



Questionnaire survey on the usabilities of Navigational instruments for Masters and Deck officers

1. Introduction

Currently, discussion regarding “e-navigation” is proceeding in IMO (International Maritime Organization) aiming increase of navigational safety in shipping through reduction of burden and improvement of efficiency by result of improvement of information exchange between ship and the ship and shore.

Japan Ship Technology Research Association (JSTRA) has conducted “Review of related standards accompanying the implementation of e-navigation strategy” funded by the Nippon Foundation.

The interface between navigational equipment and human onboard is an issue to be considered and deeply related to improvement of safety in shipping in the discussion of “e-navigation”.

Accordingly, questionnaire survey has been conducted on using navigational equipment for those who engage in ship navigation or those who have experience of ship navigation.

This questionnaire investigation is intended for captains and officers working on ships of not less than 500 gross tonnage.

The purposes of this investigation are:

- .1 to identify kind of navigational equipment to which improvement of operability and user-friendliness seems to be needed and its reasons; and
- .2 to gather information on near-miss cases through use of navigational equipment; for considerations on matters to be proposed to discussion of “e-navigation” in IMO.

2. Outline of the Questionnaire

Questionnaire on using navigational equipment attached on this paper was conducted with the cooperation of The Japanese Shipowners' Association (JSA), Japan Federation of Coastal Shipping Association, Japan Passengerboat Association and Japan agency of Maritime Education and Training for Seafarers (JMETS) from September to December 2016. The tabulation result is displayed below.

The total number of answers to the received questionnaire is 813 cases and the breakdown of Japanese seafarers and non-Japanese seafarers is as depicted in the following pie-chart:

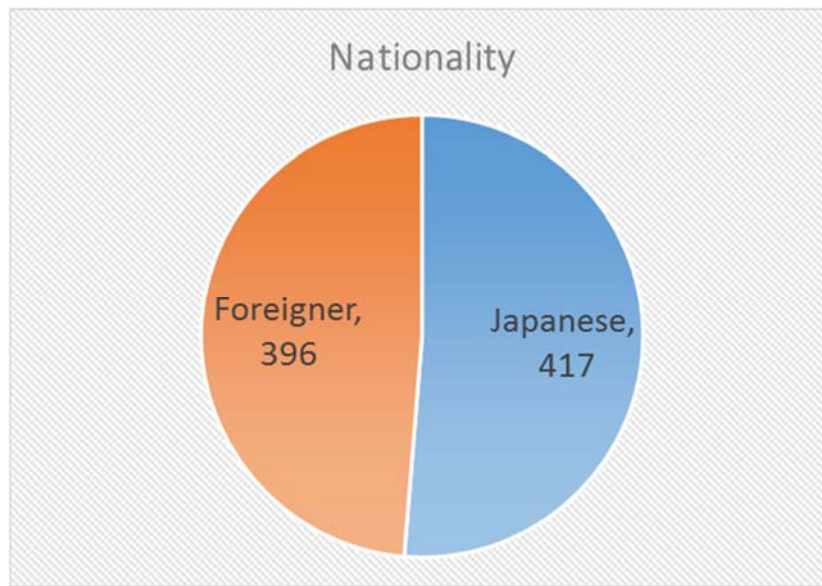


Fig.2.1 The total number of answers of questionnaire

3. Results of questionnaire

As per question 1, the questionnaire survey was carried out to masters and deck officers, which asked Voyage area (International or Domestic), Onboard experience, Current job title and Qualification (Grade of the STCW Certificate) as shown in the Annex.

Then as per question 2, the questionnaire survey was carried out to masters and deck officers about their opinions of improvement on using navigational equipment.

As per question 3, the questionnaire survey was carried out to masters and deck officers about near-miss cases experienced and navigational equipment involved.

Concerning comments on survey results on questions 2 and 3, the results had been initially classified under the descriptive factors from 1 to 9 in the following table. The detailed results were then analyzed by qualified and experienced master mariners.

Table 3.1 Classification of result of analysis

No.	Classification	Explanation
	(middle classification)	(small classification)
1	Visual sensation	color-coding, brightness, display, character, size, etc. e.g. display character are too small to understand
2	Auditory sensation	sound types, loudness, sound quality, sound timing, adjustment method, etc. e.g. alarm buzzer is too loud
3	Tactile sensation	layout of buttons, size, cursor, dial, touch panel, etc. e.g. allocation of buttons are complicated to operate
4	Efficiency (function)	amount of information processing, processing reaction, detection capability, durability, according to the number of function, etc. e.g. information processing capability is too low
5	Operation method	differences of operation procedure, differences of setting method, difficulty of the operation, etc. e.g. operation method is too complicated to use
6	Type	a type of screen display, a type of printing paper, specifications of respective countries, possibilities of data sharing, etc. e.g. record paper need to be changed frequently
7	Version	model version, unwanted mechanism, etc. e.g. recording media is still floppy disk
8	Expression	abbreviation, languages, etc. e.g. used abbreviation is difficult to understand
9	Human factor	human error, a usage standard, rules, etc. e.g. incorrect operation leads danger situation

3.1 【Question 1】 Background of respondents

In regard to years of onboard experience, highest proportion is the ratio of seafarers of 0-10 years on board, followed by 11-20 years (31%), 21-30 years (17%) and seafarers more than 30 years at 12%.

In regard to current job title, Captain and Second officer are a little (less than 30% each), Chief officer and Third officer are around 20% each.

In regard to voyage area, more than 60% of seafarers are working on international voyages and a little less than 40% of seafarers are working on domestic voyages.

In regard to kinds of ship on board, approximately half of seafarers are working on “Other cargo ships”, 30% of seafarers are working on “Tankers” and 20% of seafarers are working on “Passenger ships”.

Further, it has been decided not to compare about seafarer’s certificate in this survey because there is a difference in category with Japanese seafarers and seafarers of different countries.

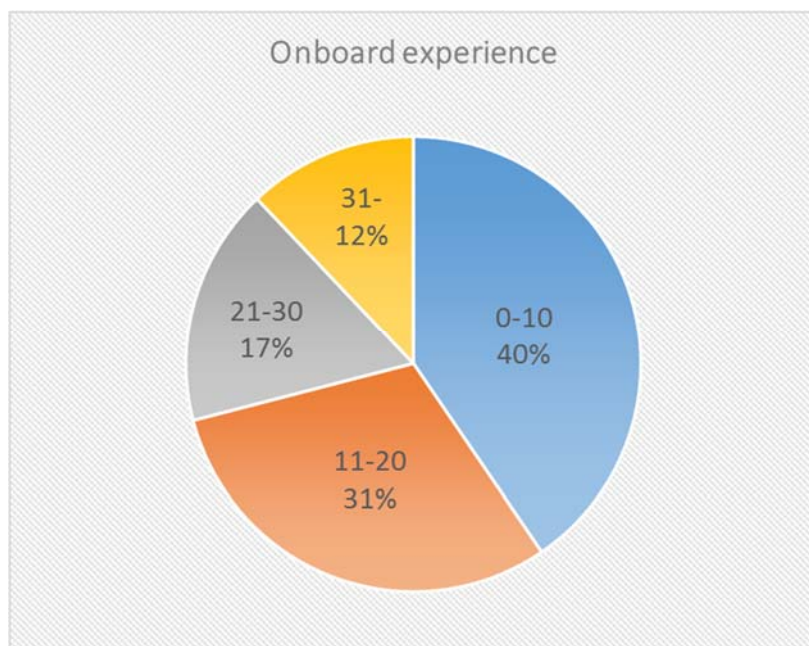


Fig.3.1 Onboard experience

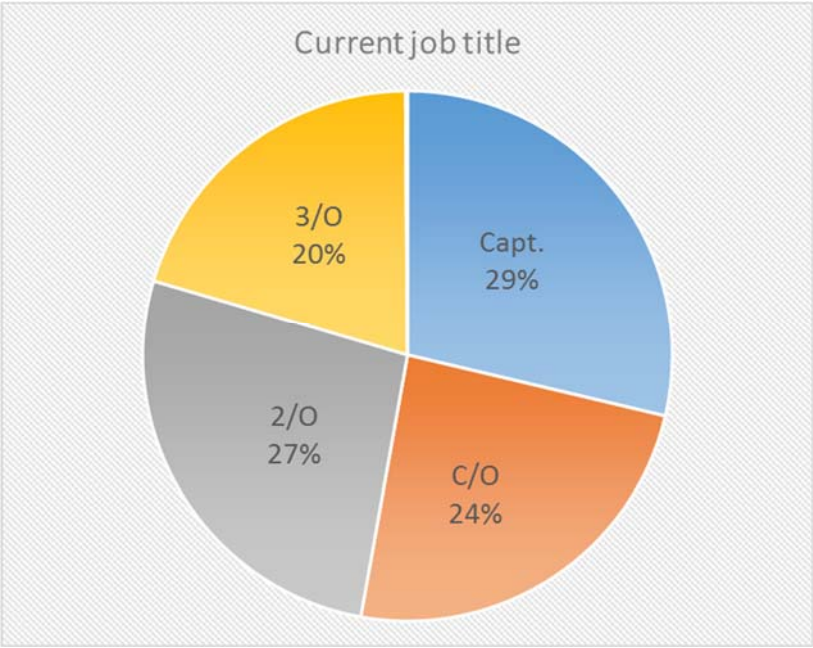


Fig.3.2 Current job title

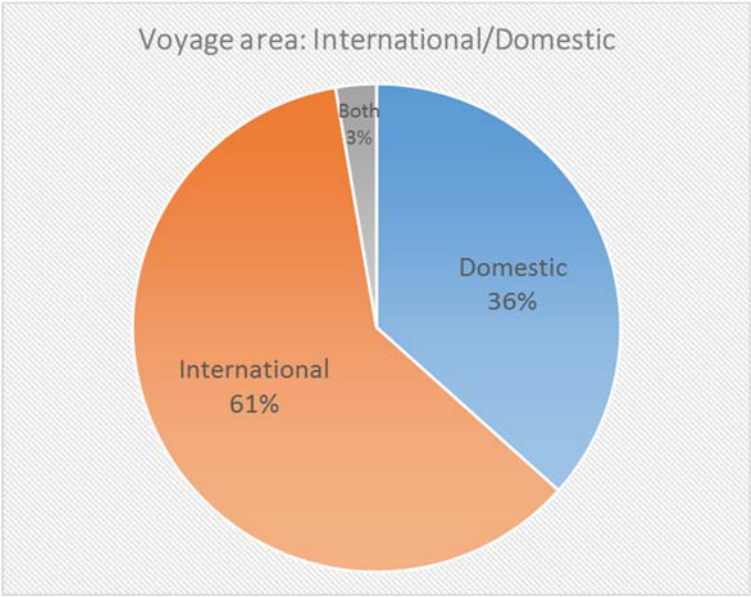


Fig.3.3 Voyage area

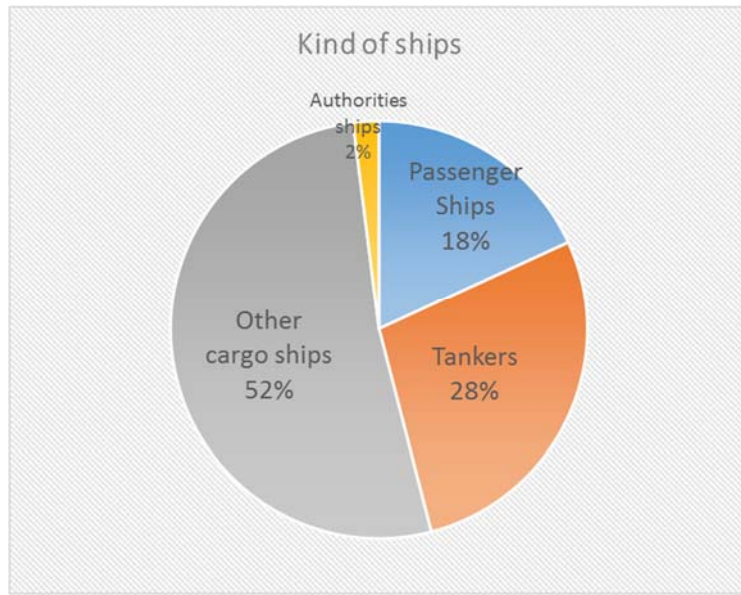


Fig.3.4 kind of ships

3.2 【Question 2】 Identification of instruments which may need to be improved in both their operation and their user-friendliness

✧ Total result of Question 2:

In regard to Question 2, the survey was conducted to specify instruments that may need to be improved in operation and user-friendliness

The total result of question 2 shows that suggestions for improvement of ECDIS and Radar/ARPA are 20% each, suggestions for improvement of AIS are 10%, suggestions for improvement of VHF radio telephone and NAVTEX receiver are a little (less than 10%), as shown in Fig.3.5.

It has been found out that 60% of suggestions for improvement consists of these 5 navigation instruments.

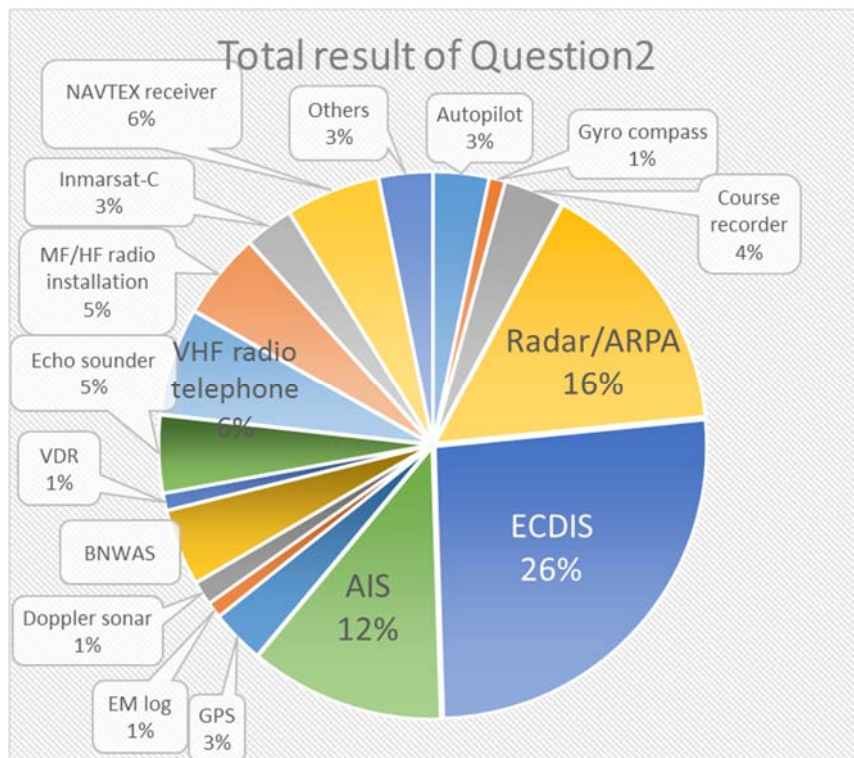


Fig.3.5 Total result of Question 2

✧ The distinction of the international voyage only; of the domestic voyage only; and of voyages that combine both the international voyage and the domestic voyage.

