
User Test using Eye-tracker

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Purpose and methods

- **Purpose**
 - Finding out frequently used symbols and operations by ship bridge operators to achieve navigational tasks and functions
 - Providing useful references to develop the S-Mode guideline
- **Methods**
 - seafarers including captains and pilots
 - ship-handing simulators, eye tracking devices, interviews and online tests
- **Participating Organisations**
 - Korea Maritime and Ocean University (KMOU)
 - Korea Institute of Maritime and Fisheries Technology (KIMFT)
 - Supported by KR and MOF

Overview of the test

Test Cases

Case	Contents	Place
A	Navigational watch-keeping on a navigational vessel	Ro-Ro Passenger ship (Busan ↔ Osaka)
B	Achieving planned scenario on ship handling simulators for 20 minutes - including route monitoring, course changing and action to avoid collision	Ship Handling Simulation center (3 different makers)
C	Achieving 22 navigational tasks on ship handling simulators	

Overview of the test

Time period

19th April 2018 ~ 4th May 2018

Testees

- 33 seafarers(active deck officers and captains)

Career(yr)	persons
0~2	6
3~5	18
6~10	7
11~	3

Rank	persons
3/O	0
2/O	22
C/O	10
Captain	2

Type of Vessel	persons
Container	3
Tanker	7
Gas Carrier	9
PCTC	6
Bulk Carrier	1
ETC	8

Current route	persons
Far East Asia – Middle East Asia	13
Far East Asia – Europe	9
Far East Asia – America	6
Far East Asia – Africa	1
ETC	5

Overview of the test

Target outputs

- To identify frequently used voyage information and functions as they are navigating
- To measure the time to perform certain functions on ECDIS/RADAR
- To find out useful points to put in the S-mode guideline

Tools and simulators

- Eye tracking device – Tobii Pro
- Ship handling simulators – JRC, Kongsberg, Transas



Case A – Actual navigation test

Descriptions

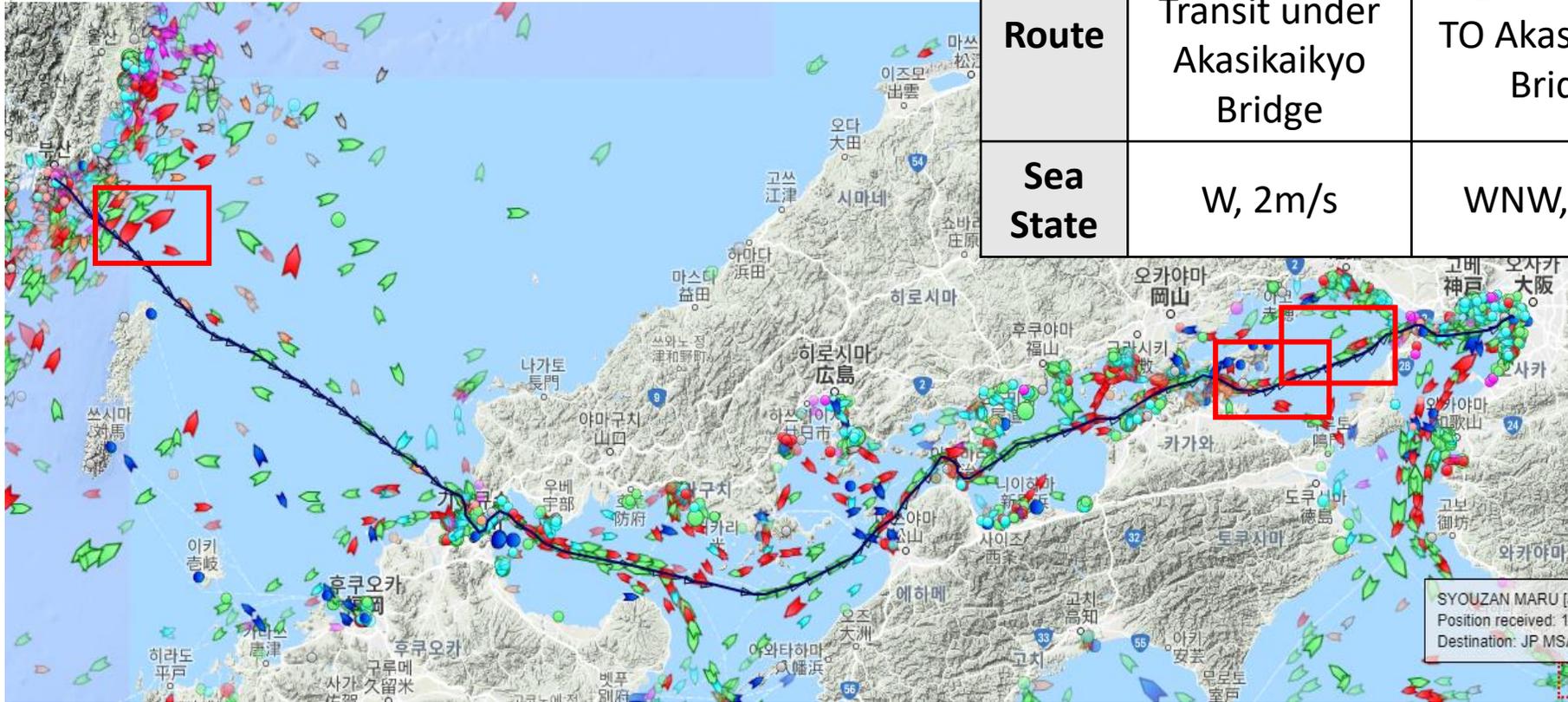
- Captain and 2 duty officers (c/o, 2/o) conducted navigational task using an eye tracking device
- Watch-keeping with Route Monitoring, Course Changing, Action to avoid collision etc.



