

Usability Evaluation of e-Navigation MSP 2(NAS)

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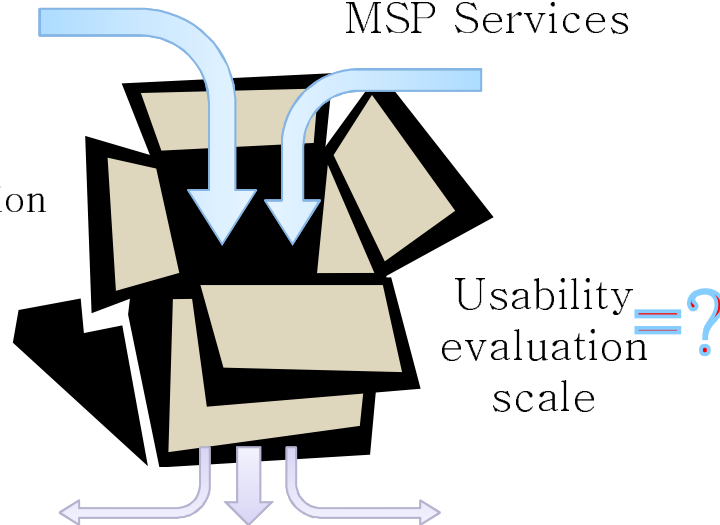
- Introduction
- MSP : e-Navigation IT Service
- What is the HCD
- IMO HCD Assessment-A NAS
- Tool for HCD Assessment
- HCD Assessment utilizing Tools
- Result and Proposal

❖ Introduction

e-Navigation Systems

MSP Services

Evaluation
Tool



Efficiency

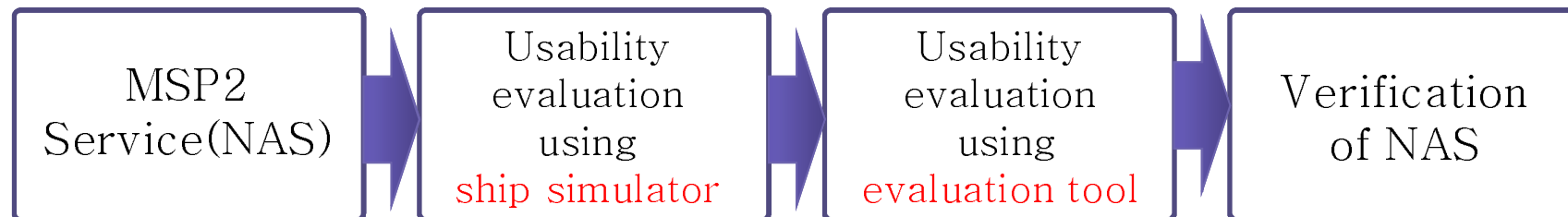
Effectiveness

Satisfaction



- Usability evaluation of e-Navigation systems and MSP required
- Usability of MSP should be verified before adopted in real service
- Requirement of each MSP should be defined in standards

Study progress on usability evaluation for verification of MSP



❖ MSP : e-Navigation IT Service

	Service description
MSP1	VTs Information Service (INS)
MSP2	Navigation Assistance Service(NAS)
MSP3	Traffic Organization Service(TOS)
MSP4	Local Port Service (LPS)
MSP5	Maritime Safety Information (MSI) service
MSP6	Pilotage service
MSP7	Tugs service
MSP8	Vessel shore reporting
MSP9	Telemedical Maritime Assistance Service(TMAS)
MSP10	Maritime Assistance Service (MAS)
MSP11	Nautical Chart Service
MSP12	Nautical publications service
MSP13	Ice navigation service
MSP14	Meteorological information service
MSP15	Real-time hydrographic and environmental information services
MSP16	Search and Rescue(SAR) Service

	Service description	Particulars IT service description
MSP2	Navigation Assistance Service(NAS)	Route Plan Exchange Service

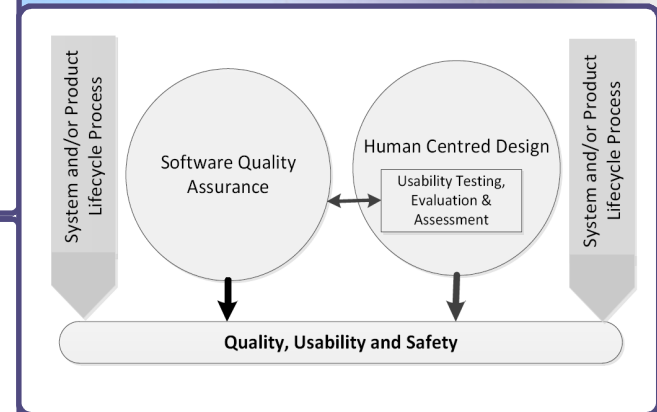
Evaluate usability of route exchange service using IMO HCD criteria

❖ What is the HCD

- HCD (Human Centered Design)

HCD is the set of activities to achieve usability goals in e-Navigation systems and IT services

- U-TEA is used to ensure good usability in HCD
- HCD, SQA, U-TEA guidelines are considered concurrently
- SQA helps ensure S/W reliability in e-navigation



- ◆ Usability evaluation process based on U-TEA activities

1. Planning	Timing
2. Preparation	Setting of tasks
	Selection of test participants (if required)
3. Implementation	Preparation for tests and selection of scenarios
	Implementation and record
4. Analysis	Evaluation and analysis
	Report of test results
5. Feedback	Iterate if required (whether formative or summative approach is used)

- ◆ Results of usability evaluation

- Effectiveness : The rate of mission success (Normally 80%)
- Efficiency : The planned time on mission accomplishment
- Satisfaction : Subjective evaluation through surveys and interviews with participants