There are the most opinions about ECDIS from members on international voyages and on combined international and domestic voyages.

On the other hand, there are the most opinions for Radar /ARPA from members of the domestic voyages. However, there are a little less than 20% opinions from members of the domestic voyage.

Concerning AIS, there were many improvement opinions from masters and deck officers

of the domestic voyages and from the combined international and domestic voyages.

It should be noted that there are many opinions for MF/HF radio installation from masters and deck officers of the international voyages

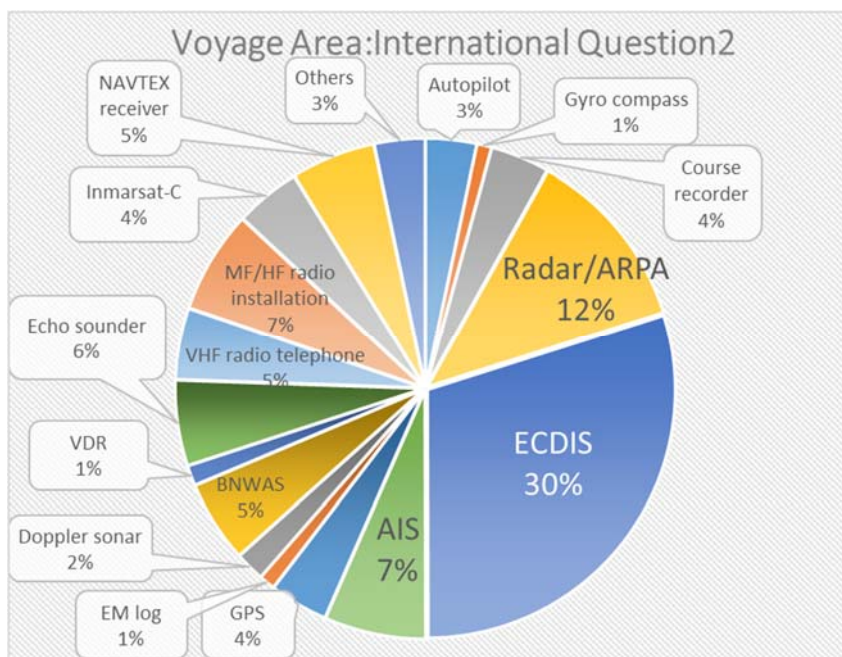


Fig.3.6 Seafarers on international voyages

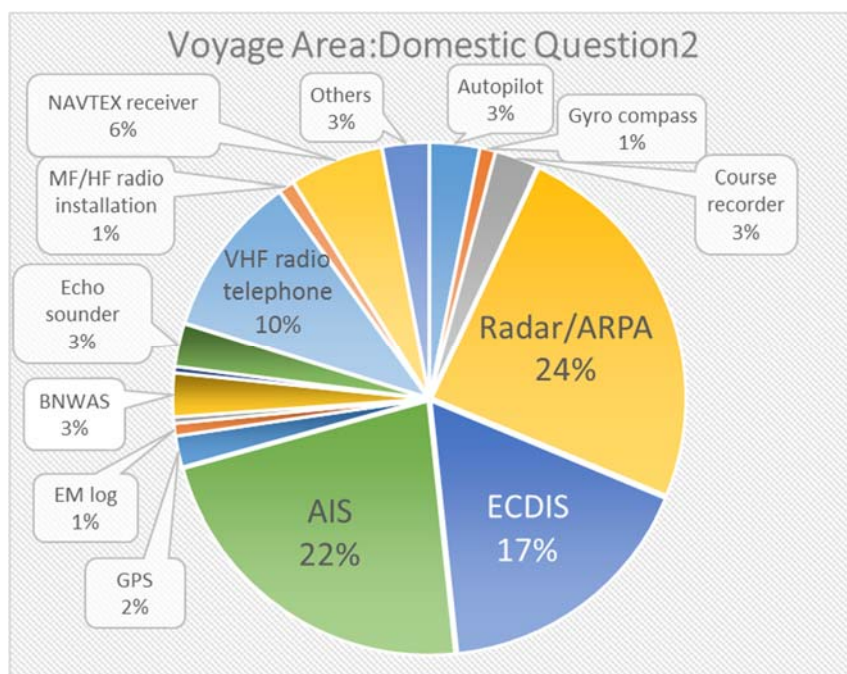


Fig.3.7 Seafarers on domestic voyages

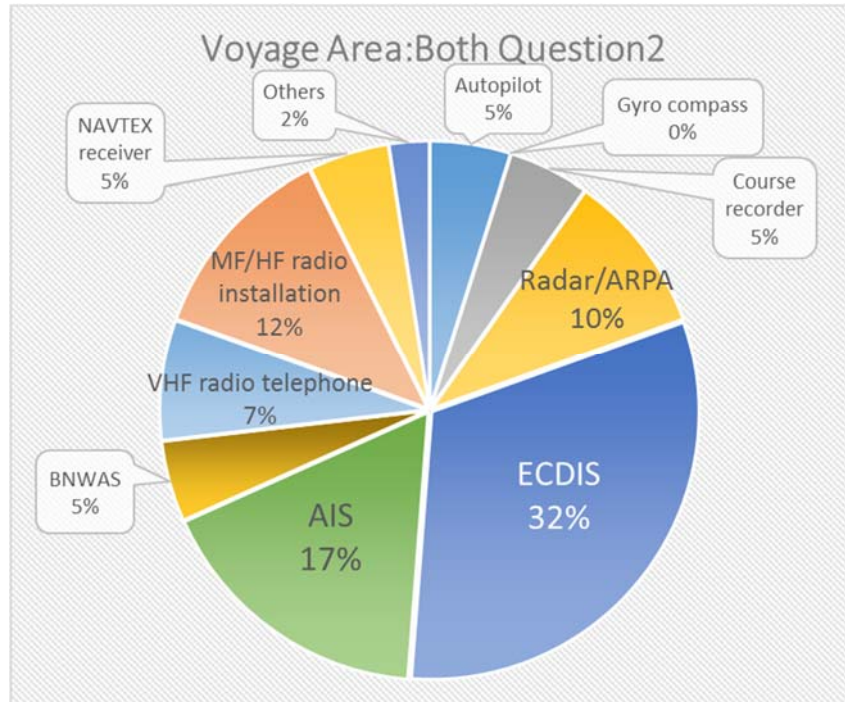


Fig.3.8 Seafarers on combined domestic and international voyages

✧ Distinction of each kind by years of onboard experience

There is some difference by the distinction of years of onboard experience, and almost the same tendency is seen in their opinions.

In other words, difference in improvement awareness did not appear in the number of years of onboard experience conspicuously, so it can be seen that seafarers in all years of onboard experience have almost same improvement consciousness with similar apparatus.

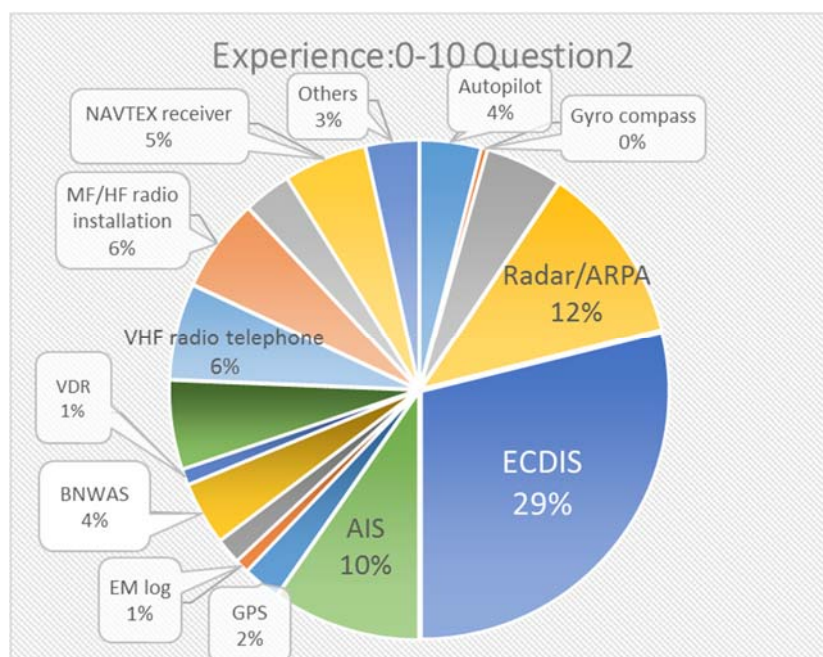


Fig.3.9 Answer of seafarers of 0-10 years' experience

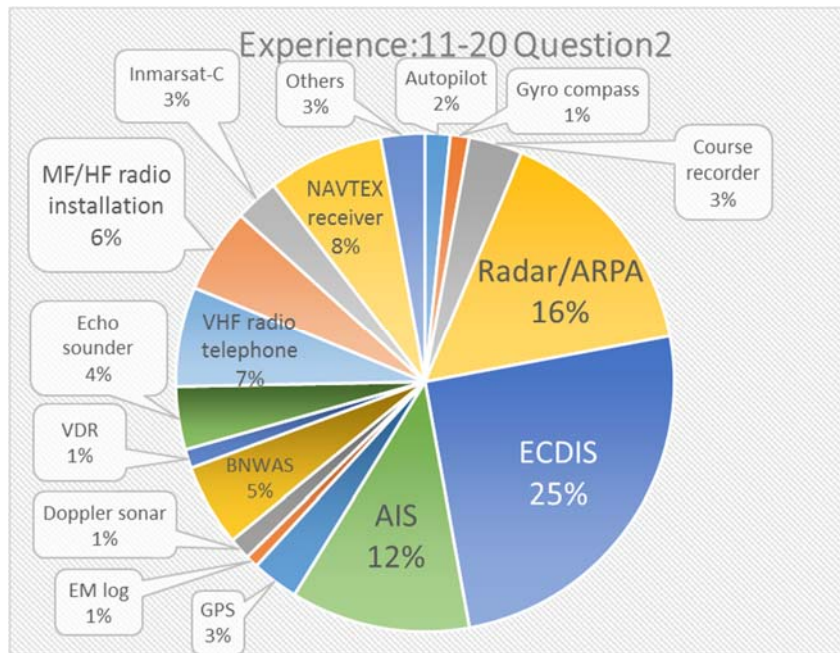


Fig.3.10 Answer of seafarers of 11-20 years' experience

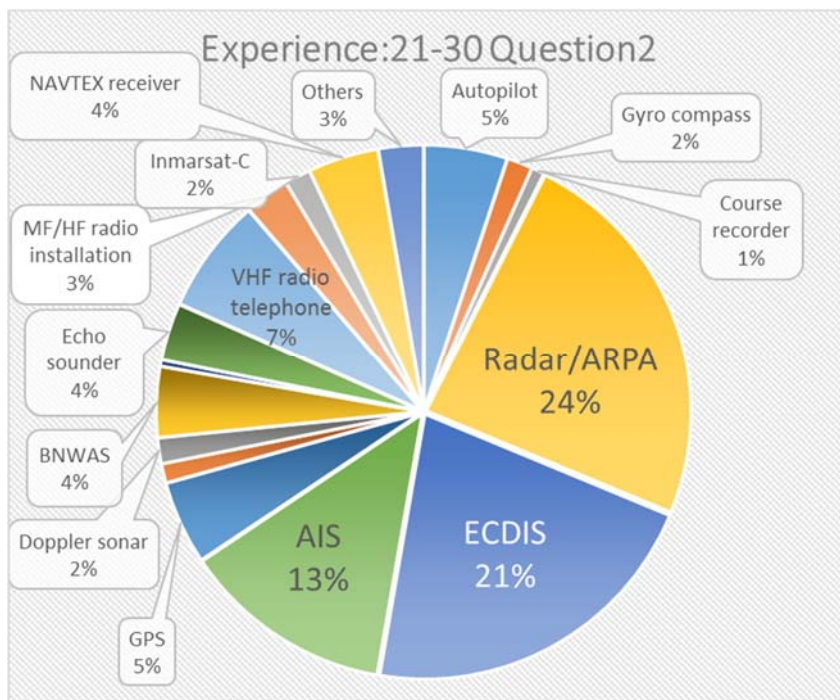


Fig.3.11 Answer of seafarers of 21-30 years' experience

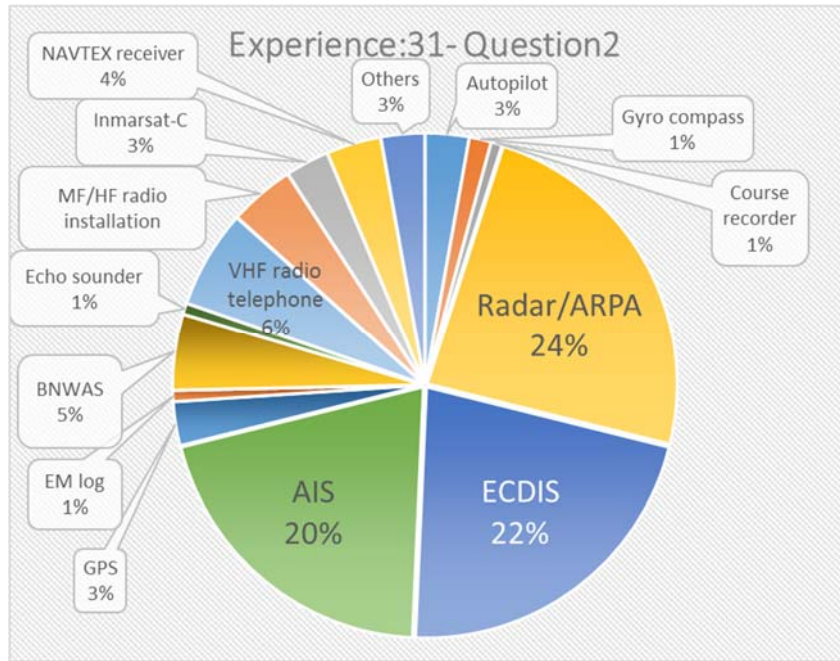


Fig.3.12 Answer of seafarers with more than 30 years' experience

✧ Distinction of each current job title

As for the distinction of current job title, suggestions for improvement are almost the same distribution as the years of onboard experience distinction.