Case A – Actual navigation test

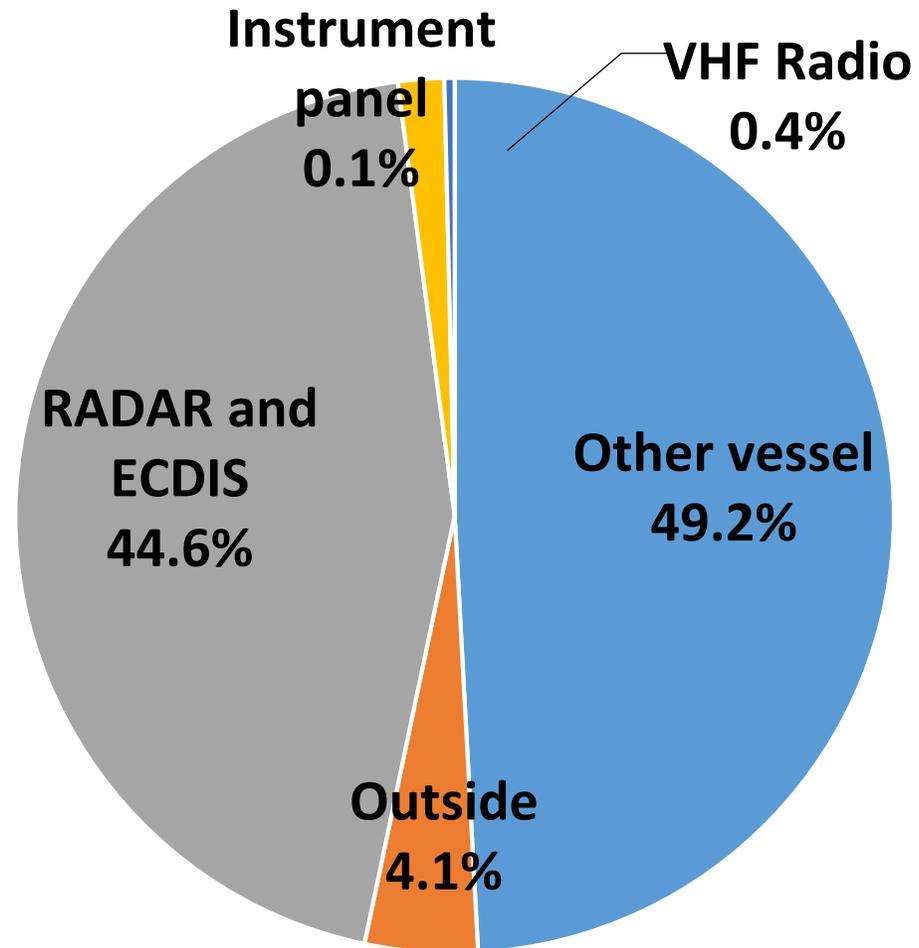
Routes and tasks

	Captain	C/O	2/O
Time	20 th , Apr 18:00~18:20	20 th , Apr 08:00~09:30	19 th , Apr 17:00~17:50
Route	West bound Transit under Akasikaikyo Bridge	East bound TO Akasikaikyo Bridge	East bound Busan to Kanmon
Sea State	W, 2m/s	WNW, 1m/s	WSW, 7m/s