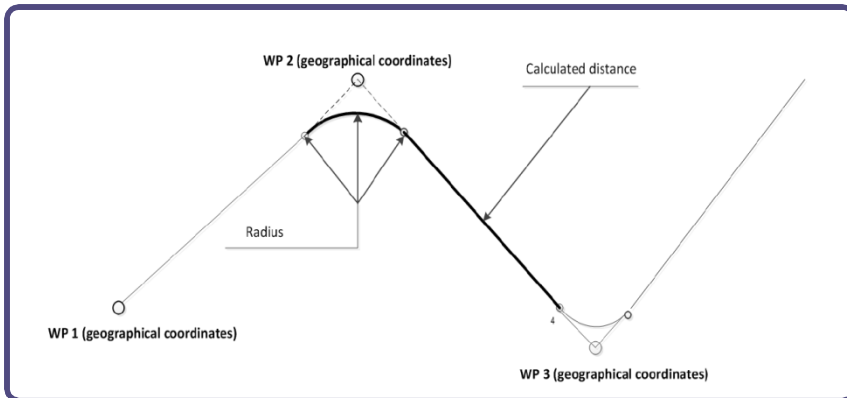
Evaluation of Route Plan
Exchange Service Based on HCD

❖ IMO HCD Evaluation – Route Plan Exchange

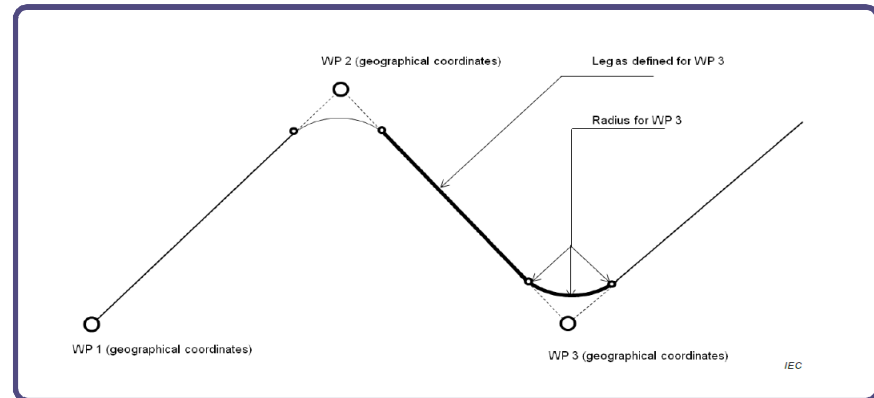
◆ Route Plan Exchange Using NAS

- NAS uses Route exchange to recommend and optimize a ship's route
- IEC 61174 Electronic chart and information system(ECIDS)

Example of distance of waypoint 2 and waypoint 3



Example of parameters that belong to waypoint 3 section



Route Plan Exchange format description(IEC 61174)

1

Route node
information

2

Waypoint node
information

3

Route schedule
node information

XML Compressed
File

The extension .rtz

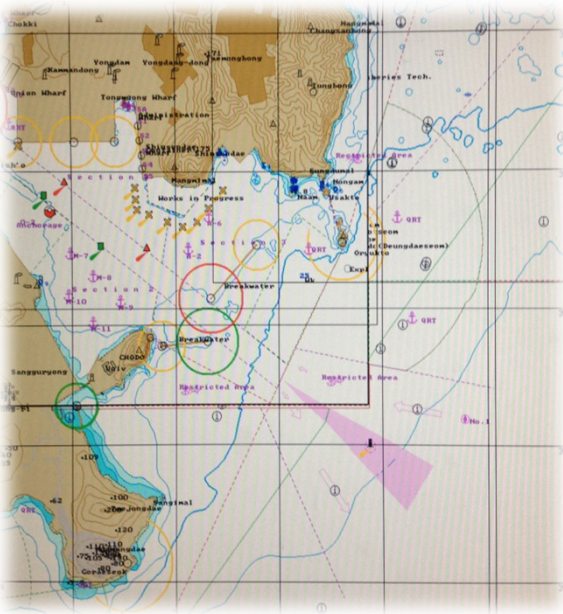
IEC 61162-450
transmission

❖ IMO HCD Evaluation – Route Plan Exchange

◆ Route Plan Exchange IT Service

- Usability evaluation for verification of NAS
- Full Mission Ship-Heading Simulator used

◆ Proposed simulation process



When route plan
information of other ships
is not provided



When Route plan
information of other ships
is provided

Navigation Route Plan

Vessel Traffic
Center(VTS)

Using AIS or VHF
Equipment

Route information
distribution

ECDIS or INS Display

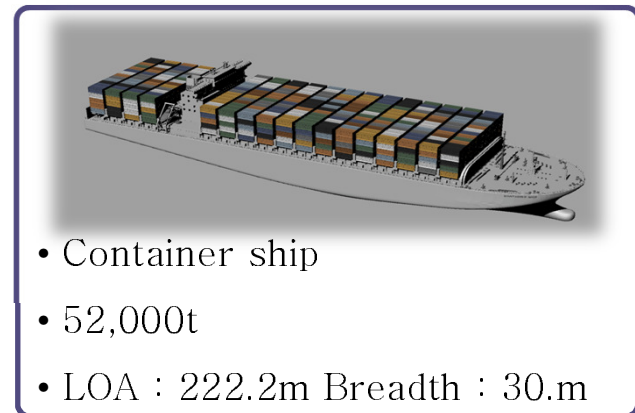
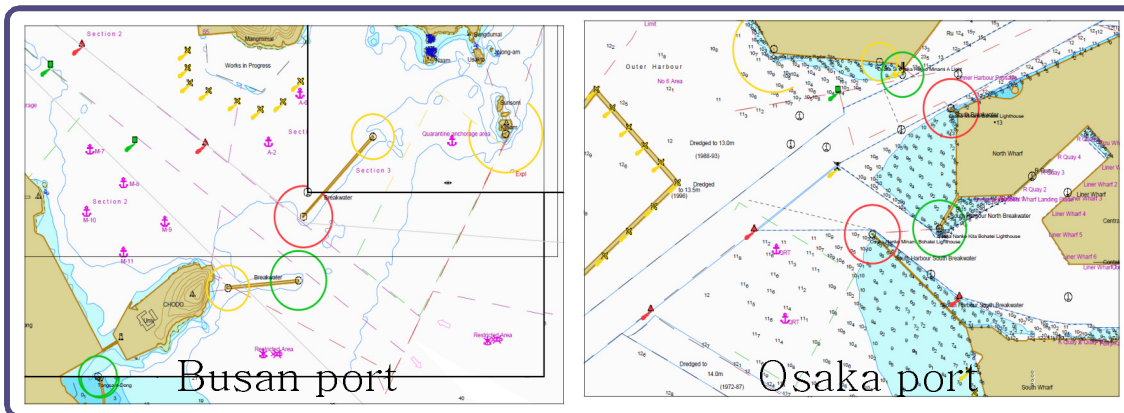
❖ IMO HCD Evaluation – Route Plan Exchange