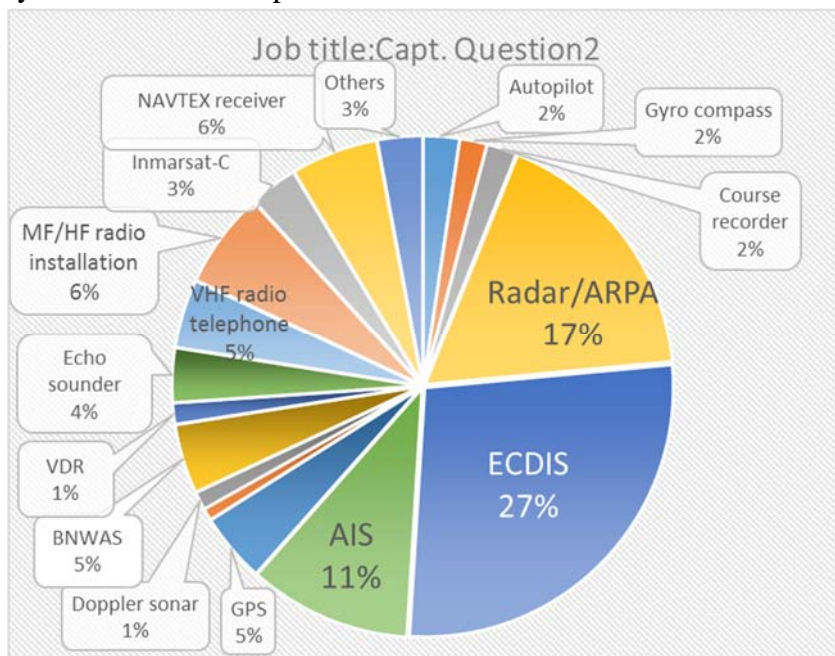


Fig.3.13 Captain (Capt.)

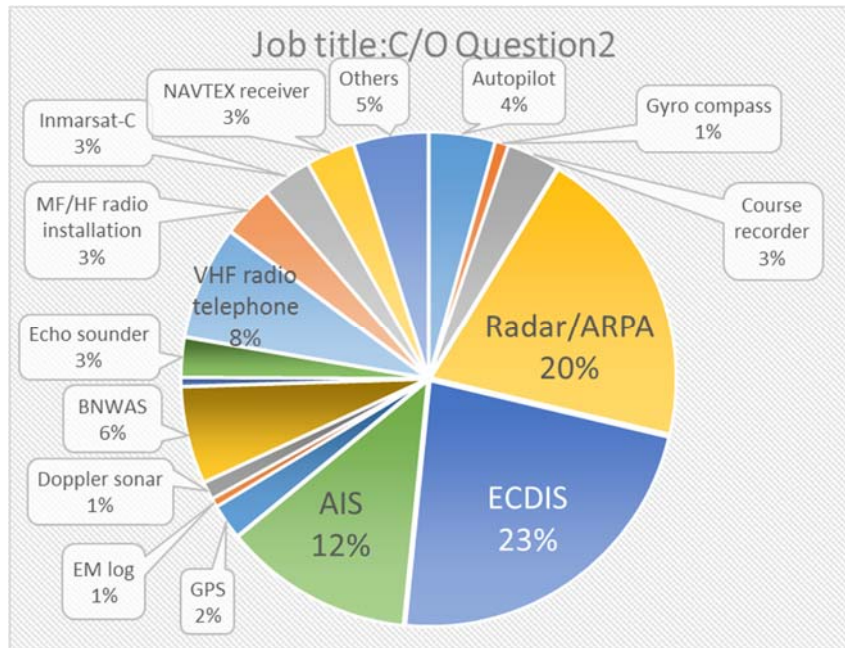


Fig.3.14 Chief Officer (C/O)

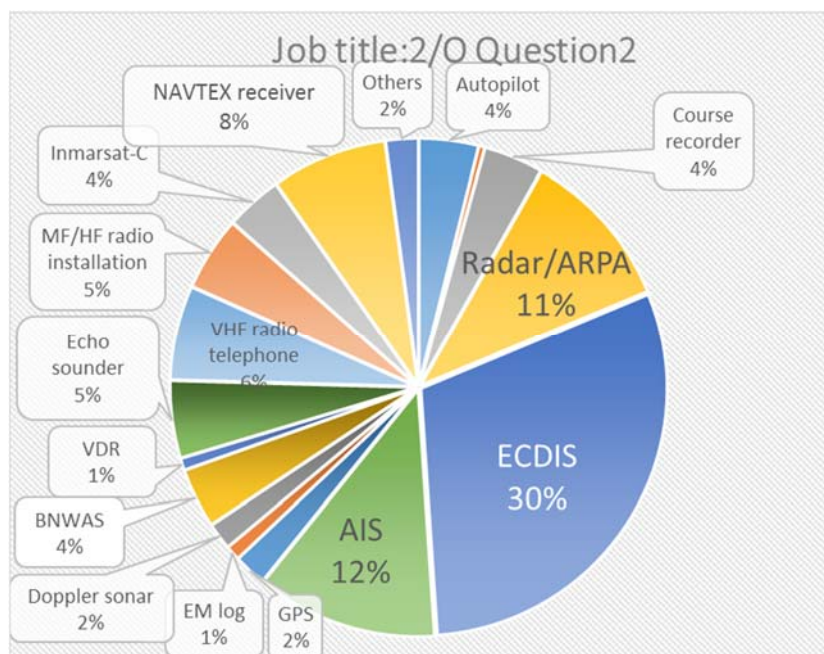


Fig.3.15 Second Officer (2/O)

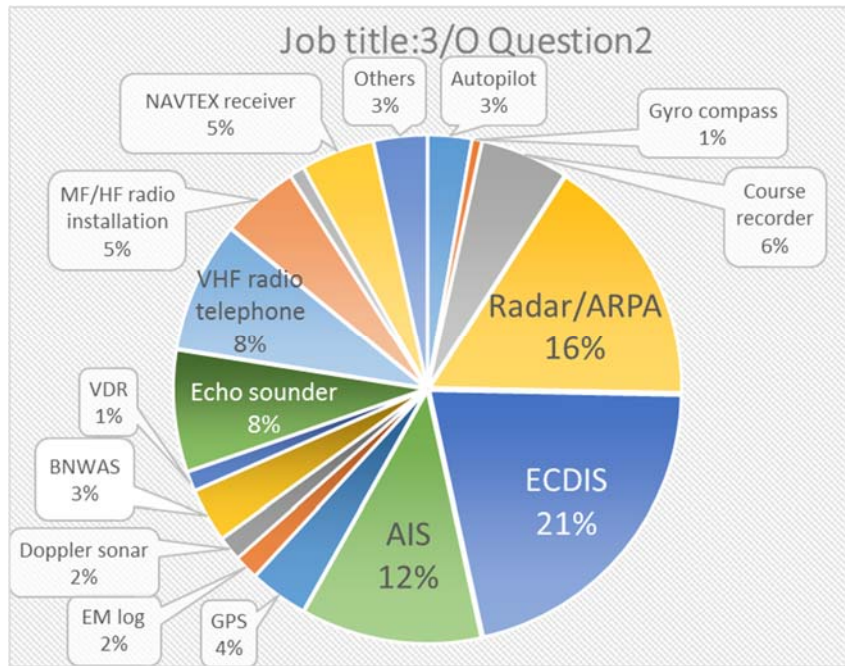


Fig.3.16 Third Officer (3/O)

✧ Distinction of each kind of ship

As per distinction of kind of ship, the opinions from masters and deck officers of passenger ships are concentrated on Radar /ARPA and AIS.

On the other hand, the improvement opinions are in almost the same ratio other than passenger ship.

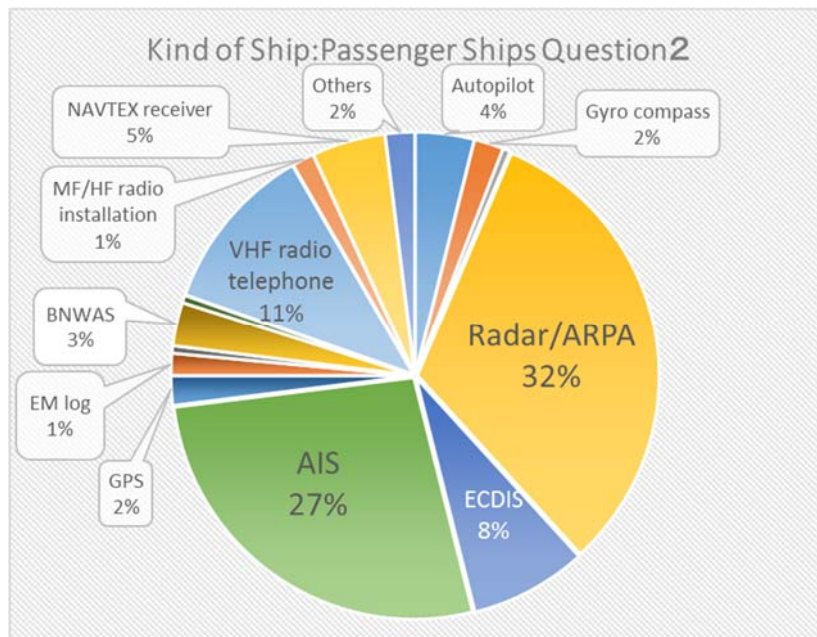


Fig.3.17 Passenger Ships

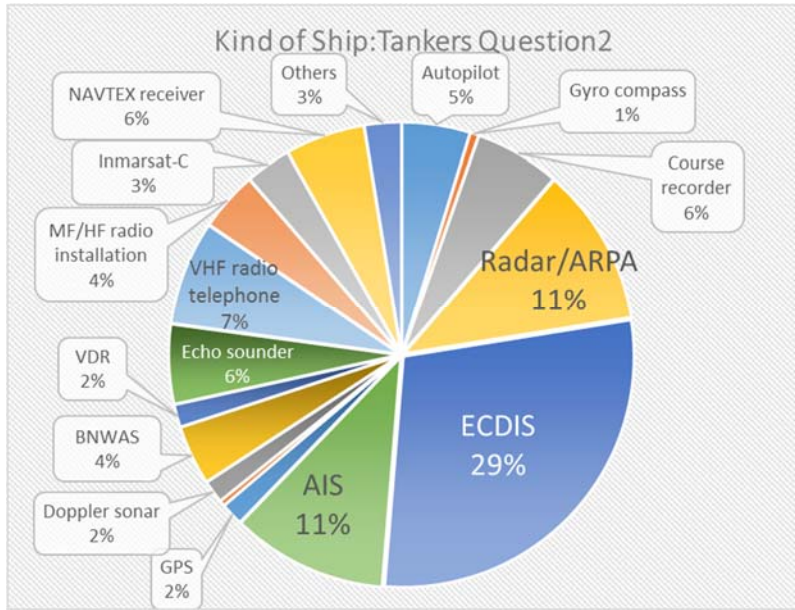


Fig.3.18 Tankers

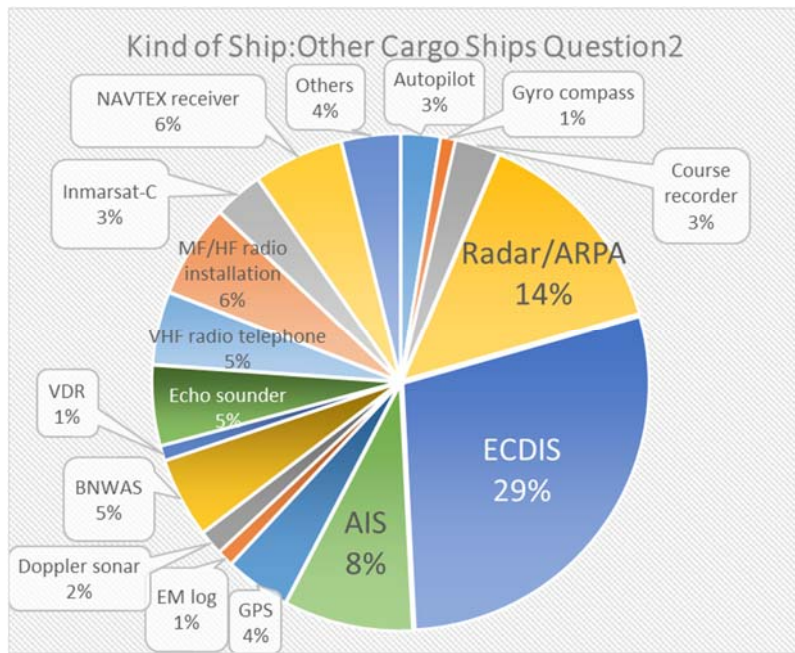


Fig.3.19 Other Cargo Ships

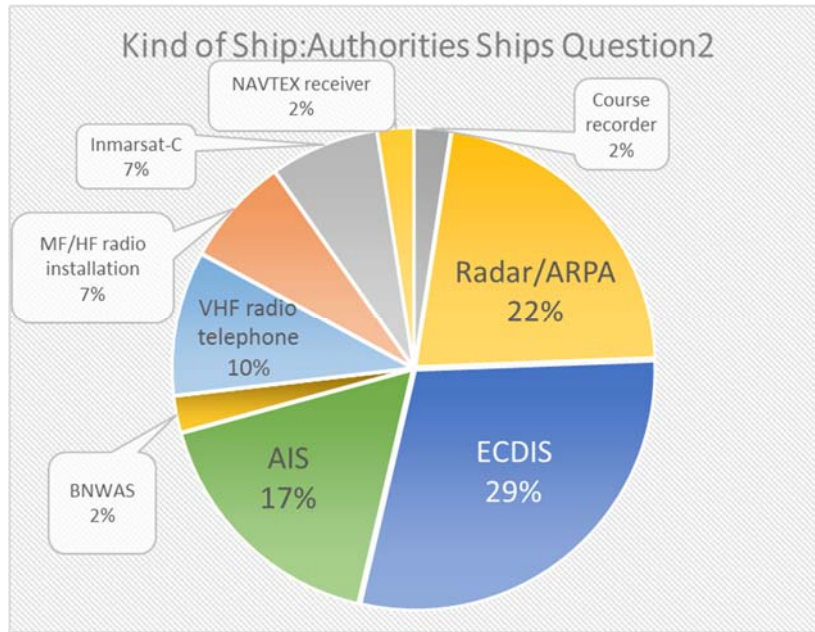


Fig.3.20 Authorities Ships

- As per question 2, the total results have been classified and analyzed by the experienced master mariner for ECDIS, Radar/ARPA, AIS, VHF radio telephone and NAVTEX, where there are particularly many improvement opinions as follows:

【Improvement Opinions to ECDIS】

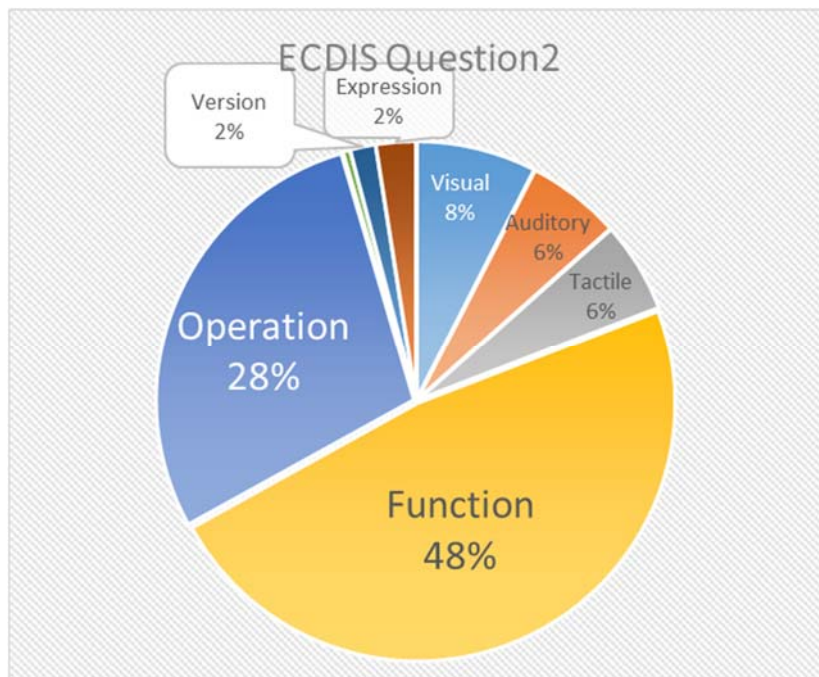


Fig.3.21 Improvement opinions to ECDIS(middle classification)

As per ECDIS, “Function” is 48% and “Operation” is 28% and both factors occupy most of the opinions.

“Function” related opinion

- Please simplify the calculation of the average speed at each waypoint.
- It is more inconvenient than a paper chart.
If there is the function that I can make freely with a curve to include no-go areas, it would be convenient.
- In making Passage Plan, paper charts would be necessary to input the latitude and longitude.
If a direction and a distance from the way point can be got by divider function, the position from main object and the distance from the shore can be set. Please provide this function.
- When symbols of the ship are distinguished by ship class or type, it would be convenient.
- When matching a cursor with the AIS symbol on the screen, AIS information such as ship's name, COG (Course over the ground) is displayed in a simplified way.
Furthermore please establish the function that a user can input, such as in an indication item like the draft and the destination etc.
- The screen is too small. It is not inconvenient to make it chart-plotter size. In addition, it is difficult to select the suitable function for use because of too many functions.
I feel particular ECDIS of Japanese maker has poor user friendliness.
- There is a way to fix ship’s position with LOP (Lines of position) in coastal navigation. On the other hand, we can use GPS to get ship’s position at any time.
I think that to have two methods to decide ship’s position in ECDIS is meaningless.
- There are sometimes malfunctions for running equipment because of little recording capacity.
It is necessary to increase recording capacity.
- If there is an exclusive (stand alone) keyboard, I can carry out passage plan making earlier.
- It would be grateful if there were ways to display 2 routes in the table of way-points and functions of copy and paste.
- The touch screen system would be useful.
- It is slow to display a menu after clicking the button.
- It’s dangerous if the setting of ECDIS is incorrect.
- Nautical chart symbols are not enough.

“Operation”

- It takes time because it is possible to use only a mouse to input data for voyage plan.
I want it to be possible with a keyboard in all makers’ ECDIS equipment.
- I want there to be improved methods to input anchorage ranges, no-go areas and anchoring self-restraint areas more easily and by all makers.
- The usage of the function of LOP is too complicated, and frequent position fixing is not possible.
- Operation is too complicated (a lot of opinions).
- I want to be able to change the screen more smoothly.

- When I perform a route setting, I want a way to carry it out simply.
- Operation procedure is different for each maker. Moreover Type-Specific Training is conducted for each model of ECDIS.
I suggest to make standard methods such as basic operation and to unify them.
- The burden on seafarer should be reduced by shortening the time for familiarization training. For this purpose, I wish to see unity of user interface, not different from each maker and each model.
- Can different operability in each maker be unified to a certain extent?
For instance, in making voyage plan, the function of setting veering on beam such as T maker-made seems to be essential.
- There are differences in operation by types. Unification is desirable. I feel insecure until getting used to the operation.
- It needs to improve transfer operation of base point position of EBL (Electronic bearing line) and VRM (variable range marker).
- Text of user chart cannot be rotated.

【Improvement opinions to Radar/ARPA】

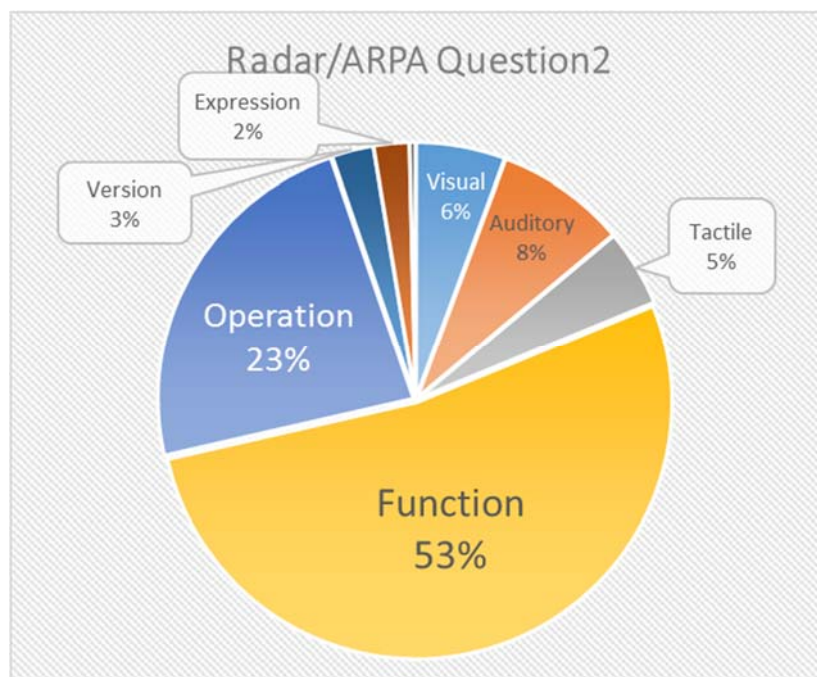


Fig.3.22 Improvement opinions to Radar/ARPA (middle classification)

As per Radar/ARPA where there were many of the improvement opinions, “Function” is 53% and “Operation” is 23% and both factors occupies most of the opinions.

“Function”

- I would like to ask makers to improve detecting capacity because yacht or fishing boat is not

sometimes reflected even if I adjust it so much.

(There are a lot of opinions about detecting capacity)

- I would like to ask “A” maker to set up display function of shoreline on a radar screen in same or similar way as “B” maker.
- I would like to ask all makers to be originally equipped with the function of switching method of mile and km.
- I would like to ask makers to increase more information of targets at same time. (There are a lot of similar opinions)
- I would like to ask makers to be able to call VHF-DSC (Digital Selective Calling) of the other ship directly from the AIS indication on the radar screen to add VHF telephone function.

It is expected that the burden on the seafarer will be considerably reduced and safe navigation will be enhanced by this function.

- I want a setting preservation function because preference of setting of every duty officer on watch is different.
- S band radar is unsuitable for use in ports and their vicinities because there are many false images.

I would like to ask makers to improve because fishing gears or a fishing boat are sometimes not reflected. (There are a lot of similar opinions about false image)

- Because there are a lot of functions and one button has more than one function as for specific new radar, sometimes I use wrong function and waste time to put it back.
I expect little simpler function because I may not achieve my purpose of use.

“Operation”

- The function is substantial, but I want makers to simplify its operation more.
- It takes a lot of time for start-up (from standby to usable state).
I would like to ask makers to arrange the setting to easily operate it because of interfacing with Radar, GPS, AIS, etc.
In addition, it may be the apparatus which they should master, but half of the crew cannot operate the method of operation.
- I hope for unification of the basic operation as operation varies according to the maker. (There are a lot of similar opinions)
- I have felt adjustment of effects of STC (Sensitivity Time Control) and FTC (First Time Constant) at the time of the stormy weather are too strong to adjust.
- The “Time to go” function of the cursor is useful but JRC radar does not have it.
- “Bow Crossing Range” and “Bow Crossing Time” are not displayed when another vessel operates equipment. On the other hand, “Bow Crossing Range” and “Bow Crossing Time” are displayed because of getting echo of target on radar when another vessel does not operate AIS.

【Improvement opinions to AIS】

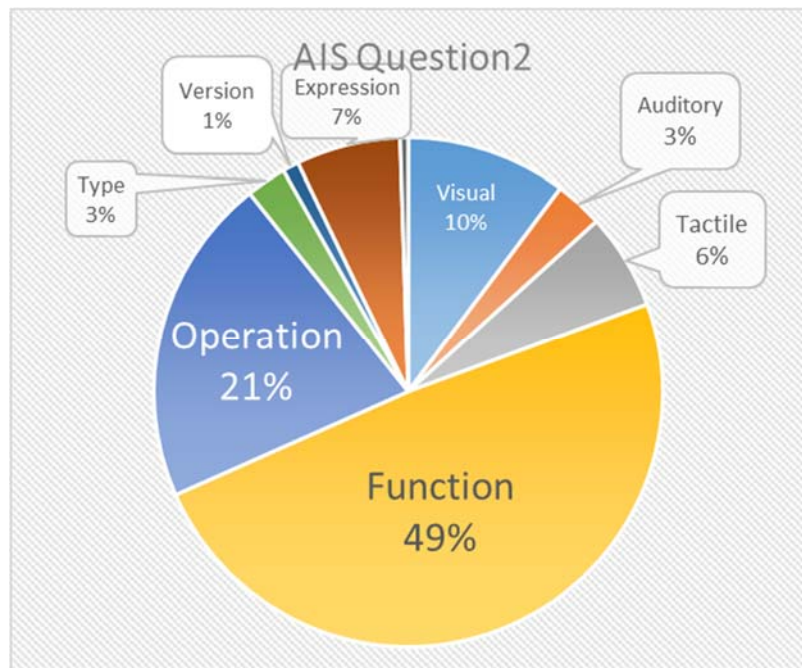


Fig.3.23 Improvement opinions to AIS (middle classification)

As a result of having added up the middle classification about AIS where there were many of the improvement opinions, “Function” is 49% and “Operation” is 21% and both factors occupied most of the opinions.

“Function”

- Turning a dial is only way to choose a ship but this method takes time/too long until desired choice appears. You should be able to use touch panel. (It’s better to be able to use touch panel.)
- It was pointed out by Japan Coast Guard office when I input a wrong code of port of destination by mistake without noticing.

I would like to ask makers to set up checking function for right code.

Furthermore, because a port of destination code is incomprehensible, I would like to request makers to add a function of postscript of destination written in Alphabet (Not Japanese letters) in parentheses.

It’s dangerous to confirm a code table one by one in a chart room which cause an insufficient lookout.

- I would like to request makers to display a name of port but not a code of port.
- There are ships which are under way without setting voyage information. When it is lacking in input, I want makers to add the function that alarm for this is activated. (A lot of additional opinions of the check function)
- I would like to request makers to set up a choice indication to know the correct ETC which the target ship uses: either UTC or LMT.

- I would like to request makers to distinguish the AIS indication mark of the small craft separately from a large ship.
- AIS information is sometimes not displayed whether a receiver is bad or a transmitter is bad.
- There is too little information in the AIS of class B that fishing boats set up.
I want makers to display at least HDG (Heading).
- A keyboard is necessary for simple input

“Operation”

- It is hard to find out a port code of the port of application and takes time to check it. It is hard to input.
- I would like to request makers to more simplify the reply to a report.
- It takes time to find out a ship I am looking for. I would like to request makers to make the response of the cursor better.
- Because there are not displayed the metropolis and districts of the domestic destination, it is hard to find out where it is.
- The ellipsis indication of the destination is incomprehensible.
The booklet to check separately is written in many places and not in alphabetical order, and it is incomprehensible, and time consuming. (There are a lot of similar opinions)
- I cannot operate it intuitively. Because user interface does not have a sense, I expect improvement.
- I want it to be possible for the change of setting of the voyage state in ECDIS at the anterior surface in the bridge.
- It's difficult to make messages on AIS because there is not keypad.

【Improvement opinions to VHF radio telephone】

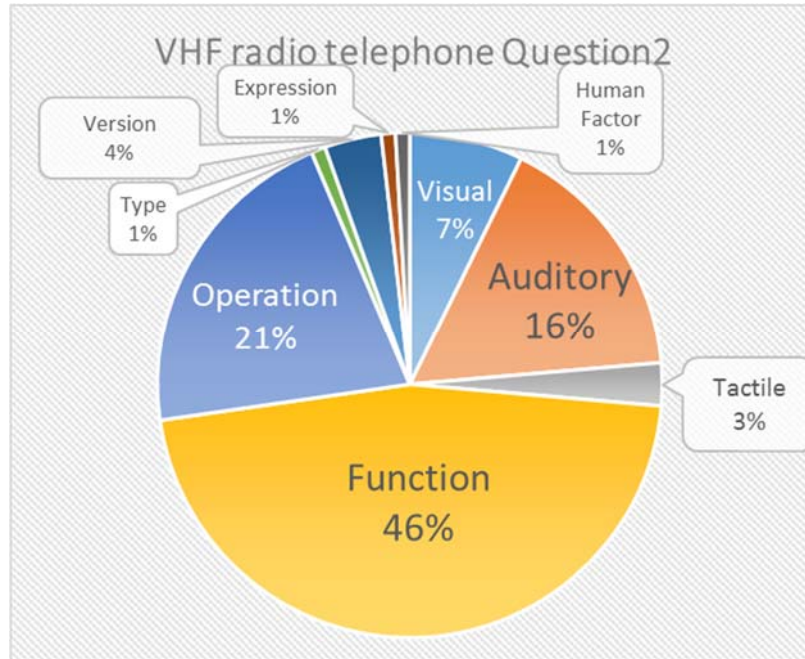


Fig.3.24 Improvement opinions to VHF radio telephone (middle classification)

As a result of having added up the middle classification about VHF radio telephone in which there were many improvement opinions, “Function” is 46%, “Operation” is 21% and “Auditory” is 16%.