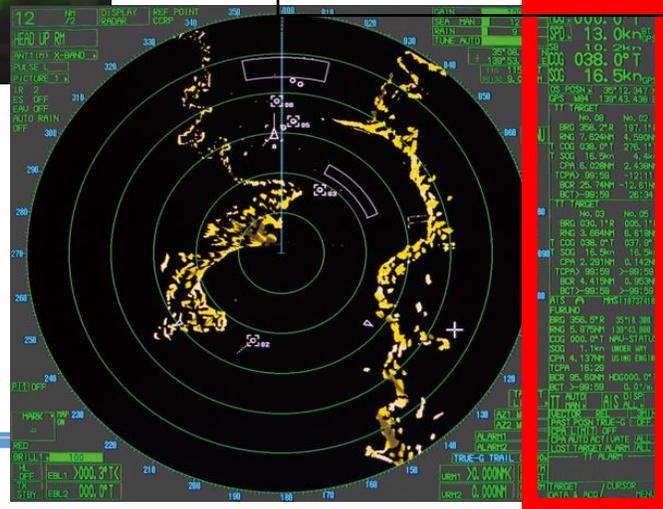
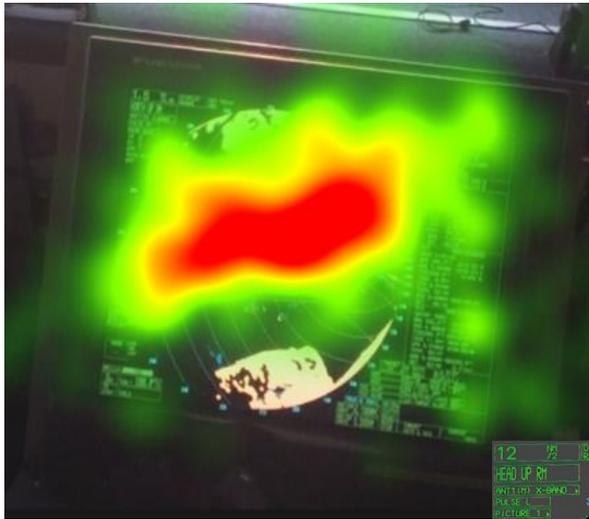
Case A – Actual navigation test

Areas of Interest(AOI)
over the bridge



Case A – Actual navigation test

Heat map analysis



Ownship	Other ship ARPA	Other ship AIS	EBL
HDG SPD COG SOG	Target No. COG SOG CPA TCPA	Ship name Coordinate	Value of EBL

Case B – Simulator test with a scenario

Descriptions

- Ship handling simulator test with eye tracker for 20 minutes to perform a scenario composed of route monitoring, course changing and actions to avoid collision
- Short type specific training was provided if needed