◆ Information of participants in simulation

	Company	Embarkation career
1st grade license-holder A	Panstar-line	11 year
1st grade license-holder B	HYUNDAI Shipping	7.5 year
3rd grade license-holder C	HANJIN Shipping	6 month
3rd grade license-holder D	Sangji Shipping	9 month



◆ Simulation Ports



◆ effects of wind and tide

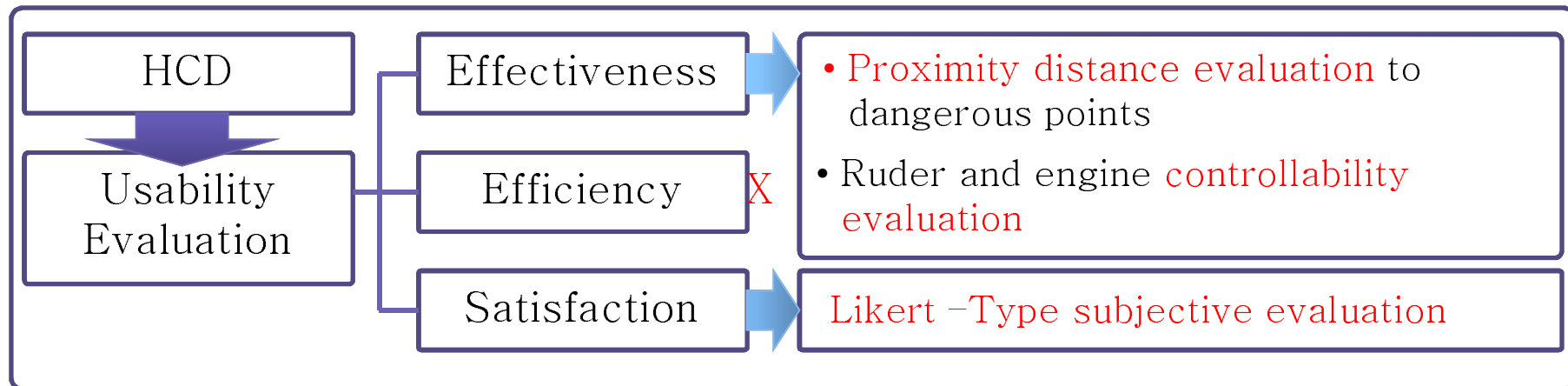
	Wind		Tide	
	Direction	Speed	Direction	Speed
Busan port	280°	10 knots	100°	0.5 knot
Osaka port	053°	10 knots	233°	0.5 knot

❖ IMO HCD Evaluation – Route Plan Exchange

◆ Result of simulation

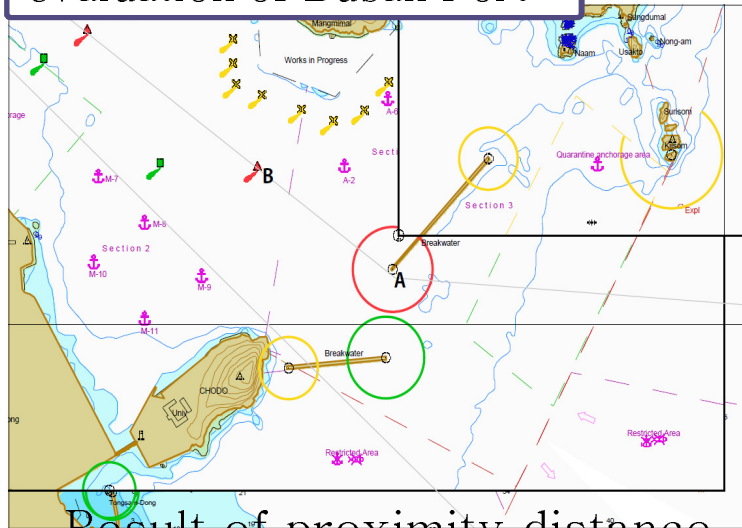
	Busan port		Osaka port	
1st grade license-holder A	Without NAS	Collision (O)	With NAS	No collision (X)
1st grade license-holder B	With NAS	No collision (X)	Without NAS	No collision (X)
3rd grade license-holder C	With NAS	Collision (O)	Without NAS	Collision (O)
3rd grade license-holder D	Without NAS	Collision (O)	With NAS	No collision (X)
Total number	4		4	

