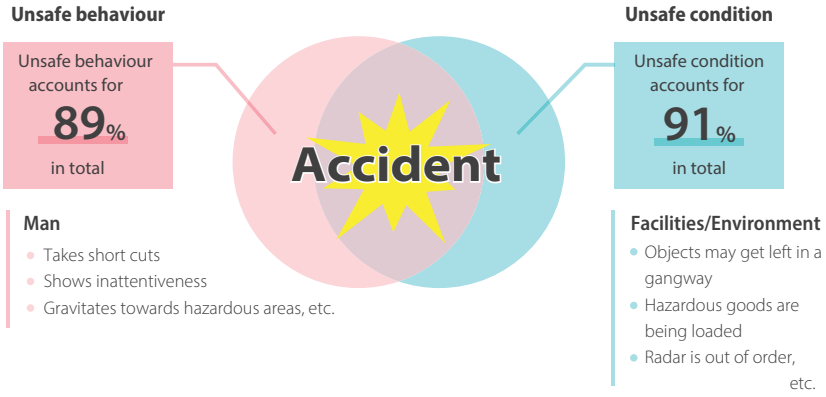
- P&P Network: Meaning and object of OJT (Provisional translation)
- Japan Industrial Safety & Health Association　Training materials from a Cause analysis and prevention seminar through lessons learned from disaster cases (Provisional translation)

JISHA

Attachment 1

4M4(5)E Analysis



Percentage of accidents that occur when the two overlap

85.6%

1 Site investigation

・Carry out investigation in as much detail as possible, ideally by a third party (such as a surveyor or marine consultant etc.)

2 Analysis of site investigation report

・Clarify accident cause/s (4M) using a classification table and so on.
・Organize these into a matrix to examine the facts.
・Furthermore, clarify which items need to be inspected/investigated again.

3 Once the above have been established, compile this information into an accident cause/s matrix (unsafe behaviour and unsafe conditions).

・Refine relevant items.
・Carry out a Why Why Analysis.

4 Once the above 3 has been completed

・Classify the direct cause, indirect cause and root cause of the accident referring to the 4M5E table.
・Devise a countermeasure for every 5E item.

5 Carry out and verify countermeasure based on the above

⇒ Brush up with PDCA cycle.