Type specific training

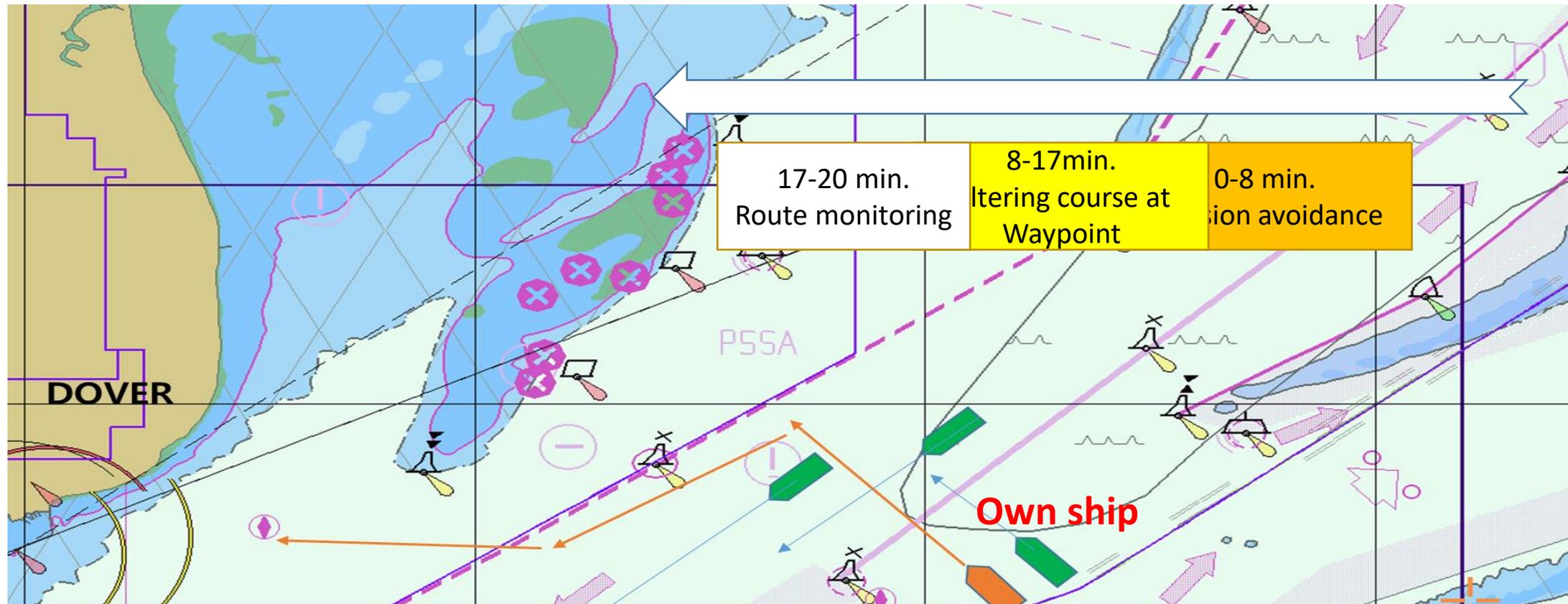


Action to avoid collision



Changing Course

Case B – Simulator test with a scenario



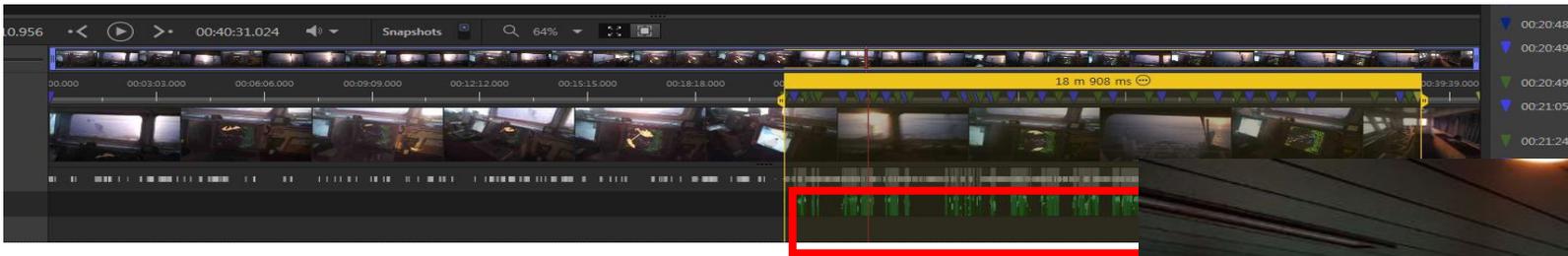
Sailing to Dover Strait; participants performs

- Collision avoidance with another vessel approaching the starboard of the ownship
- Turnaround from 320 degrees to 245 degrees in order to enter Dover Port
- General route monitoring