◆ Usability evaluation scale

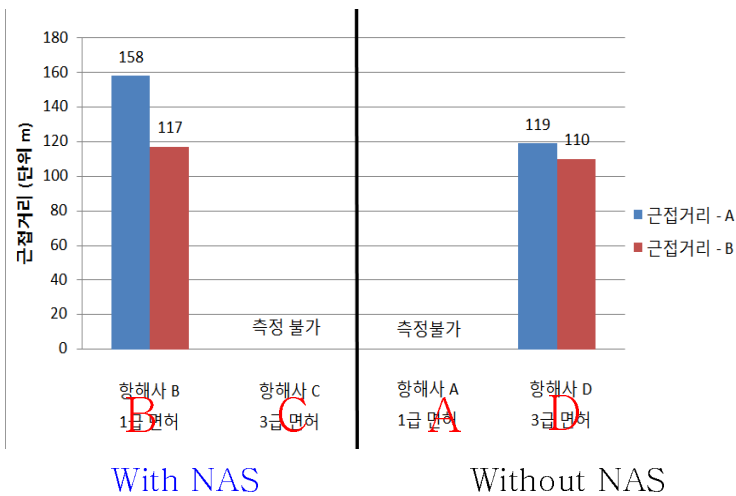


❖ IMO HCD Evaluation – Route Plan Exchange

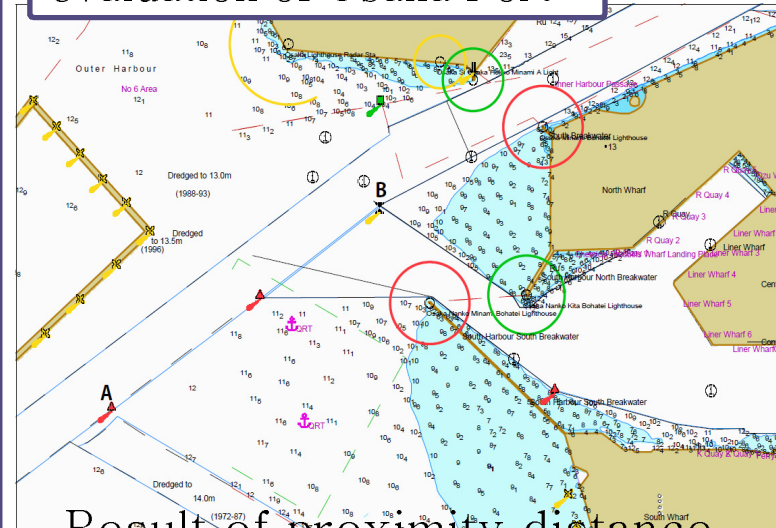
The proximity distance evaluation of Busan Port



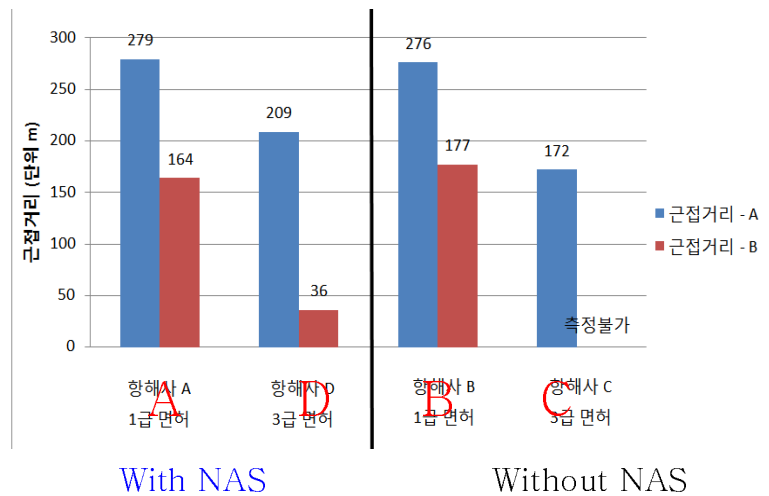
Result of proximity distance



The proximity distance evaluation of Osaka Port



Result of proximity distance



❖ IMO HCD Evaluation – Route Plan Exchange

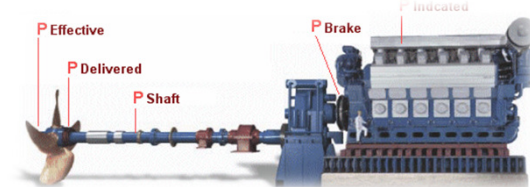
The controllability evaluation of Busan Port

	Rudder Angle		Engine RPM	
	Average(degree)	Allowance(%)	Average(rpm)	Allowance(%)
Captain A	4.8689	86.09	34.4754	65.52
Captain B	4.2131	87.96	50.1148	49.89
3rd Mate C	8.2951	76.30	29.5082	70.49
3rd Mate D	5.0492	85.57	49.9672	50.03

With NAS, Without NAS

The controllability evaluation of Osaka Port

	Rudder Angle		Engine RPM	
	Average(degree)	Allowance(%)	Average(rpm)	Allowance(%)
Captain A	7.0984	79.72	52.3607	47.64
Captain B	6.3559	81.84	57.5082	42.49
3rd Mate C	6.2143	82.24	45.6071	54.39
3rd Mate D	11.6393	66.74	54.1639	45.84