“Function”

- In the case of no operation of VHF during a few minutes, I would like to request makers to install the function to return VHF channel to Ch.16 automatically. (A lot of same opinions)
- I would like to request makers to install an alarm system to VHF in case of being forgotten to return to Ch.16. (A lot of same opinions)
- Measures for the abuse of Ch.16 (A lot of same opinions)
- In conjunction with AIS and ECDIS by using DSC (Digital Selective Calling), I would like to request makers to communicate directly only to an opposing ship.
- I would like to request makers to understand the state of volume level by eye.
- I would like to request makers to set up system which can confirm an available channel beforehand so that a channel to use between ships does not get interference.
- I would like to request makers to do something because there are many false reports.
- I was not able to receive the calling in the state that a receiver continued to be pushed all the time.
- I cannot receive a calling signal depending on weather even in the vicinity. I hope for improvement.

“Operation”

- When I receive a distress warning, the warning alarm continues sounding, and a procedure to

reset is long.

I would like to request makers to do reset operation more easily.

- I would like to request makers to implement method of the DSC (Digital Selective Calling) self test a little more easily.
- When I don't change a switch to SLAVE, after the communication, it can not adjust to the channel change of other stations.
- Because there is not a printer, there is not a daily test record.
- Makers should establish a VHF near an ECDIS or a Radar.

“Auditory”

- An alarm tone of the distress warning is too loud. It is necessary to install an adjustment function. (A lot of same opinions)
- Even if the volume setting of the speaker is the same, about volume adjustment, there is a difference in volume hearing depending on other vessels.
It's better to be installed the function that can automatically coordinate same volume without manual control. (A lot of same opinions)
- I would like to request makers to improve sound quality at the time of the reception.

【Improvement opinions to NAVTEX receiver】

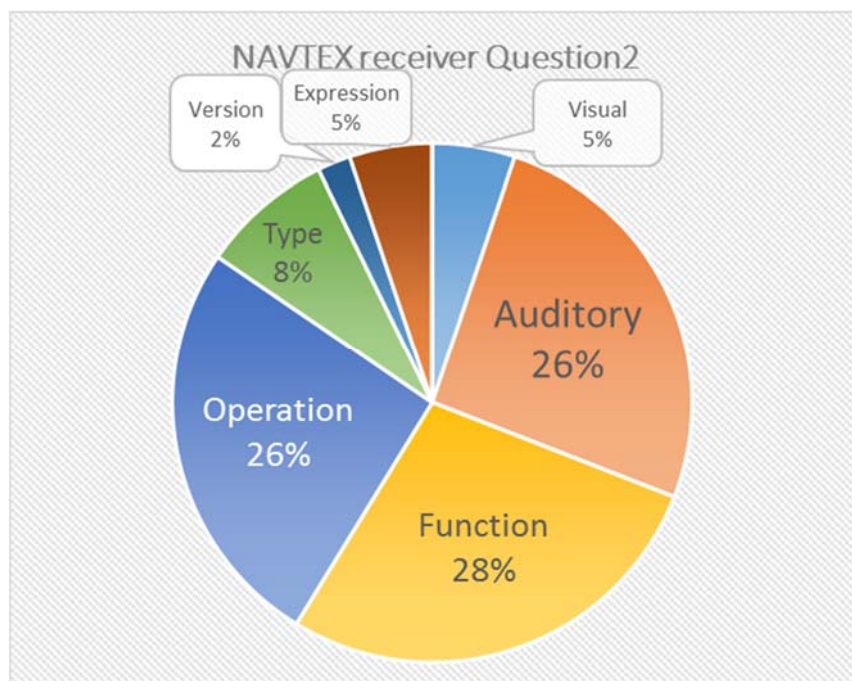


Fig.3.25 Improvement opinions to NAVTEX receiver (middle classification)

As a result of having added up the middle classification about NAVTEX receiver in which there were many of the improvement opinions, “Function” is 28%, “Auditory” is 26% and “Operation ” is 26%.

“Function”

- There is too much irrelevant information.
- I would like to request makers to install the function to confirm regular information of reception digitally and allow to print only necessary information.
- I could receive information of SINGAPORE DDV (Deep Draft Vessel) after passage of Singapore Strait eastward even if the station was selected. I thought whether it was the situation peculiar to this ship.
However I have heard many same cases in the company, it need to investigate causes for this situation.

“Auditory”

- An alarm continues sounding when I receive an emergency warning and disturbs the concentration. I want that an alarm is stopped automatically. (A lot of same opinions)
- The alarm volume is too loud.
- During the navigation, a warning alarm sounds and can not be stopped without performing some kind of operation. That is correct.
It 's too loud of alarm to keep concentration for navigation. There are dangerous situations in congestion area.
I would like to request makers to make a system to stop alarm automatically after sounding several times.

“Operation”

- It takes about 10 minutes on average to exchange the recording paper as there is a place that it is hard to let pass.
- The work of looking back brings a dangerous situation because of lack of a lookout at sea.
- I would like to request makers to make a system which can change a printer ribbon or which can adjust the density of letter.
- There are some cases of bad printed because of bad paper feeding mechanism.
- Because a printer is not installed, I cannot confirm data. (A lot of same opinions)

3.3 【Question 3】 Near-miss cases experienced and navigational equipment involved

◇ Total result of Question 3

The total result of the question 3 shows that opinions for improvement of Radar/ARPA are 20% of all, opinions for improvement of ECDIS are 15%, suggestions for improvement of MF/HF radio installation are 12%, opinions for improvement of VHF radio telephone and AIS and Autopilot are around 10% each.

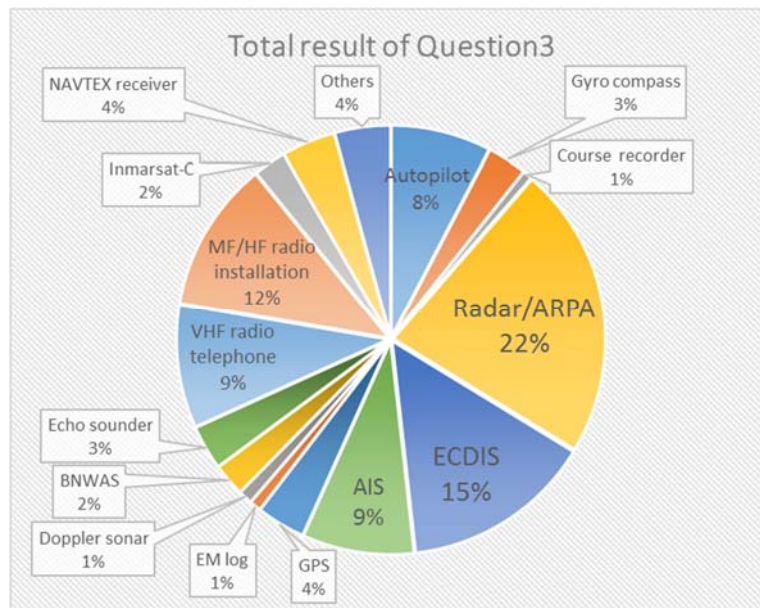


Fig.3.26 Total result of Question 3

◇ The distinction of the international voyage only; of the domestic voyage only; and of voyages that combine both the international voyage and the domestic voyage.

Opinions of ECDIS, Radar/ARPA and MF/HF radio installation occupy half of all in members of the international voyage.

Opinions of Radar/ARPA and VHF radio telephone occupy half of all in members of the domestic voyage.

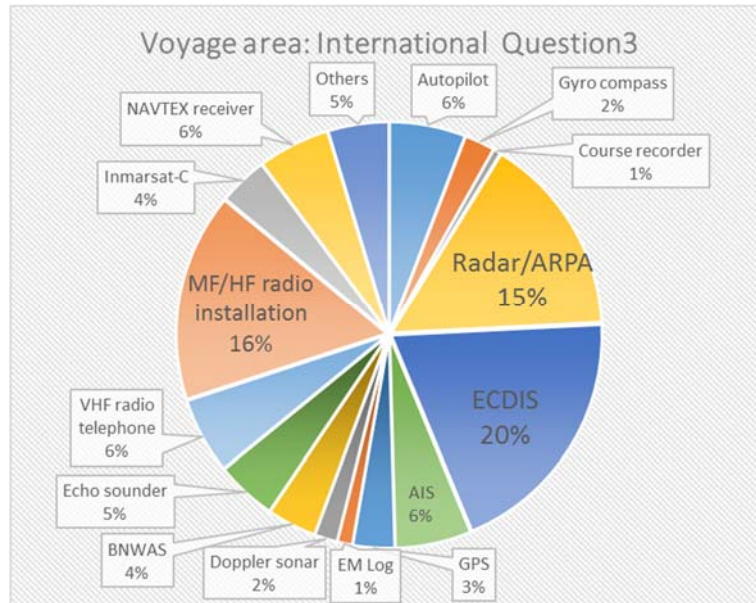


Fig.3.27 Seafarers on international voyages

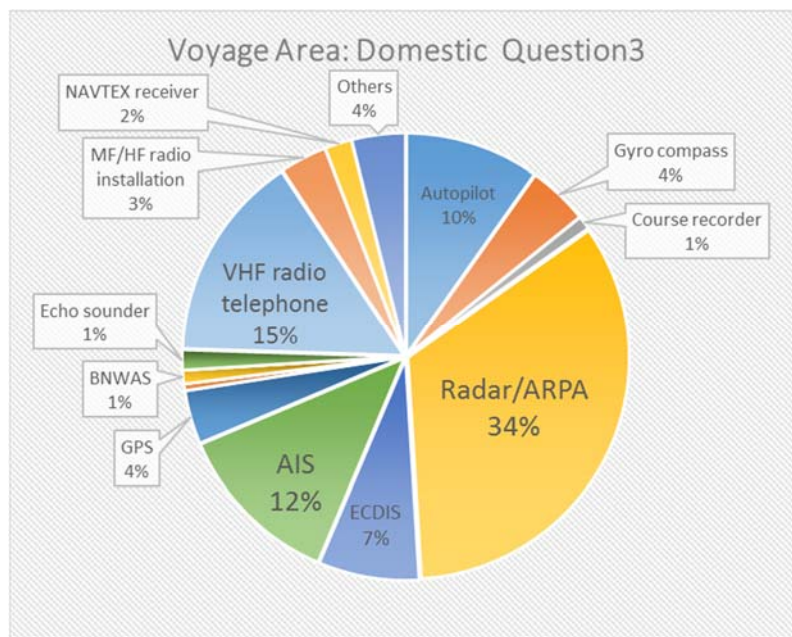


Fig.3.28 Seafarers on domestic voyages

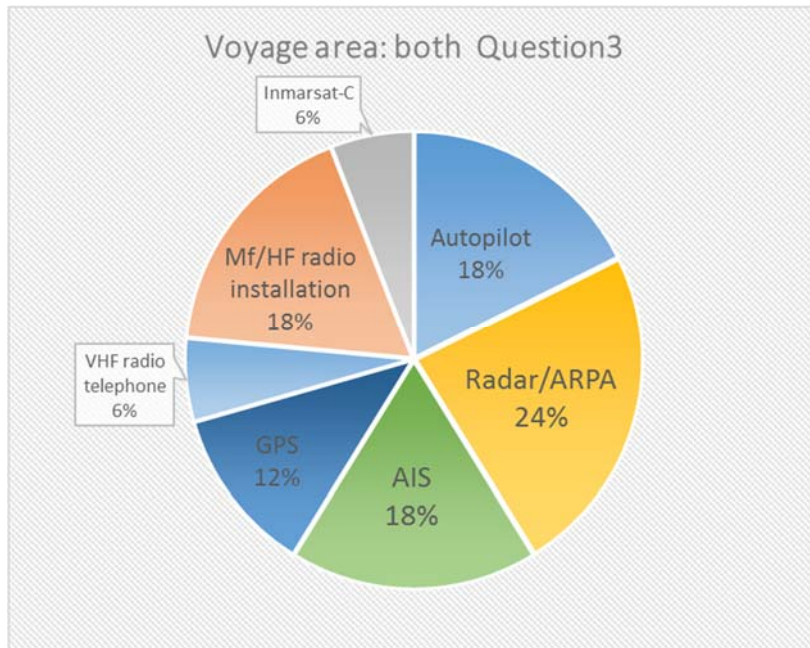


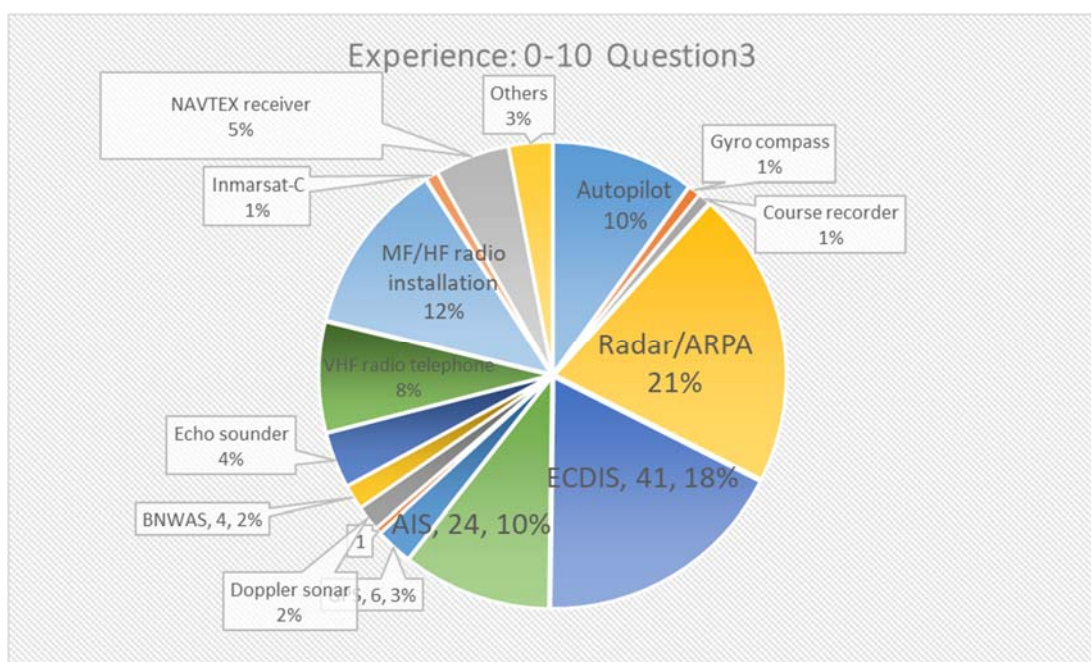
Fig.3.29 Seafarers on combined domestic and international voyages

✧ Distinction of each kind by years of onboard experience

In every distinction of years of onboard experience, the percentage of Radar/ARPA of opinions is just over 20%.