Case B – Simulator test with a scenario

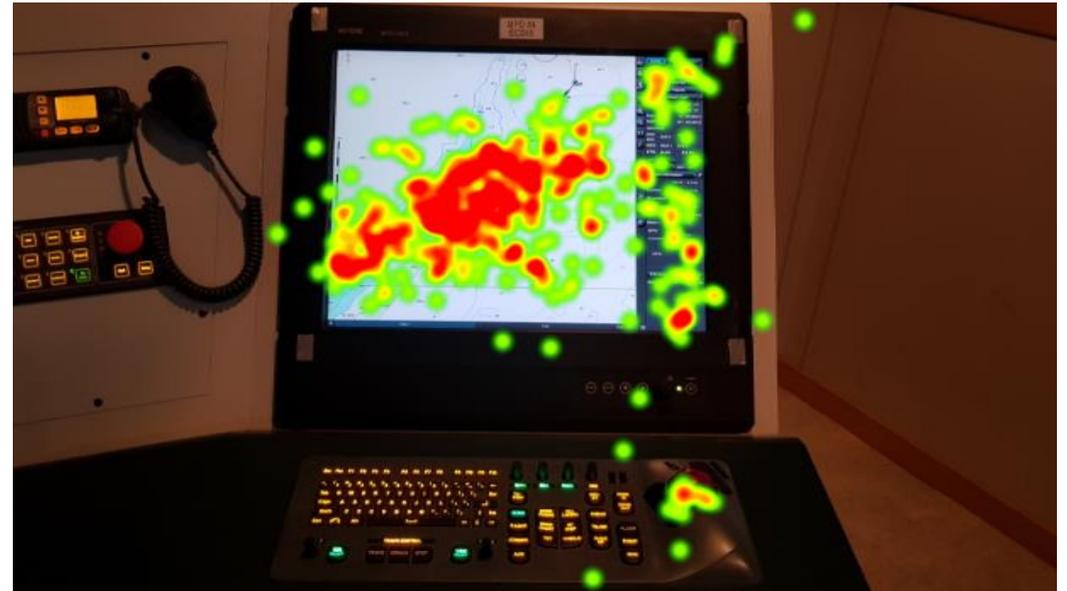
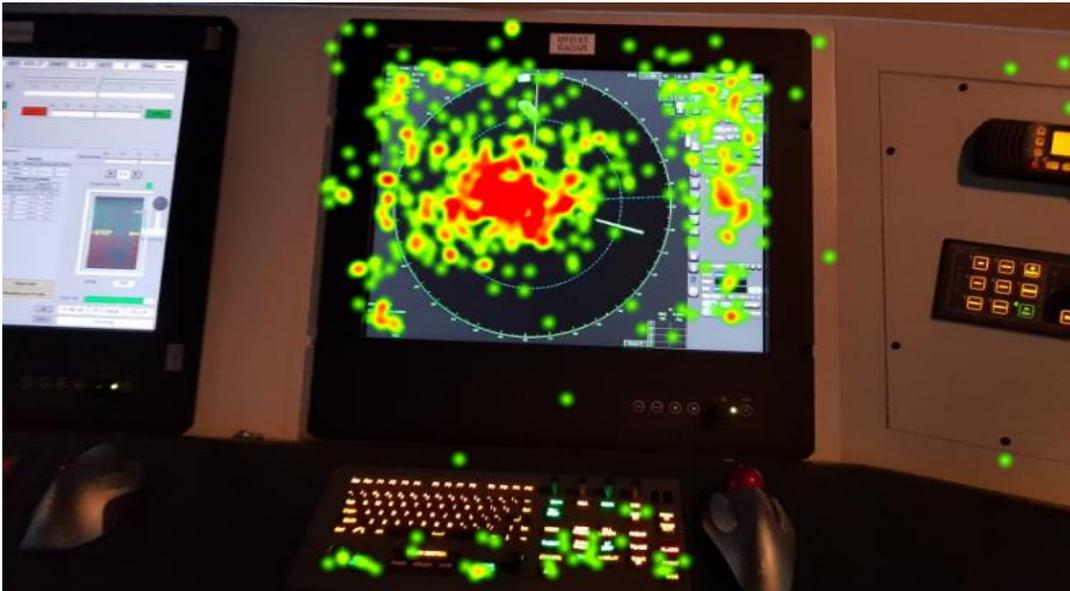
Procedure of analysis