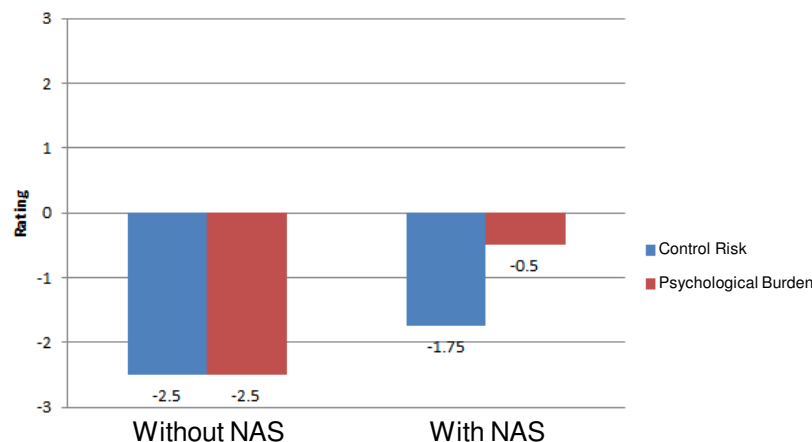
NAS doesn't improve Control

❖ IMO HCD Assessment – Route Plan Exchange

◆ Subjective Assessment Item

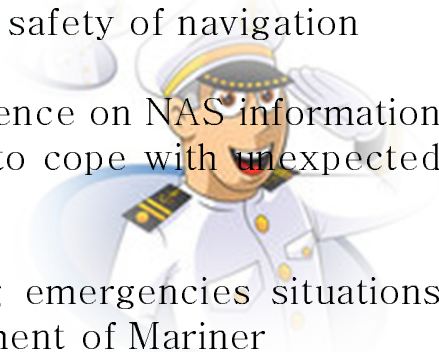
Item	3	2	1	0	-1	-2	-3
Control Risk	Very Safe	Safe	Somewhat Safe	Not sure	Somewhat Unsafe	Unsafe	Very Unsafe
Psychological Burden	Very Comfortable	Comfortable	Somewhat Comfortable	Not sure	Somewhat Uncomfortable	Uncomfortable	Very Uncomfortable

◆ Subjective assessment of IT service



◆ Officer comments

- Route Plan Exchange information help to reduce psychological burden
- Notice of relatively dangerous vessels is helpful to improve safety of navigation
- Too much dependence on NAS information makes it difficult to cope with unexpected situations
- Not helpful during emergencies situations due to embarrassment of Mariner



❖ Tool for HCD Assessment

◆ Ship Handling Simulator



Full Mission Navigational Simulator

- Understanding and education for complex dynamics of vessel
- Expensive equipment
- Operation requires a lot of manpower
- Test preparation takes a long time

Need to develop assessment tools for IT service

◆ User requirements of assessment tool for IT Service

- Easy to edit and operate IT service scenario
- Possible to control own ship
- Easy to change navigational environment
- Allows recording, stopping & replaying
- Play with smooth movement and realistic navigational environment on the PC
- Vital equipment onboard should be implemented with inter relational operation

