Forschungshafen Rostock

Kompetenz und Strategie der Hochschule Wismar auf dem Gebiet der Maritimen Forschung unter Einsatz des Maritimen Simulations Centrums Warnemünde - MSCW –

Competency and Strategy of HS Wismar On maritime research using the Maritime Simulation Centre Warnemünde – MSCW -

Meeting of the BSPC Working Group on Integrated Maritime Policy 20-21.1.2010

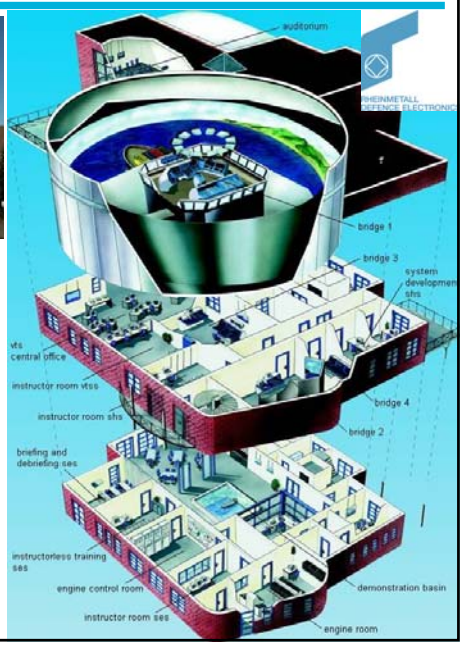
Knud Benedict
Hochschule Wismar, Faculty of Engineering,
Department of Maritime Studies
Maritime Simulation Centre Warnemünde / MSCW
GERMANY

Content

1. Introduction: Infrastructure & Equipment of Maritime Simulation Centre
2. Missions and Research & Samples - Overview
3. Samples of research projects using the MSCW

HS Wismar & Maritime Simulation Centre Warnemünde

MSCW overview & upgrade

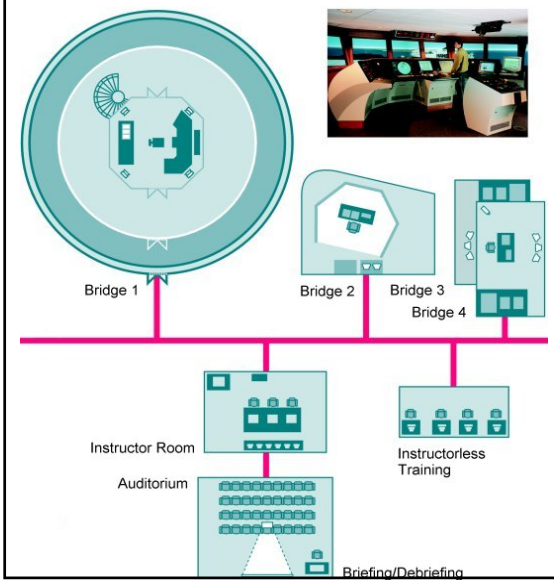


3 Simulator-Segments: Upgrade 2007/8

- Shiphandling: 4 Bridges and 8 ILT-Part-task Stations, new GMDSS and visual system and others…
- Ship Engine Operation: ECR, ER and 12 ILT Part-Task stations LC&Tanker-Simulator . Safety &Security Trainer…
- VTS: 9 Operator Consoles and 2 Part-Task stations (Upgrade planned 2008)

Better Interfacing of all simulators

MSCW Ship-Handling-Simulator (SHS): Structure



Training Area:

- 4 Bridges of different size
- from Full Mission to Multi-Task
- GMDSS ECDIS AIS … on all 4 Bridges

Instructor Area:

- 4 Instructor consoles for Multi-Session-Exercises
- 1 Instructor for SES for interfaced mode

Briefing/Debriefing Area:

- Full Digital Replay of exercises, including Communication
- 8 Stations for Instructorless Part-task Training

MSCW / SHS Bridge 1

Full Mission Bridge:

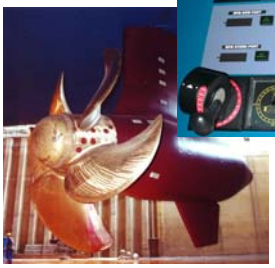
- 360° Visual System,
- NACOS- INS-System,
- Engine-MCS,
- Emergency Management System
- Consoles for steering; Joysticks, Azimuth /POD-Drives and HSC Handle can be added

- GMDSS, Navigation Sensors; Voyage Planning Station, AIS

New exchange panels for propulsion and steering

Conventional manoeuvring console with KAMEWA Joystick for integrated manoeuvring control

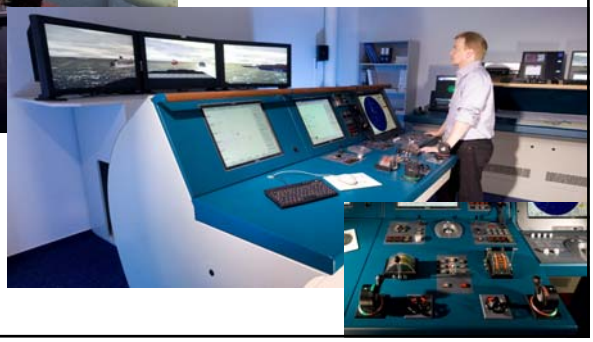
4 Azimuth Thruster Handles



2 Water jet-propulsion-Handles

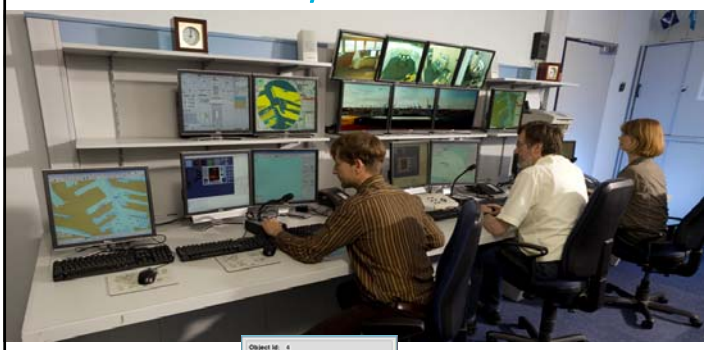
MSCW / SHS Bridges 2 – 4: fully integrated Bridge Systems

Bridge 2:
- 255° Visual System
- Change of Eye point and viewing direction for piloting ships from Bridge wing
- Exchange panels

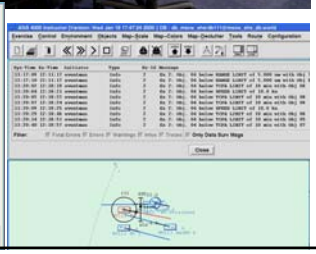


Bridge 3 + 4:
Radar, ECDIS/AIS
+ Navigation Equipment
Communication;
120° Screen based Visuals

MSCW/ SHS Instructor Area



Selecting thresholds for alarm parameters before the exercise in order to alert the instructor during exercise and to store markers into the replay to be used for debriefing session



Instructor Area:

- **4 Instructor consoles for Multi-Session-Exercises**
- **1 Instructor for SES for interfaced mode**

Screens for:

- **Video Cameras**
- **Slave displays for Radar, Visual system and ECDIS/Radar**
- **Scenario Design and Exercise Control on ECDIS**
- **Surveillance /Ass. Tools**
- **VHF, GMDSS-Communication**

MSCW / SHS Briefing / Debriefing

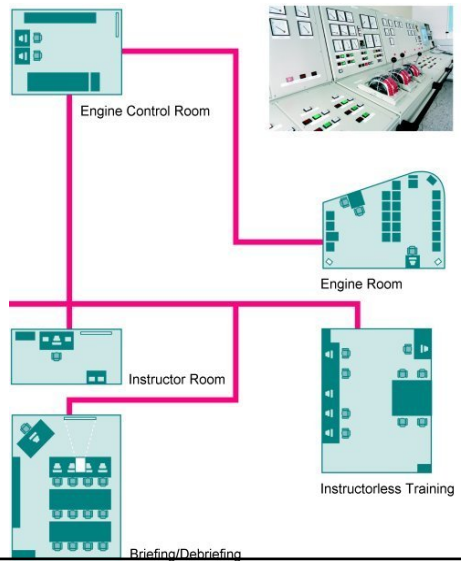
Briefing/Debriefing Area:

- Full Replay of exercises (ECDIS, Visual Presentation and Communication)

- 8 Stations for ILT-Part-task Training - new with full RADAR ARPA und ECDIS functionality

- Also to be used as own ships!

Structure of Ships Engine Simulator (SES)



Training Area:

Engine Room and Engine Control Room, representing the full ships' machinery system for 6 different types of engines

Instructor Area:

• Instructor console for Exercise design and control

Briefing/Debriefing Area:

• Full Replay of exercises including Communication

• 12 Part-task Instructorless Training Stations

•Tanker simulator and Liquid Cargo Simulator

Ship Enging Simulator (SES) Engine Control Room

• **Engine Control Console** with Conventional Mock-Up plus

• **Monitoring and Control System**

• **Main Engine** of 22.000 KW;

•2-Stroke, 5 Cylinders Diesel engine,
•Type 5 RTA 84 C by SULZER

•6 new engine models incl. Diesel-Electric-Azipod and configurable touch screen

Primary Switching Panel for

•electrical supply, auxiliary engines, supply systems, steam generation, containered food refrigeration and loading areas

•Plus Diesel Electric Plant and Medium Voltage network

MSCW Ship Engine Simulator (SES): Engine room

Main Engine Control Station:
Main engine controls, Lubrication, Safety system, Alarm indicators

Electrical Power Supply:
Auxiliary diesel generators,
Turbo generator,
Emergency diesel generator.

Supply and Secondary Systems:
for cooling, air, fuel, lubrication , seawater evaporator,
steam generator system,
fire extinguishing systems and cargo and provision refrigerating system

Sound System for Engine Noise Generation

Ships Engine Simulator (SES) : Briefing /Debriefing

Briefing/Debriefing Area:

• Full Replay of exercises including Communication, Full use of Tools for Data Logging and Evaluation /Assessment

• 12 Part-task Instructorless Training Stations comprising full machinery system simulation

• Multi-Plant-Engine/ Multi-shaft – Propulsion and others

Maritime Simulation Centre Warnemünde / VTSS
Structure of Vessel-Traffic-Services Simulator

Training Area:

•9 VTS-Operator Training Consoles

•Configuration: Either 1 large Centre or up to 3 separate or adjacent Centres with main Operator stations

Instructor Area:

• 3 Instructor consoles for parallel Multi-Session-Exercises

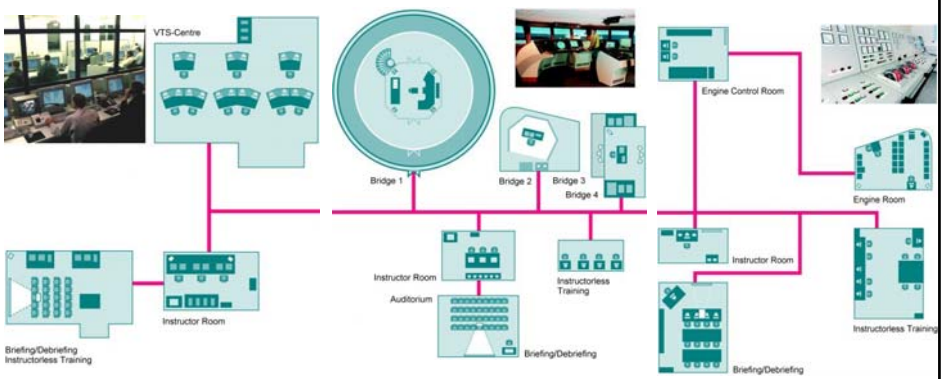
Briefing/Debriefing Area:

• Full Replay of exercises on ECDIS and Radar plus full Communication

• 2 Part-task Instructorless Training Stations

Maritime Simulation Centre Warnemuende
Integrated Mode of Operation

VTS- Simulator **Shiphandling Simulator** **Ship's Engine Simulator**



• **Separate Operation Mode: 3 Exercises in parallel, both in SHS and VTSS,**

• **Integrated Operation Mode: All simulators can be run collectively in 1 complex exercise (Bridge 1 using the full machinery of SES and SHS is linked to VTSS; additionally full part task training.**

Missions of MSCW and Research Aspects

1. **Three Mission** areas:
   - Education and Training / Students Education
   - Further Education and Training / Courses: Transfer of Knowledge between practice & science
   - Research & Development /
2. **Research aspects**

Research is a key objective of our Department, especially the Operation of large systems like Ships, Plants, Traffic systems.
About a dozen specialists permanently engaged at the Dept.
Projects are funded fully by third parties at both national and international level (EU-Programs, both 4th and 5th FP)
Research budget up to 1 Mio Euro a year.

In this paper some examples are given of projects from the past and of ongoing investigations...

Objectives of research at department and MSCW

- Insight into processes and application of technologies for increased safety and effectiveness in shipping
- Transfer of knowledge to training of students and into industry
- Improvement of Simulation and laboratory infrastructure for sustainable competency at department and MSCW
- Support of regional shipping companies and maritime industry

Mission and research samples

1. **Focus on several Research Areas - Project Samples:**
   - VESPER: Maritime Safety & Security analysis for RoRo Ships, Simulation & Training aspects
   - ADANAV & ZUMANZ: Bridge Equipment and Ship Operation
   - ComBew & ISMES: Simulation basis tools & training programs
   - HoFriWa: Inland waterway design studies
   - EMBARC: European Maritime Baseline for Regional and Coastal traffic management
   - MARNIS: Maritime Navigation & Information Services
   - HICOSS: Teaching methods /E-learning
   - TEBEF / MARSPEED: Super Fast Wing-Ship Development and Training
   - …

Safe and efficient Sea traffic – Research areas at Department of Maritime Studies

Core research areas:

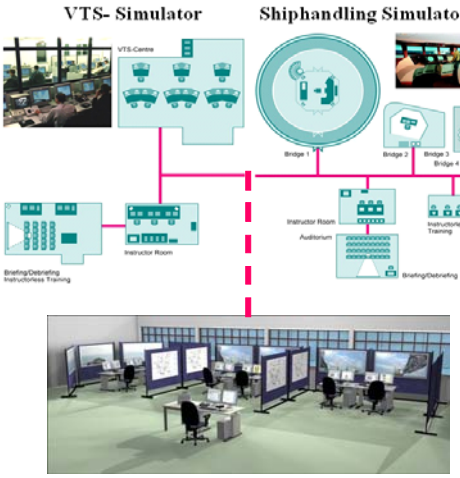
- Maritime Navigation- and Information systems and –services; Adaptive Navigation; Innovative Ships modules
- Planning and Design of fairways to ports and berthing places
- Manoeuvring simulations of sea- going vessels and inland waterway barges and ship
- Impact of human factors on safe chip operations; accidents investigations
- Enhancement of simulation equipment and -scenarios

VeSPer – Research for Civil Safety – Protection of Traffic Infrastructures

- **Project:**
  - funded by the German Federal Ministry of Education and Research Berlin, surveyed by Centre of Technology, VDI Centre Düsseldorf
- **Consortium:**
  - Overall coordinator FGAN (Research Institute for Applied Science Bonn – Wachtberg);
  - Seven partners (system developer, suppliers as well as research institutes and Wismar-University) are co-operatively involved.
  - Investigations are supported by competent national authorities
- **Objectives:**
  - System analysis of present security condition in German ports and on board of RoRo-Pax-Ferries
  - Improvement of the protection against threats and terrorism in the maritime field of ferry links to reduce the risk of casualties and implementation of the ISPS-Code
  - Development and implementation of security based systems and technologies for improved security in ports and on board the vessels
  - Proposals for Training both for student education and further training of officers and crew on ships and in ports – **this will be done by using SST / mars²**