1. Preparing a panorama shot
2. Analyzing the videos
3. Creating heat maps
4. Identifying AOI



Case B – Simulator test with a scenario

Heat map analysis on radar and ECDIS

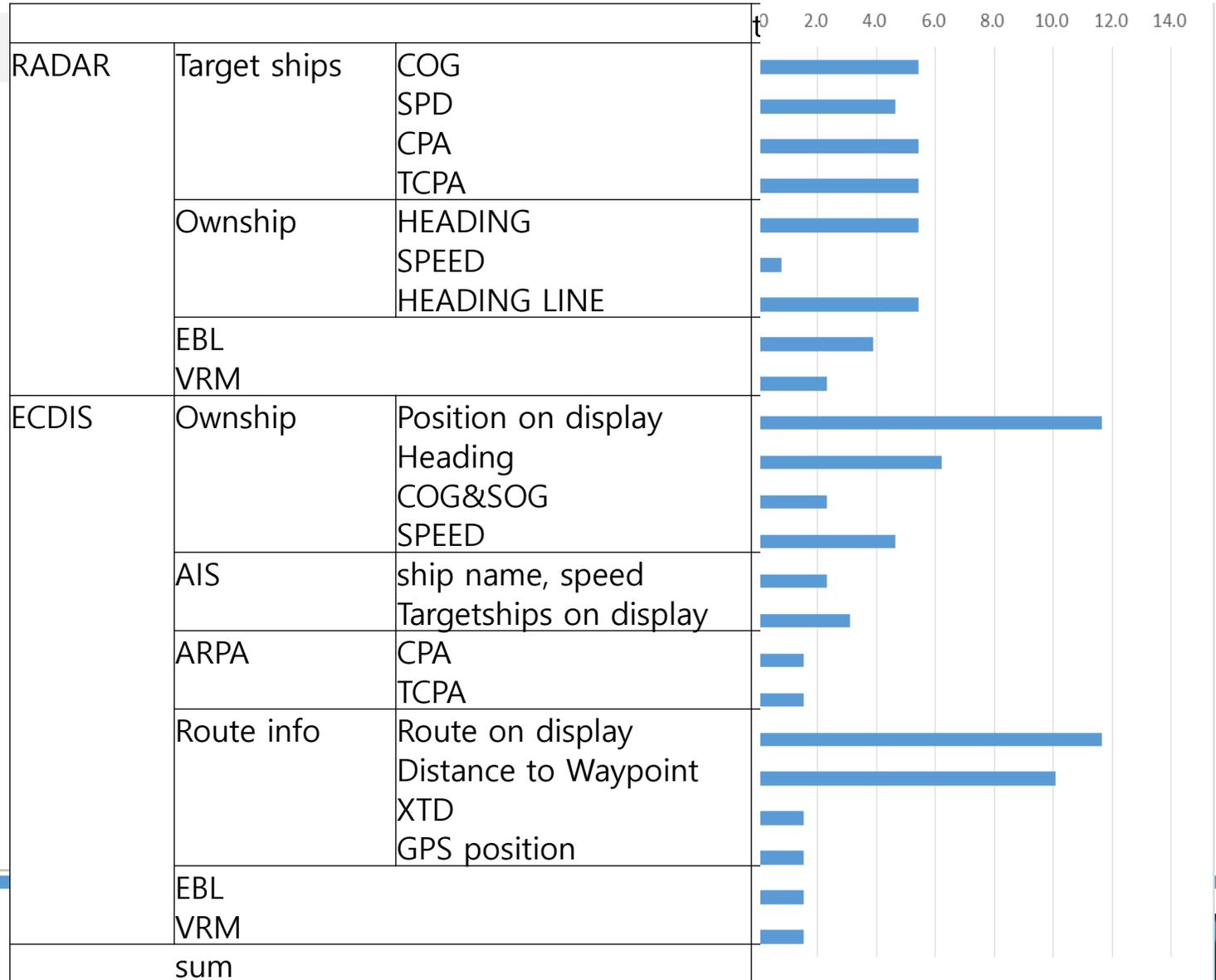


Test objectives:

- Identifying radar/ECDIS functions and information on interests

Case B – Simulator test with a scenario

Information on interests



Case B – Simulator test with a scenario

Functions on interests

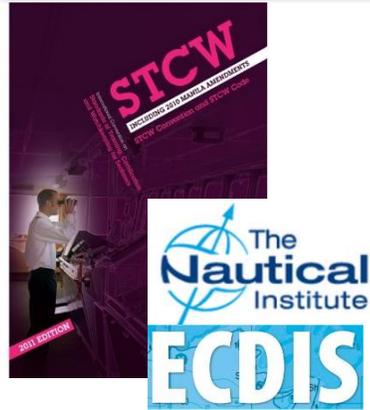
Equipment	Function	FORM	QUALITY	TOTAL	DATE
ECDIS	AIS, RADAR OVERLAY	■			
	VRM	■	■		
	EBL	■	■	■	
	ZOOMIN, ZOOM OUT	■	■	■	■
	OTHER VESSEL INFORMATION	■	■		
RADAR	EBL	■	■		
	VRM	■			
	ALARM OFF	■	■		
	TARGET DEL	■	■		
	TARGET ACQ	■	■	■	
	OFF CENTER	■	■	■	
	ZOOMIN, ZOOM OUT	■	■		
	TARGET DATA	■	■		