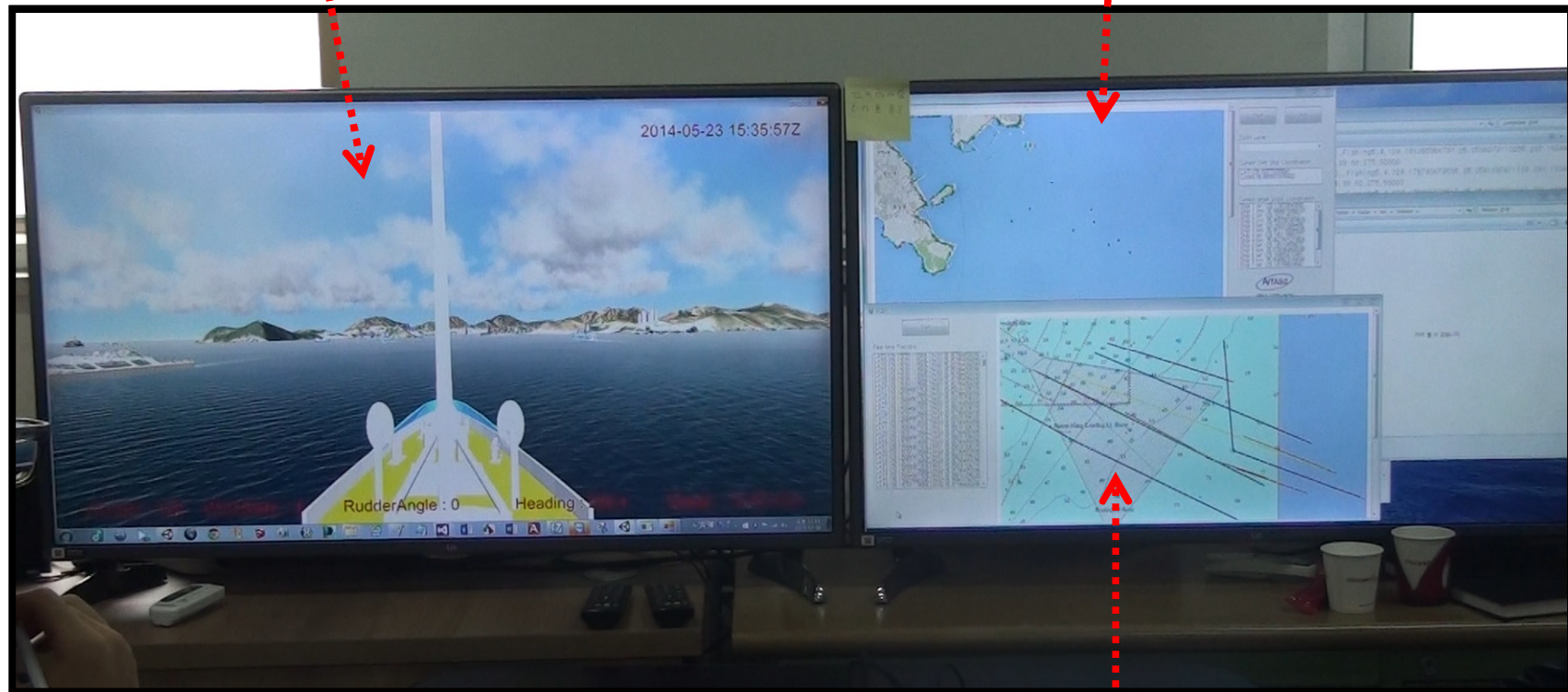


❖ Simulation Tool for HCD Assessment

◆ Simulator Configuration for assessment of NAS

3D Navigation visualization

Radar



ECDIS displaying Route Plan Exchange for NAS

❖ HCD Assessment utilizing Developed Simulator

◆ Route Plan Exchange

Assessment Tool System

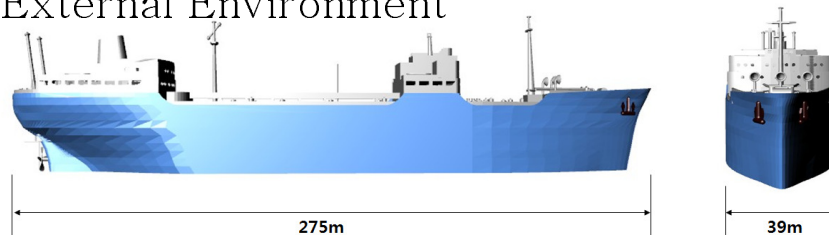
The usability test for
Route Plan Exchange

- Carried out additional simulation which is not easy with FMSS
- What happened when route changed suddenly different from informed planned route?
- What should be done to increase efficiency of Route Plan Information Exchange?

◆ Scenario

Class	Information	
Simulation No. 1	Radar, Route Plan Exchange	Route of the ship with the risk of collision not changed
Simulation No. 2	Radar, Route Plan Exchange	Route of ship with the risk of collision changed without correcting information

◆ External Environment

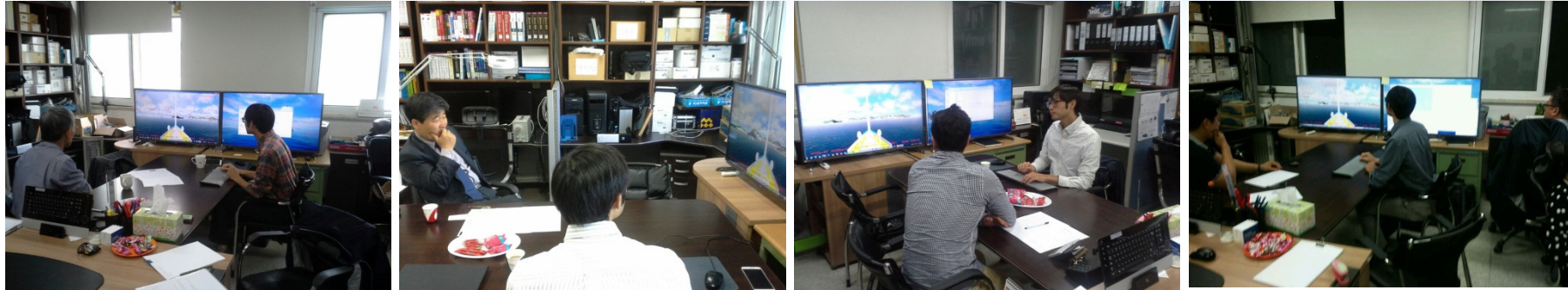


Sea Status 3, clear day

Busan port entry conditions
(initial speed of 10 knots)

Effectiveness , Efficiency and Satisfaction Evaluation

❖ HCD Assessment utilizing Developed Simulator

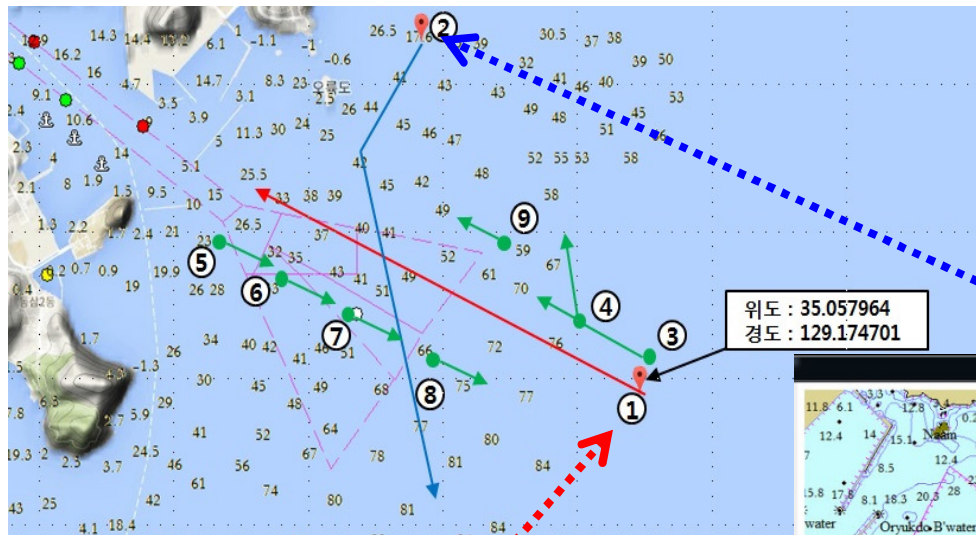


Object of experiment	License class	Boarded Career	Position	Respondent	License class	Boarded Career	Position
1	1st	12 years	Master	7	3rd	6 month	Trainee
2	1st	8 years	Master	8	3rd	6 month	Trainee
3	1st	7 years	Chief Mate	9	3rd	6 month	Trainee
4	2nd	6.5 years	Second Mate	10	3rd	6 month	Trainee
5	2nd	3 years	Second Mate	11	3rd	6 month	Trainee
6	3rd	3 years	Second Mate	12	3rd	6 month	Trainee