Integrated concept of MSCW & New Element SST

INTERFACING SIMULATORS TO COMPLEX SYSTEM



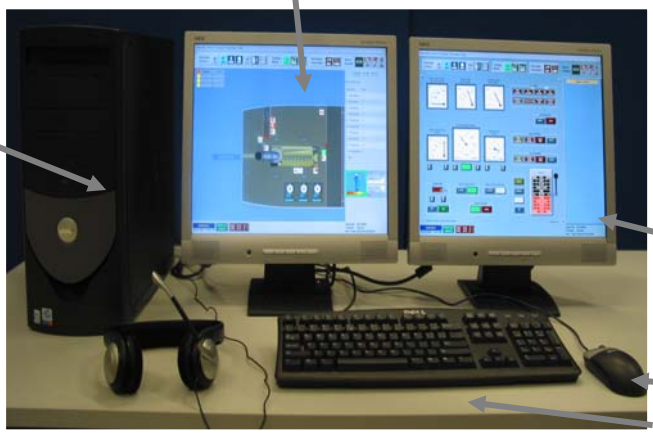
- **Separate operation mode** (3 parallel exercises, both in SHS and VTSS)
- **Integrated operation mode** (all simulators run collectively in one complex exercise (use of bridge 1, full machinery of SES and link to VTSS)

New Simulator: SST /mars²
Safety and Security Trainer
Simulation for stand-alone and integrated mode

Safety & Security Trainer SST: General Simulator Set up & Sample Configuration

1 Instructor and 2 to 16 Stations form a SST mars ² Simulator

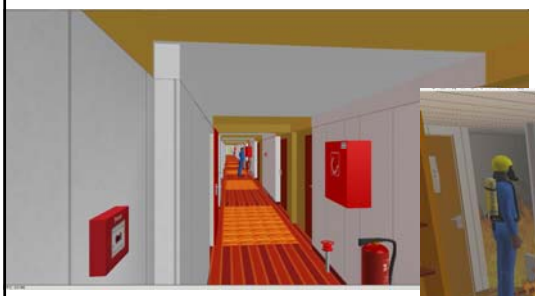
SST Equipment: PC and monitors at trainee station

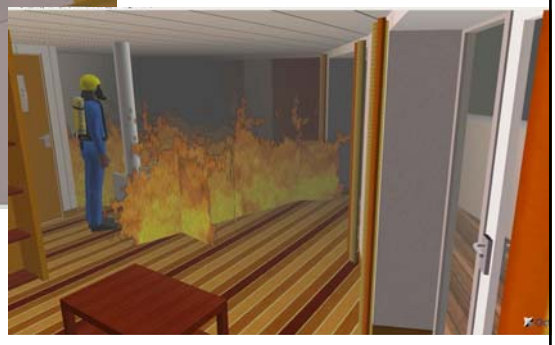


Training course at MSCW auditorium - Fire Fighting Ex.

Enthusiastic Discussions,
- And call for more time!

SST Enhancements: 3 D Visualization (1)





Screenshots of new development: Model Passenger Vessel with compartments, safety equipment and fire display, seen through the eyes of the trainee as the „strategic figure“

SST Enhancements: 3 D Visualization (2)

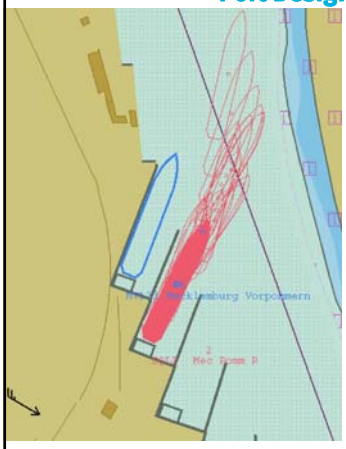
Engine room with active crew member and equipment