Then, the percentages of ECDIS and MF/HF radio installation and VHF wireless telephone are next.

The big difference by the years of experience was not confirmed.



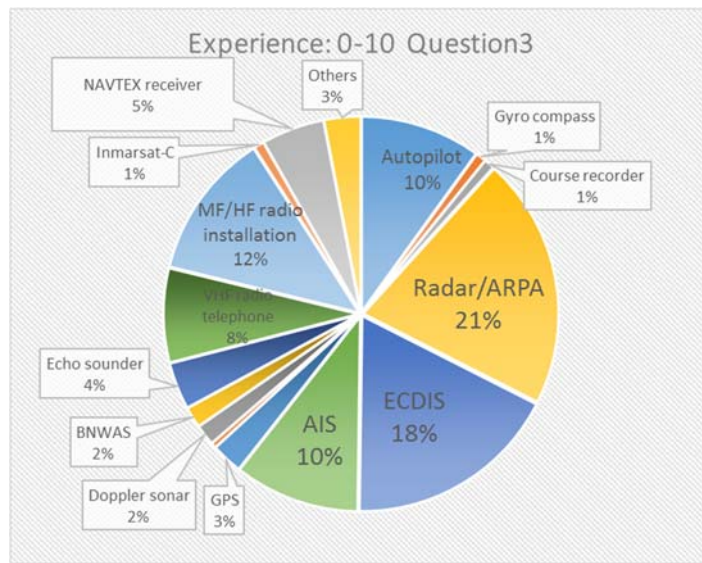


Fig.3.30 Answer of seafarers of 0-10 years experience

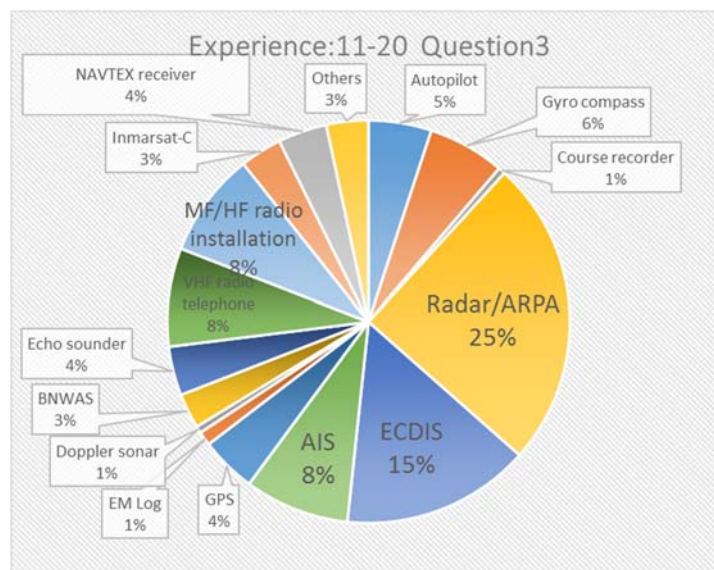


Fig.3.31 Answer of seafarers of 11-20 years experience

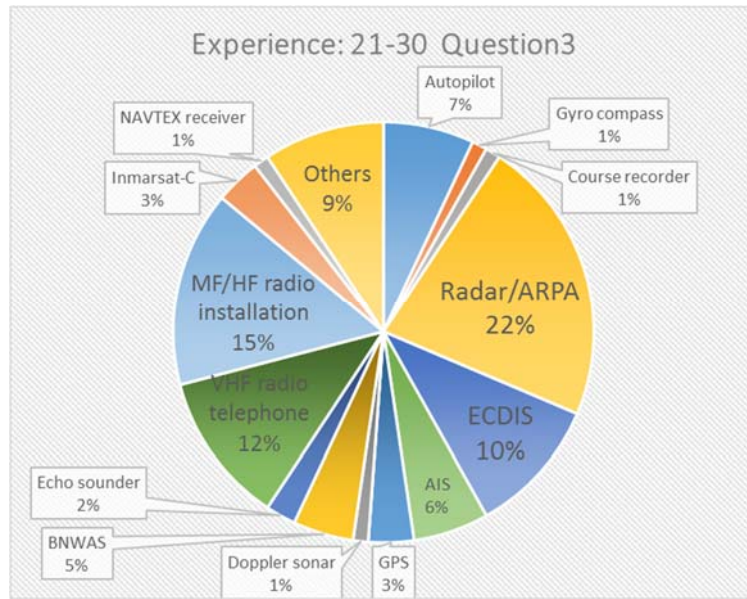


Fig.3.32 Answer of seafarers of 21-30 years experience

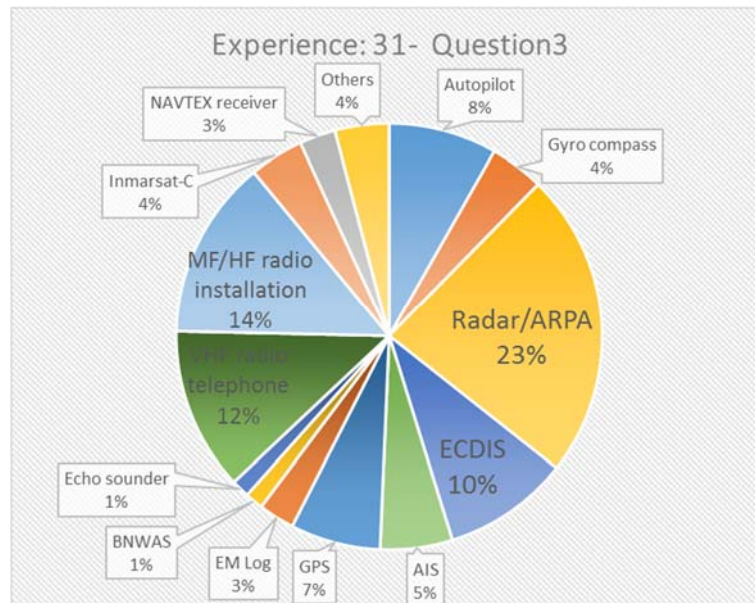


Fig.3.33 Answer of seafarers with more than 30 years experience

✧ Distinction of each current job title

More than 30% of answers of Chief Officer are about Radar/ARPA. More than 10% of answers of every current job title are about ECDIS. There are 14% of near-miss cases due to AIS in Third Officers' answers.

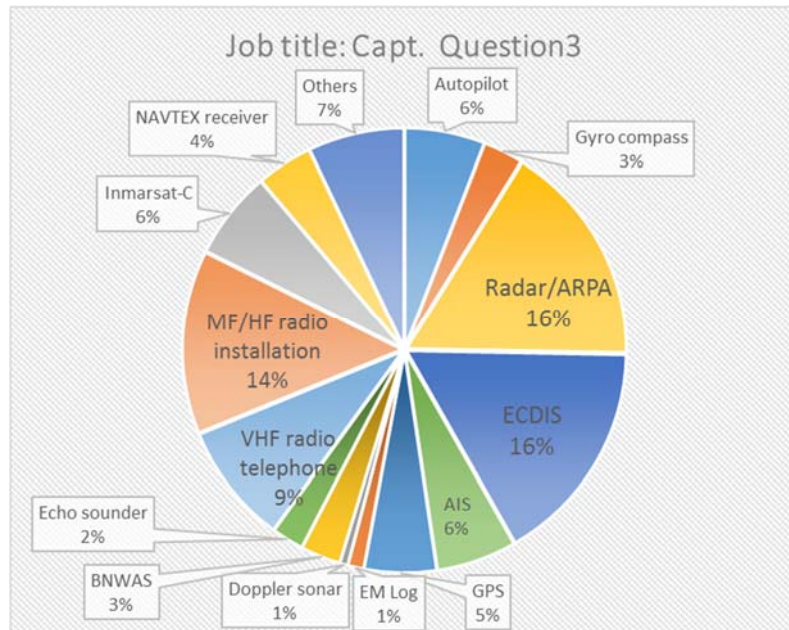


Fig.3.34 Captain (Capt.)

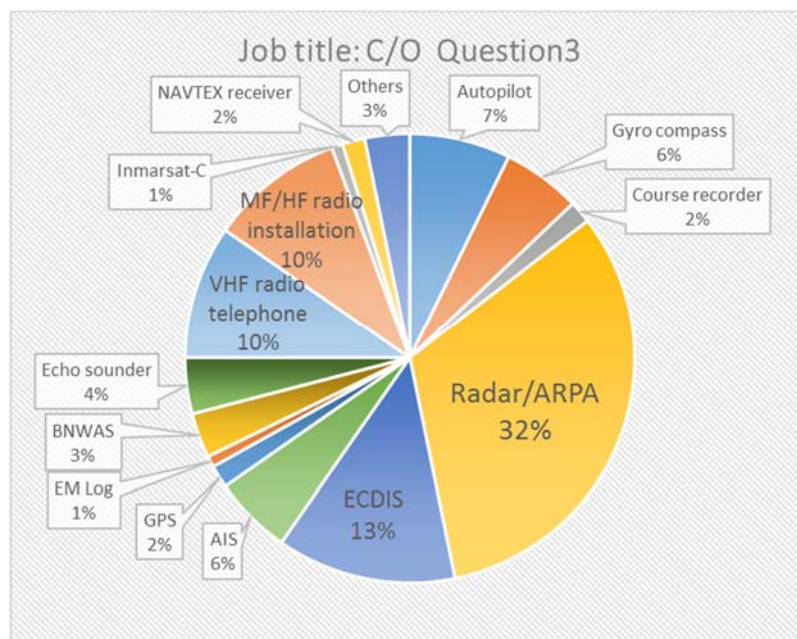


Fig.3.35 Chief Officer (C/O)

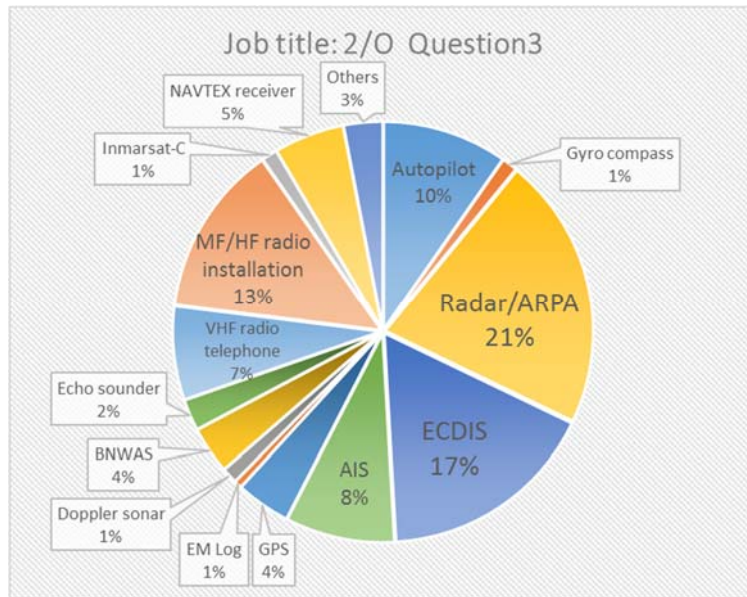


Fig.3.36 Second Officer (2/O)

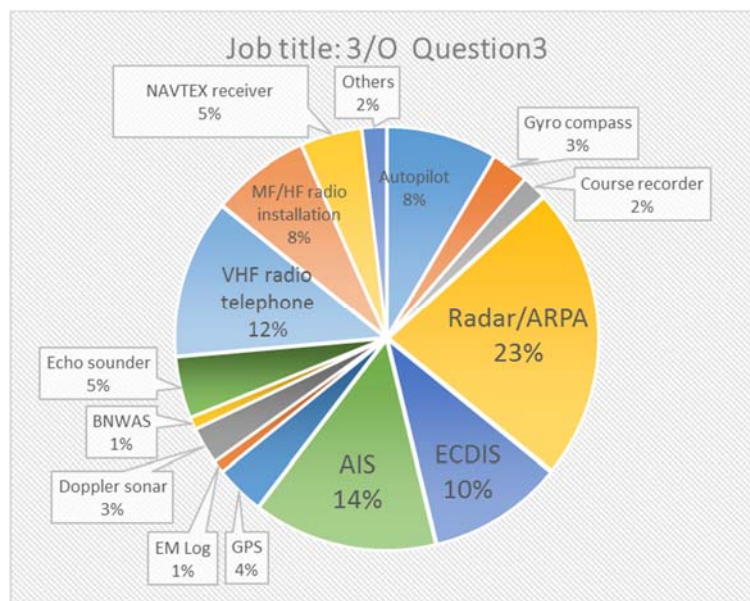


Fig.3.37 Third Officer (3/O)

✧ Distinction of each kind of certificates

It has been decided not to handle total about seafarer's certificate in this survey because there is a difference with Japanese seafarers and seafarers of different countries.

✧ Distinction of each kind of ship

The answer of Radar/ARPA is 40% in Passenger ships and is about 30% in Authorities' ships.

There are many answers of AIS in Passenger ships.

The answers of ECDIS are about 20% in Tankers and in Other cargo ships.