❖ HCD Assessment utilizing Developed Simulator

◆ Scenario No.1

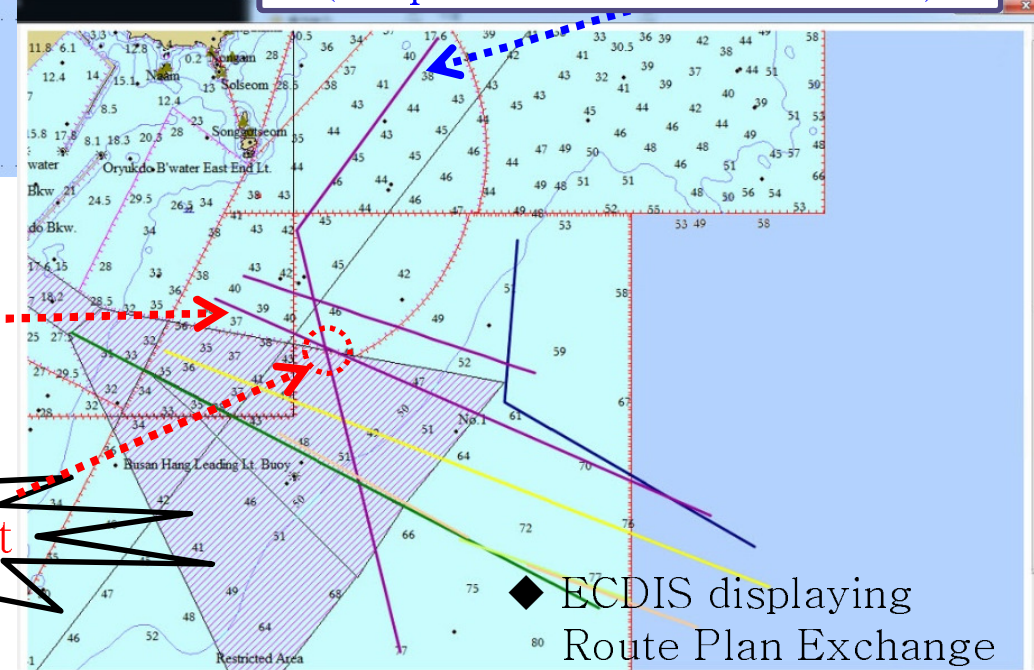
- Nine ships participate in simulation
- One of the nine ships is scheduled to be collided with own ship
- No change ship's route with the risk of collision



Planned Own ship
route

Expected collision point

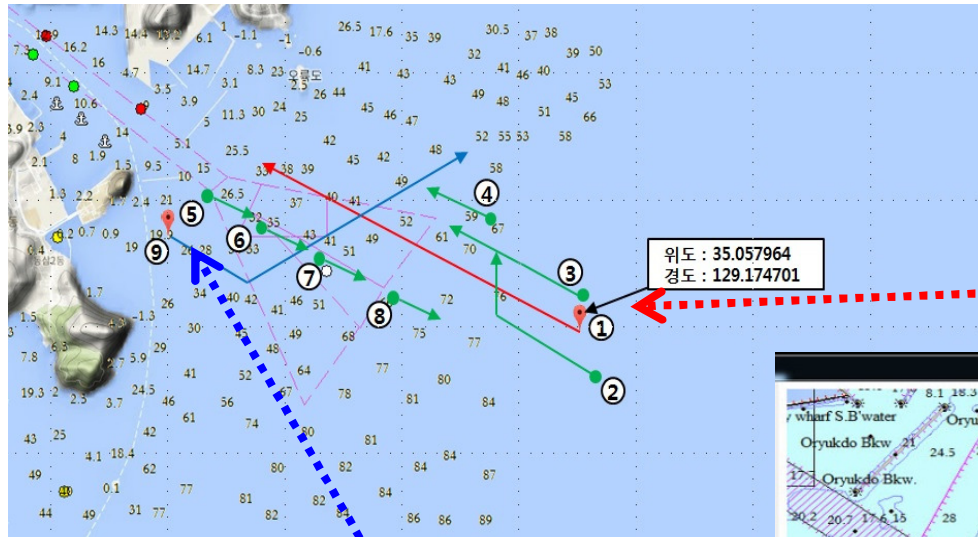
Route
(Ship with risk of collision)



❖ HCD Assessment utilizing Developed Simulator

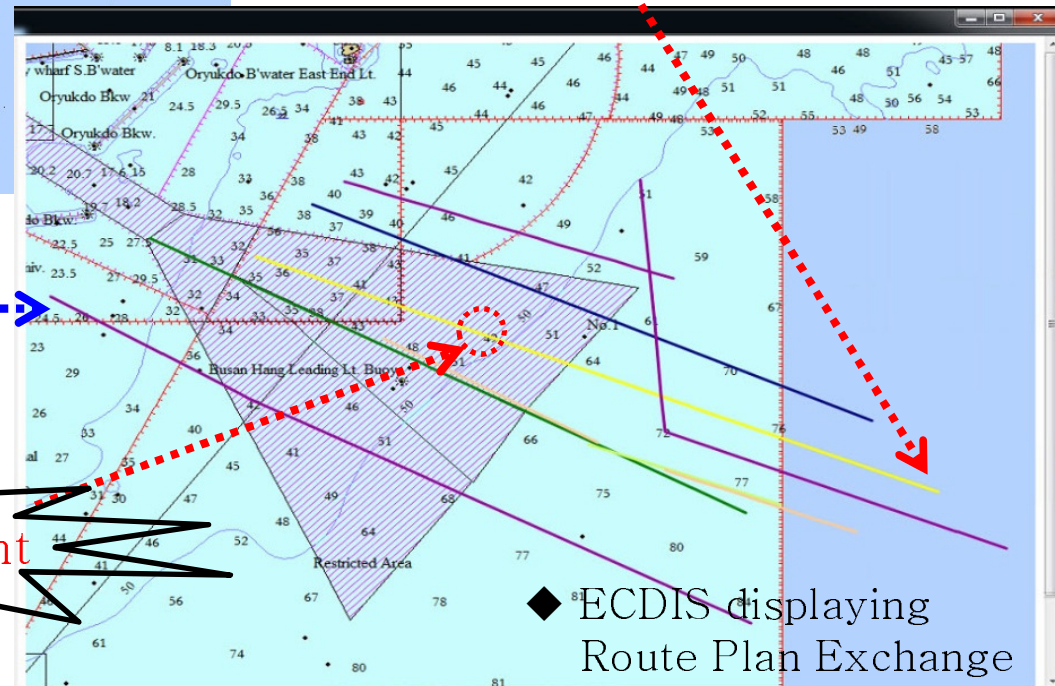
◆ Scenario No.2

- Nine ships participate in simulation
- One of the nine ships is scheduled to be collided with own ship
- Change ship's route with the risk of collision