Case C – Testing 22 tasks

Descriptions

- 25 deck officers and 1 captain conducting 22 navigational tasks on ship handling simulator
- Essential tasks from STCW, Bridge Procedure Guide(ICS) and NI's familiarization checklist
- eye-tracking and time measuring to achieve tasks

International standards/
recommendations



Group A
Voyage Planning

Group B
Route Monitoring

Group C
Collision avoidance

22 functions

13 for ECDIS

9 for RADAR



Measuring time to
achieve tasks

Case C – Testing 22 tasks

Situation	Task	Situation	Task
Voyage Planning	Import the existing route	Route Monitoring	Use the function of LOP
	Modify the existing route		Change the RADAR North/Up to Course/Up
	Change the Cross Track Limit		Overlay the RADAR screen on ECDIS display
	Select and change to alternate route		Modify the time label of ship`s position
	Change the safety contour		Overlay the ARPA information on ECDIS display
Route Monitoring	Call the planned route for monitoring	Action to avoid collision	Check the other ship`s CPA from ARPA
	Check the true course on original route		Set the CPA alarm on RADAR
	Check the distance to next waypoint		Set the Guard zone on RADAR
	Check the ETA		Set the alarm for special area
	Check the distance and bearing to forward RACON using ECDIS		Change the true vectors of ARPA to relative vectors
	Check the distance and bearing to forward RACON using RADAR		Use the trial maneuvering function on RADAR to change the course