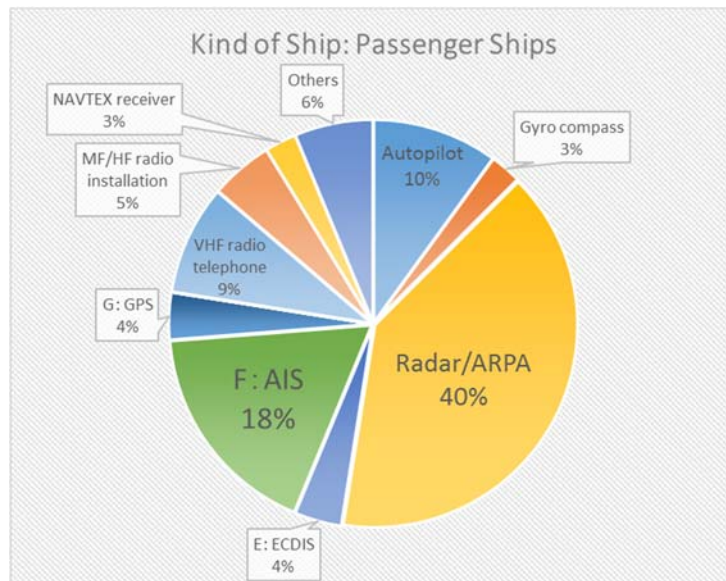


Fig.3.38 Passenger Ships

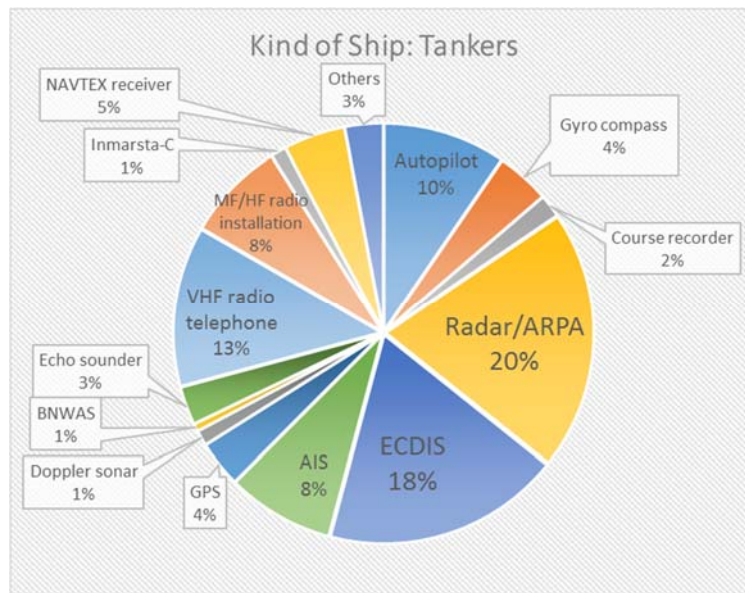


Fig.3.39 Tankers

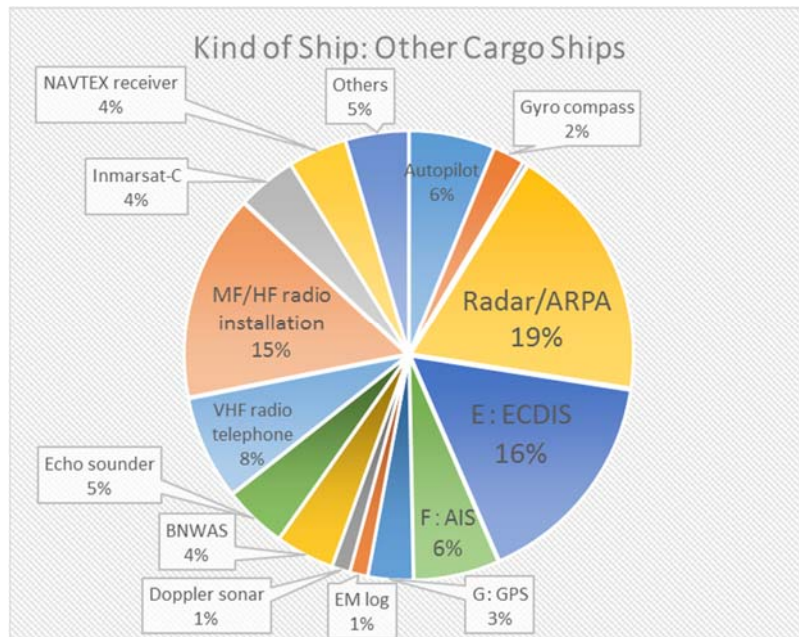


Fig.3.40 Other cargo ships



Fig.4.3.25 Authorities ships

- After adding it up by a classification, factors of near miss cases involved with Radar /ARPA, ECDIS, MF/HF radio installation, VHF wireless telephone and AIS of which were a lot of answers, are as follows.

【Opinion of near-miss cases involved with Radar/ARPA】

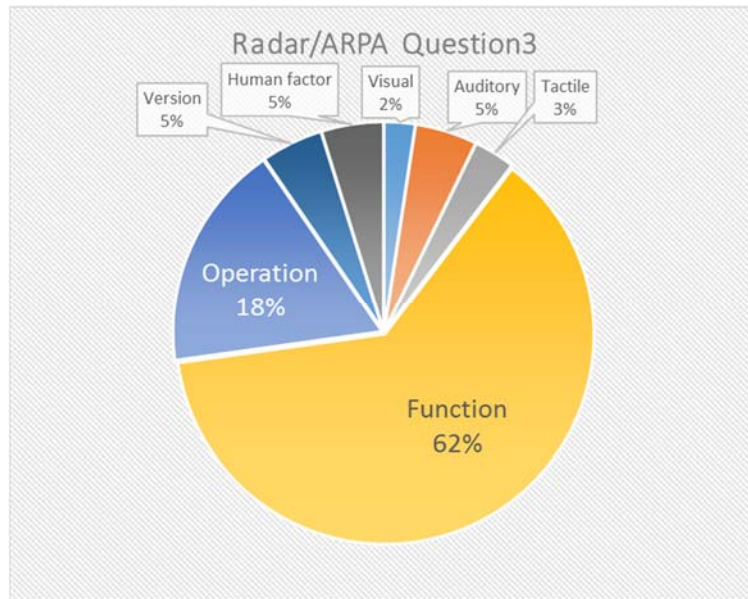


Fig.3.42 Factor of near miss case involved with Radar/ARPA (middle classification)

In factors of near miss case involved with Radar/ARPA in middle classification, “Function” is 62% and “Operation” is 18% and both factors occupied most of the opinions.

“Function”

- I was not able to get information of target immediately because the blip of the target is easy to move to other ships and buoys and I needed to catch it again.
- Early detection was late and our ship closed to a fishing boat even when the functions of Gain, STC and FTC were adjusted appropriately in rough sea and heavy rain.
- I mistook relative vector indication and true vector indication and closed to the other vessel. It was caused by the fact that vector indication was not displayed clearly.
- I felt a chill as I couldn’t catch the blip of the target and movements of the small ship by radar interference of other ship sailing in a congested sea area.
- The radar of own ship has frozen because there were many AIS ships in a congested sea area.
- It took time to check information to go to see the place where AIS is set, as AIS information is not displayed on the radar screen.
It is thought that data capacity of the radar is saturated with data.
- The vessel of same way did not change its bearing and headed for me by radar vector. It is thought that it is caused by the malfunction of the vector by bugs.
- Among two fishing boats at short distance, I was not able to detect one ship.
When ships more than three exist at 8 miles or less, a lot of false echoes occur.

“Operation”

- I couldn’t detect a vessel which is not equipped with AIS located between two vessels whose AIS marks were big.
As a result, our vessel came remarkably close to the vessel concerned.

- It took time to recover when I mistakenly displayed a mark which is not used often.
- It took time to delete the alarm of lost target while doing radar plotting.
- I was surprised that the discovery of the fishing boat was late and that was probably because I let STC, FTC work too much in heavy rain.
- I had mistaken to push button of stand-by radar instead of stopping alarm.
- I couldn't change the indication of log speed and ground speed immediately.

【Opinion of near-miss cases involved with ECDIS】

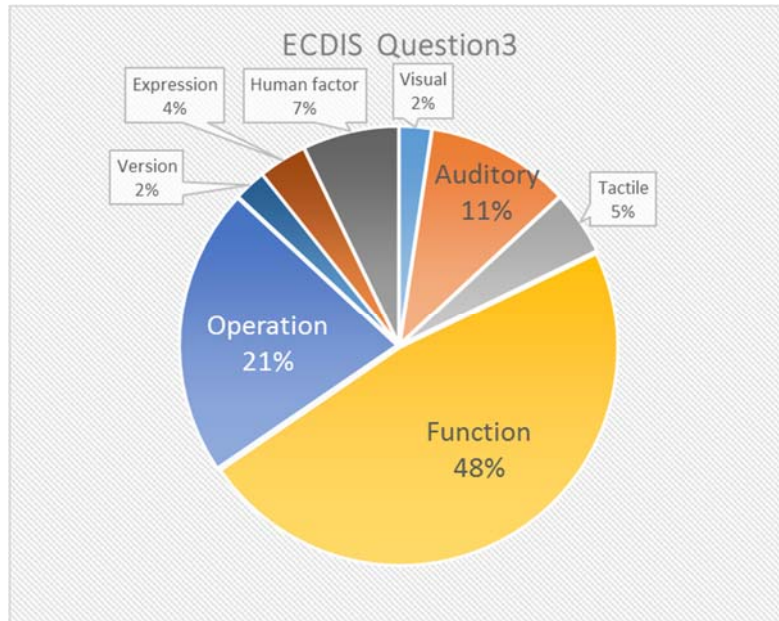


Fig.3.43 Factor of near miss case involved with ECDIS (middle classification)

In factors of near miss case involved with ECDIS of middle classification, “Function” is 48% and “Operation” is 21% and “Auditory” is 11%.

“Function”

- ECDIS suddenly froze from lack of memory.
- It took time to grasp a movement of another vessel because of low information in the congested sea area where fishing boats and vessels of the opposite way navigated. As a result, the aspect of another vessel became wrong.
- Because there was not time, our vessel went to sea after a calculation in confirming distance to next port with the Distance Table in ECDIS. However after calculating the details with a desk navigation computer, there was an error and we had to change ETA.
The distances of navigation calculated with the Distance Tables and calculated with a desk navigation computer were different because calculation methods of the rhumb-line sailing were different.
- ECDIS froze by excessive information in a congested sea area.

“Operation”

- Our vessel closed with another vessel while inputting data again because there was an omission of input in the item of the user chart.
I think that it is caused by the fact that the input of the user chart is by one item.
- In a congested sea area, AIS overflow alarm occurs.
I took time to stop the alarm.
I took procedure to narrow the capture domain but it took time to on/ off the power supply.
- There are types where the dimmer can be adjusted in the display of ECDIS.
In this system, if you set the dimmer to the darkest setting, it is difficult to put back especially for a newcomer to the vessel.
- It took me time to operate ECDIS and I felt a near miss because operation methods were different in different makers and also it was necessary to understand operation of personal computer system.
- An alarm occurred even though a safety depth contour had not been set.
- I felt a near miss by a lack of lookout because it took time to plot ship's position.

“Auditory”

- A warning sounded for loss of AIS but I confused it with an important warning, and AIS alarm was not recognized.
- In berthing work, I did not notice the alarm to approach the quay because there were many alarms of approaching tug boats.
There are a lot of kinds of alarm of ECDIS and the alarm sounds all the time in the pier docking work. These are causes of this near miss.
- I was surprised at the "MAX" alarm of AIS to capture ships during navigation in Tokyo bay.
I think that it is a cause that capture capacity decreases when I do range setting.

【Opinion of near-miss cases involved with MF/HF Radio installation】

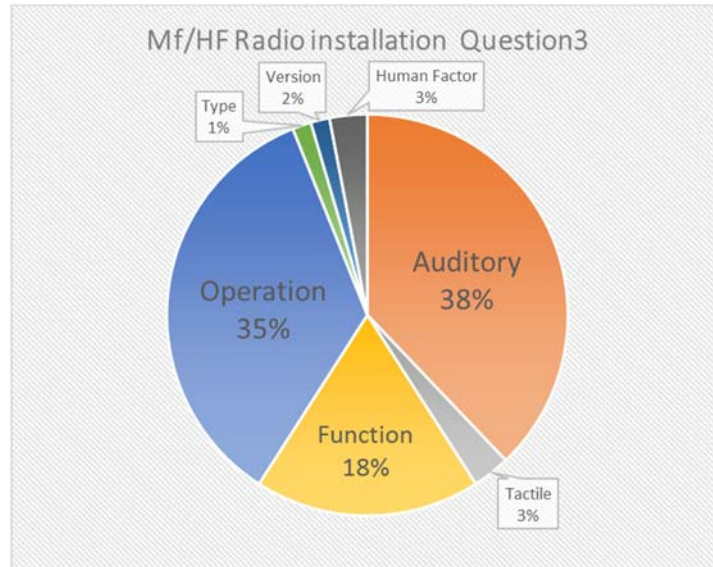


Fig.3.44 Factor of near miss case involved with MF/HF Radio installation (middle classification)

In factors of near miss case involved with MF/HF Radio installation of middle classification, “Auditory” is 38%, “Operation” is 35% and “Function” is 18% .

“Auditory”

- It took me time to do stop of the alarm, and the discovery of the fishing boat was late
- Volume of the alarm is too big, but we cannot adjust it.
- Concentration was reduced by an alarm of false information.
- I was preoccupied with alarms and was not able to report to Captain because of a lot of alarms during work of entering port.
- It took me time to deal with operation, and lookout became negligent without being able to distinguish it from other alarms.

“Operation”

- When I deleted an alarm, lookout became negligent.
- It is necessary to move to the radio room to stop an alarm.
- Because it was necessary to operate many keys for DSC call test implementation, distraction was given to the watch duty.
- I do not have time to stop alarms in the congested sea area.
- When I received Distress signal, an alarm re-sounded even though the position and sender information were "unknown".

It took me time to do with operation and our vessel closed to another vessel because lookout became negligent to distinguish alarms.

“Function”

- MF/HF Radio installation stopped immediately in the case of blackout.
- While conducting inspection of manual steering, I kept the steering wheel with zero angle (midships) and I left the steering stand when I received a false alarm of MF/HF Radio installation.
As a result, our vessel drifted from the original course.
- As there was a junction box on the compass deck, it was flooded.