Route
(Ship with risk of collision)

Expected collision point



◆ ECDIS displaying
Route Plan Exchange

❖ HCD Assessment utilizing Developed Simulator

◆ Criterion of usability test

	Test Item	Test Method
Effectiveness	Mission achievement	Achievement rate of avoiding risk of collision
	Distance from the ship with risk	Measure the nearest distance between own ship and ship at risk for collision
	Controllability during a specific time	Control ratio of ship handling during 7-13 minutes
Satisfiability	Satisfaction of the NAS provided	Questionnaire Survey about satisfaction of service provided (Likert Type)

- Time measurement for mission accomplishment(scheduled time) is excluded

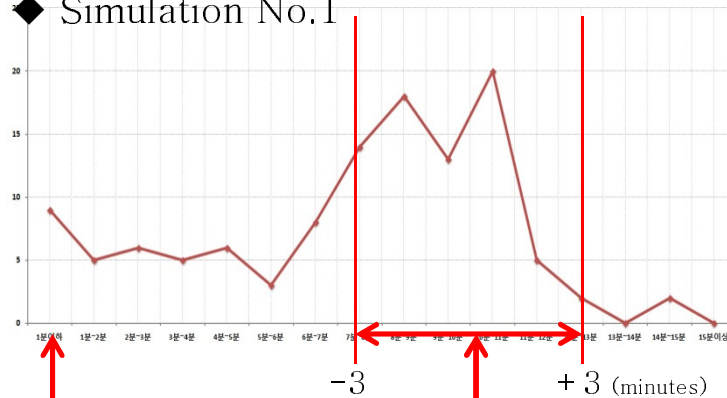
❖ HCD Assessment utilizing Developed Simulator

◆ Effectiveness

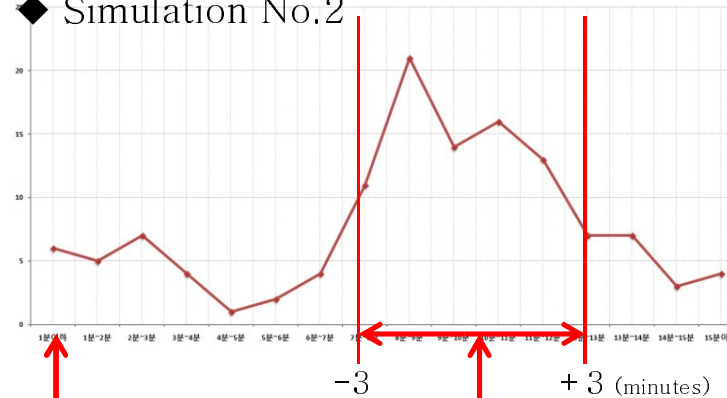
	Simulation No.1	Simulation No.2
Mission achievement	58%	67%
Distance from the ship with risk (avg.)	166m	159m

Number of Control during	Simulation No.1(No route change)			Simulation No.2(Route change)		
	The number of total uses	average	rate	the number of total uses	average	rate
± 3 minutes from the time to collision (7 ~ 13 minutes)	75	12.5	60%	72	12	63%
Exclusion of ± 3 minutes	50	4.3	40%	44	4.4	37%
Total period	125	7.2	100%	116	7.8	100%

◆ Simulation No.1



◆ Simulation No.2



❖ HCD Assessment utilizing Developed Simulator

◆ Likert-Type Assessment Scale for the Service satisfaction

Scale of helpfulness for safe navigation	Strong Agree	Agree	Don't know	Disagree	Strong Disagree
	5	4	3	2	1

◆ Satisfaction Result

Navigator	Utilization of Service	Helpfulness for the safe navigation	
	Answer	Answer	Level
Navigator 1	X	Agree	4
Navigator 2	○	Strongly Agree	5
Navigator 3	○	Disagree	2
Navigator 4	X	Disagree	2
Navigator 5	X	Disagree	2
Navigator 6	○	Disagree	2
Navigator 7	○	Disagree	2
Navigator 8	○	Disagree	2
Navigator 9	○	Agree	4
Navigator 10	○	Don't know	3
Navigator 11	○	Disagree	2
Navigator 12	○	Disagree	2
Average	75%	2.67 – NAS does not improve safe navigation	

❖ Result of HCD Assessment

◆ Result

- Low mission success rate (each 58%, 67%)
- Too close from the risk (average distance 160m)
- In case of Simulation No. 2(route change without correcting route information) rudder command commenced faster rather than Simulation No. 1
- When collision is imminent, rudder command commenced.
- Too low service satisfaction in questionnaire survey (disagree 2.67)

◆ Proposal

- Provision of route planning exchange should be done in real time.
- Corrected Route plan should be announced before making route change
- When the nominated risk ship not follow planed route, alert emitted onboard
- Only display route of ship with collision risk to avoid screen clutter.
- Mariner should not depend on route exchange.
- Route should be shared between large and medium-small ships.
- Based on the evaluation results various studies, experiments, education and training of mariner for practical application should be done.



THE OCEAN IS PAST, PRESENT AND
FUTURE, ALWAYS BLUE OCEAN.

:

Thank you for Listening.