Case C – Testing 22 tasks

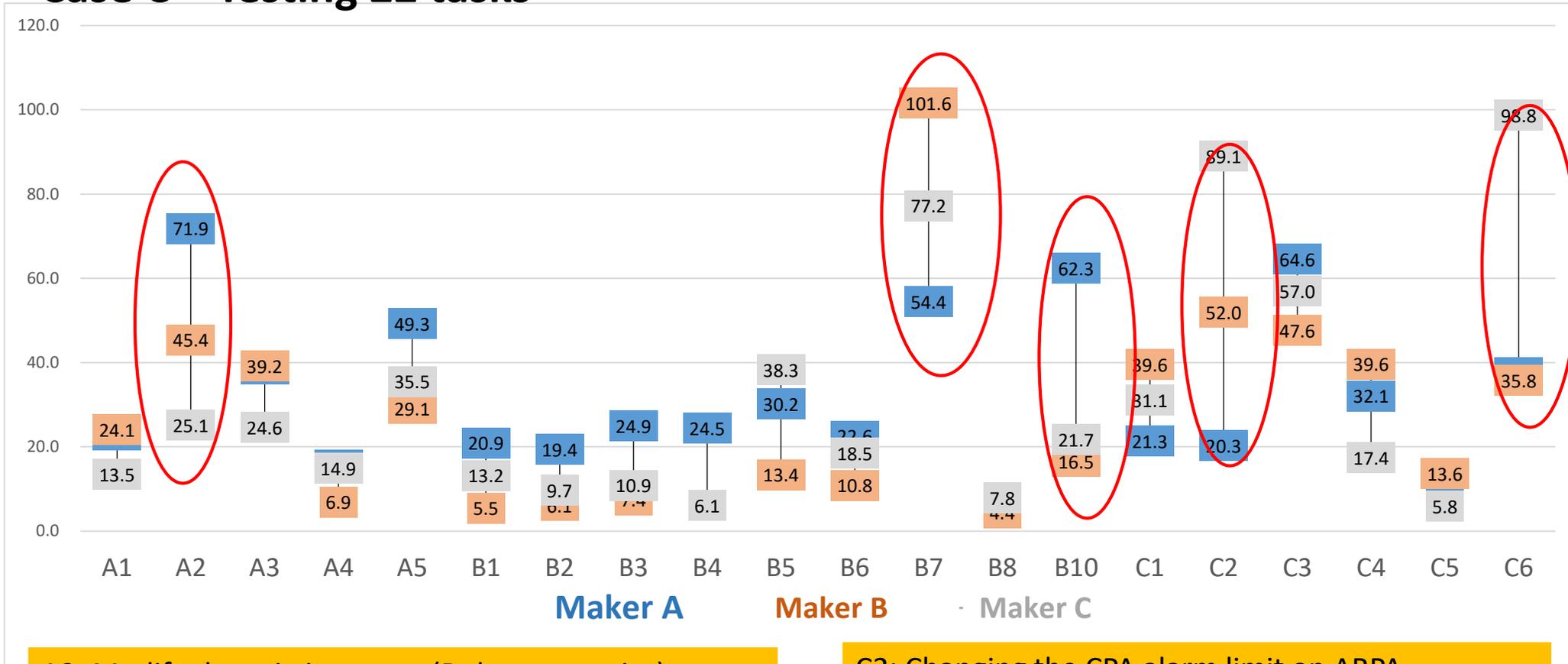
Testing scene



- Instructors giving tasks
- Testees performing the tasks and answering verbally if needed
- Instructors checking the time consumption



Case C – Testing 22 tasks



A2: Modify the existing route (Delete waypoint)

C2: Changing the CPA alarm limit on ARPA

B7: Fix ship's position using the LOP (line of position)

C6: Use the trial maneuvering function on RADAR

B10: Modify the time label of ship's position

Case C – Testing 22 tasks

Navigational tasks	Maker	Time required to completed the function (Second)	Number of operations for function use (Number of clicks, etc.)	Icons on Appendix I	single/ simple operation Appendix 3
Situation A. Voyage planning					
A1. Import the existing route(Dover)	Maker A	13.5	4	 ROUTE	None
	Maker B	22.8	4		
	Maker C	24.1	4		
A2. Modify the existing route	Maker A	25.1	5	 PLAN	None
	Maker B	71.9	2		
	Maker C	45.4	3		
A3. Change the Cross Track Distance	Maker A	24.6	6	 PLAN	None
	Maker B	38.5	2		
	Maker C	39.2	5		
A4. Select and change to alternate route	Maker A	14.9	6	 ROUTE	None
	Maker B	15.7	3		
	Maker C	6.9	4		
A5. Change the safety contour to 13 meters	Maker A	35.5	4	None	None
	Maker B	49.3	4		
	Maker C	29.1	6		

SUB-COMMITTEE ON NAVIGATION,
COMMUNICATIONS AND SEARCH AND
RESCUE
6th session
Agenda item 7

NCSR 6/INF.13
13 November 2018
ENGLISH ONLY

GUIDELINES ON STANDARDIZED MODES OF OPERATION, S-MODE

Practical user interface test methods for standardization and
improvement of navigation equipment

Submitted by the Republic of Korea

SUMMARY

Executive summary: Usability tests can be performed to improve existing equipment or develop new equipment while the Guidelines for the standardization of user interface design for navigation equipment are being applied. This document proposes a few practical usability test methods for standardization and improvement of navigation equipment which have been trialed in the Republic of Korea. This document also introduces several test methods and considerations which are complementary to the application of the Guidelines for the standardization of user interface design for navigation equipment.

*Strategic direction, if 2
applicable:*

Output: 2.12

Action to be taken: Paragraph 32

Related documents: MSC.1/Circ.1512; NCSR 5/7 and NCSR 6/7

Conclusions

User tests using eye tracking

- User tests were carried out on a navigating ship and bridge simulators using eye tracking device.
 - AOI on OOW
 - Radar/ECDIS functions and information on interests
 - Time consumption check for 22 navigational tasks

Suggestions for Further works

- Testing on different conditions such as cultures, ages, non-SOLAS with leisure boats, makers and brands
- Testing on VTS and shore control centre for autonomous/automated navigation
- ➔ Outcome: AOI and baselines for tasks and functions with which:
 - Manufacturers can refer to develop products (S-mode relevant equipment)
 - Users can reduce the time to get familiar to new equipment
 - Evaluators can take into account for procedures of usability evaluation and Quality-in-Use(QIU)