【Opinion of near-miss cases involved with VHF radio telephone】

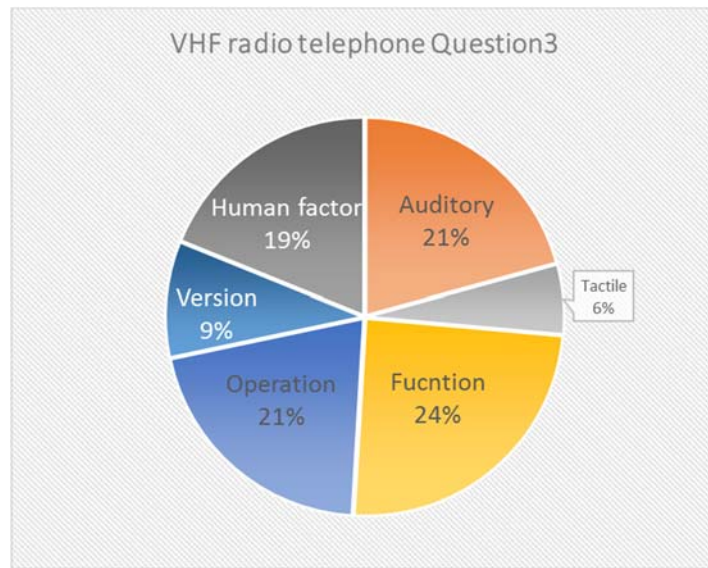


Fig.3.45 Factor of near miss case involved with VHF radio telephone (middle classification)

In factors of near miss case involved with VHF radio telephone of middle classification, “Function” is 24%, “Auditory” and “Operation” are 21% and “Human factor” is 19% .

“Function”

- While I navigated Tokyo Bay, in the case of communication with Tokyo MARTIS, communication became intermittent, and smooth information exchange became difficult. It depended on poor contact of the part of handset transmission.
- Interference of VHF is continued in the congested sea area such as Singapore strait, a dangerous situation was continued till a communication by VHF was made with an opposite course vessel.
- I almost missed a call from other ships when I squeezed the volume of the speaker because "mischievous dispatch" and "long talk" were heard on Ch.16.
I think that it is caused by the fact that there is not a function to prevent such an inappropriate use.
- I relieved the watch but was not able to reply to Ch.16. because I was not informed that the

channel of VHF was set to Ch.12.

I think that it is caused by the fact that there is not a function to return to Ch.16 automatically after a certain period of time.

“Auditory”

- I couldn't listen to Captain's order because of a loud alarm of DSC near VHF set.
- Because volume of VHF was big, I was upset.
- I cut down on the volume of the VHF radio telephone once, but forgot to put it back.

“Operation”

- It took time to put out alarm and the indication of the warning when DSC (Digital Selective Calling) operated and our vessel approached the fishing boat group.
It was caused by the fact that operation was complicated and took time.
- VHF radio telephone was facing the stern, and forward lookout became negligent.
- When passing a narrow channel, VHF radio telephone didn't react.
After a call, it is thought that the caller changed to another VHF set unconsciously.
- It took time to change channel to hear contents of speech communication of another ship.
- A setting place of VHF was far with RADAR/ARPA, and correspondence became slow in a congested sea area.

“Human factor”

- Because I forgot to return VHF channel to Ch.16, I was not able to reply to a call from another ship.
- It becomes “OFF” automatically from “OPERATION MODE” when I return a receiver to the original position at the time of use with VHF radio telephone, and it is not possible for channel change with the apparatus. I was not able to reply to a call from another ship immediately without noticing it.
- I couldn't reply to a call from another ship because I forgot to return channel to Ch.16 after checking weather and navigation warnings.

【Opinion of near-miss cases involved with AIS】

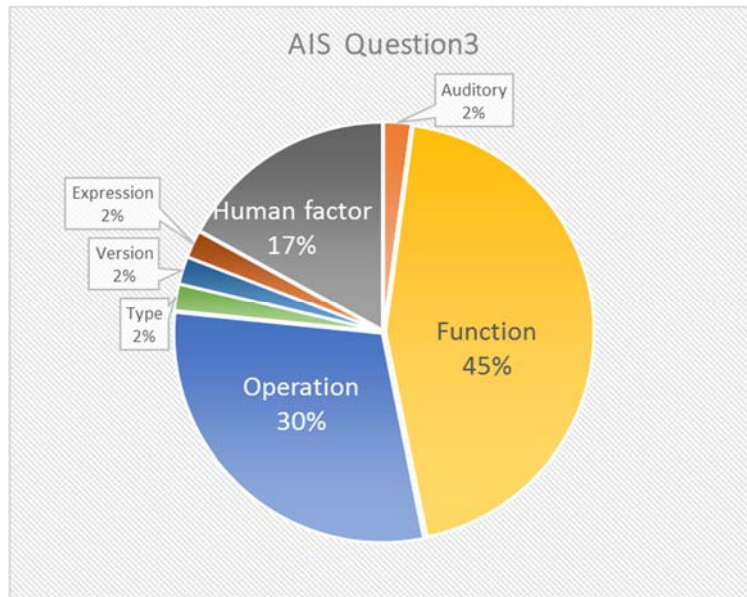


Fig.3.46 Factor of near miss case involved with AIS (middle classification)

In factors of near miss case involved with AIS of middle classification, “Function” is 45%, “Operation” is 30% and “Human factor” is 17%.

“Function”

- Our vessel approached the vessel on the same way when I changed the range of the screen to check blips.
I think that it is caused by the fact that I cannot change a range easily.
- Because an oncoming vessel did not renew data, I was troubled with wrong information.
It is thought that there is not a function to assist lapse of memory such as forgetting to renew data.
- The confirmation (destination of another ship) of the code table took time, and lookout became negligent, and our vessel came close by a high-speed pleasure boat.
- Our vessel approached another vessel because the course of the AIS information of the vessel on the same way was not being displayed and the Radar /ARPA was not able to catch the vessel because of stormy weather.
- A signal of the AIS is cut off when the signal is unstable in the Sea of Japan, and setting becomes clear, and indication becomes off.
Suddenly AIS did not display data in a congested sea area and our vessel came close to another vessel in the re-set time lag.
It was not sure whether it was the malfunction of the apparatus or malfunction of the system, but setting became clear many times.
- I was not able to identify the pilot boat which came close by, possibly because of information overload.

“Operation”

- Because a page of the destination indication was different from a page of speed, I spent time for confirmation, and it was late to notice the approach of another ship.
While I performed work to change a page several times, I think that confusion of the information happened.
- The port of destination of another ship in AIS was not input and not changed.
It was hard to understand her trend and we came close to another ship.
I think that it is caused by the fact that it takes time to input data and it is hard to judge a destination code for AIS instantly.
- It took me time to input data to AIS, and detection of another ship was late.
- When I updated information with an AIS button, a loud sound was generated and my concentration was dampened.

“Human factor”

- During the navigation, I was advised by a patrol boat because of the false input of the destination.
I think that the false input (typo: code search error) depends on a misunderstanding, an input lapse of memory.
- Because I forgot to update the information, I felt uneasiness to avoid collision with the other vessel.
- In coastal areas of China, an AIS transmitter is installed to not only the fishing boat but also the fishing net.
Innumerable, (a large quantity of) AIS marks are displayed on radar and ECDIS screen, and ship operator will do hand steering to avoid these if possible.
By this operation, an aspect to the other ship becomes worse, and the danger of the collision increases.
Especially when visibility was bad, such a problem might happen.

【Opinion of near-miss cases involved with Autopilot】

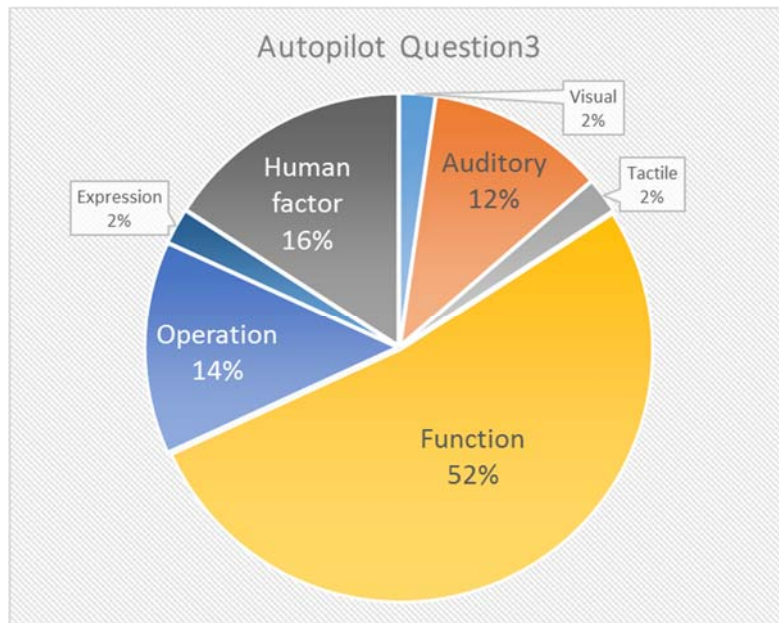


Fig.4.3.47 Factor of near miss case involved with Autopilot (middle classification)

In factors of near miss cases involved with Autopilot of middle classification, “Function” is 59%, “Operation” is 17%.

“Function”

- As the steering with autopilot was unstable, I had to make change from autopilot to manual handling in the case of the avoidance operation.
- I gave an opposing ship a question because the course stability was bad even if I used adjusting mechanism.
- The reading of the gyrocompass greatly slipped off during the navigation in stormy weather, and it became unstable, and the function of the radar was lost.
- After an avoidance operation, when I going to change from manual to automatic steering but I took the wrong operation and our vessel began to turn round at night. (I really changed it to non-follow up control).

“Operation”

- A change to non-follow up control was difficult, and operation took time and then our vessel closed on the fishing boat. I think that it was changing the steering method that was difficult to do.
- When I changed the steering system from manual steering to automatic steering, I turned off a power supply.

I have transferred three ships every three months, but, unlike other two ships, I think that the position of the lever on this ship was different.

- After the test of autopilot at night, the officer on duty forgot to instruct to the helmsman that the steering system was non-follow up control. A function to show an NFU state in the night was not set.

4. Conclusion

As for the navigation instruments which officers on duty uses, the number of instruments has been increased for the purpose of safety, security and the environmental protection that is a slogan of the IMO for innovation.

The action of the officer on duty greatly changes with the introduction of new equipment such as AIS and ECDIS in particular.

From opinions of the questionnaire survey carried out this time, the burdens on the officer on duty increased with complexity of the directions for uses and the introduction of a new instrument, and the opinion that maintenance of a safe voyage might be threatened was rather confirmed.

The navigation instrument which it is easy to use and reflected the opinion of the officer who is an end user surely lessens the near miss situations, and it goes without saying, contributes to safe navigation.

It is therefore important that new navigation equipment reflects and addresses the opinions made in this Questionnaire.

Acknowledgements

JSTRA have cooperated with Captains and Deck officers belonging to the Japanese Shipowners' Association (JSA), Japan Federation of Coastal Shipping Association, the Japan Passengerboat Association and Japan agency of Maritime Education and Training for Seafarers (JMETS) when carrying out this investigation and give to them our sincere thanks.

This research was funded by Nippon Foundation.

Annex

Questionnaire on using navigational equipment

Question 1

Please fill or select options about your background information.

- ✓ Years of onboard experience: _____ years
- ✓ Current job title: Captain, Chief Officer, 2nd Officer, 3rd Officer
(If you are on shore duty, please select the most recent job title.)
- ✓ Certification: Level _____
- ✓ Nationality: _____
- ✓ Age : _____ years old
- ✓ Kind of ship you most frequently work on:
Passenger ships, Tankers, Other cargo ships, Authorities ships

Question 2

Regarding to the navigational equipment including radio equipment you have used until now, please identify equipment, to which **improvement of operability and user-friendliness** seems to be needed, and describe situations in which improvement is needed. Please select navigational equipment you insist to describe from “List of navigational equipment code” in appendix and **fill the Code** in the following form.

In addition, if you could see year of manufacture of the equipment, please fill the year of manufacture as far as you can see.

If you wish to describe about more than five navigational equipment, please COPY AND PASTE the following forms.

(Example of description)

Navigational Equipment	(Code) J
Year of manufacture	2014
Comment for improvement of equipment: <input checked="" type="checkbox"/> During we activated the equipment on voyage, the equipment emitted beep at regular intervals and there was not “mute mode”. “Mute mode” is needed, because the beep sound is unpleasant to the ear during work on bridge.	

Navigational Equipment	(Code)
Year of manufacture	
Comment for improvement of equipment: <input checked="" type="checkbox"/>	

Navigational Equipment	(Code)
Year of manufacture	
Comment for improvement of equipment: <input checked="" type="checkbox"/>	

Navigational Equipment	(Code)
Year of manufacture	
Comment for improvement of equipment: <input checked="" type="checkbox"/>	

Question 3

Regarding to the navigational equipment including radio equipment you have used until now, if you have experienced near-miss cases during watch keeping etc., please select the relevant navigational equipment from the list in appendix and describe about the near-miss cases you have experienced.

(Example of description)

Navigational Equipment	(Code) N
Content of near-miss case and Situation at the time of occurrence: ✓ It was difficult to turn off the alarm of MF/HF which was activated due to misinformation. Because we were interrupted by turning off the alarm, we could not find fisher boat operating in front early.	
Presumed cause of the near-miss case and problem point: ✓ Although we checked according to procedure and carried out the operation for turning off the alarm, it took time because operation of the equipment was complicated and response the button was sluggish,	
Supplementary information (e.g. Type of ship, Gross tonnage, Deadweight tonnage etc.) ✓ Bulk Carrier, 30,000DWT, Delivered in 1997.	

Navigational Equipment	(Code)
Content of near-miss case and Situation at the time of occurrence: ✓	
Presumed cause of the near-miss case and problem point: ✓	
Supplementary information (e.g. Type of ship, Gross tonnage, Deadweight tonnage etc.) ✓	

Thank you for your cooperation.

(Appendix) List of navigational equipment Code

A: Autopilot	B: Gyro-compass	C: Course recorder	D: Rader/ARPA
E: ECDIS	F: AIS	G: GPS	H: EM Log
I: Doppler sonar	J: BNWAS	K: VDR	L Echo sounder
M: VHF radio telephone	N: MF/HF radio installation	O: Inmarsat-C	P: NAVTEX receiver
Q: Others (Please write name of equipment in the form)			