Extension of SST & Co-operation in maritime projects

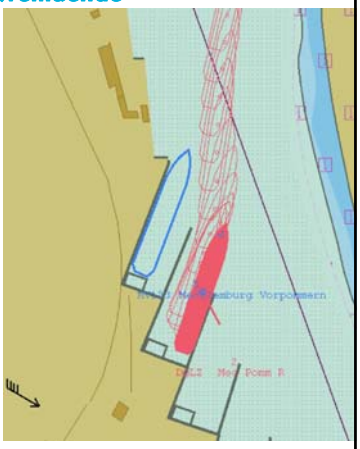
Co-operation between Wismar University and shipping companies:

- **Scandlines, TT-Lines (VESPER)**
- **LAEISZ (Simulation Courses MSCW)**
- **AIDA Cruises (3D Visualisation &** Simulation Courses MSCW**)**

Research Objectives and Projects:
Port Design Studies - Luebeck-Travemuende



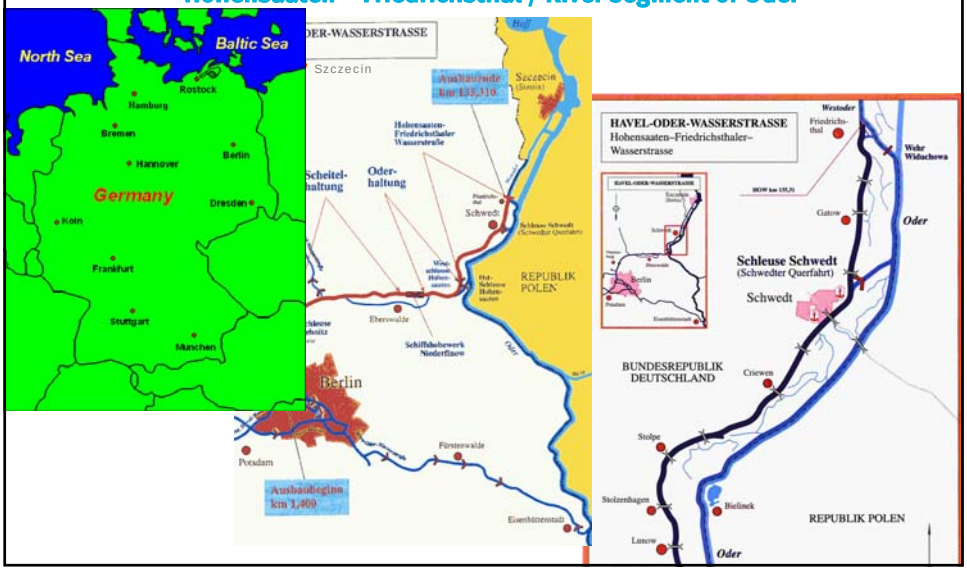
Ship-Handling Simulator:
Test runs of ferry "MV" under different Environmental condition at the jetties:

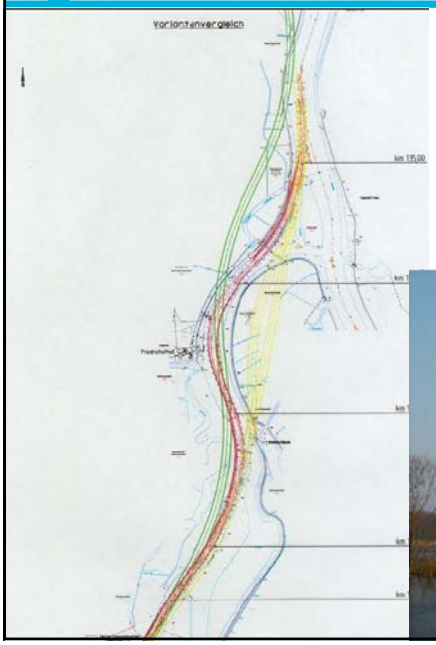


Wind 300°/ 20 kt; Current 160°/ 1.5 kt.
- Satisfactory -

b) Wind 300°/ 40 kt; Current 160°/ 1.5 kt.
- Unsatisfactory -

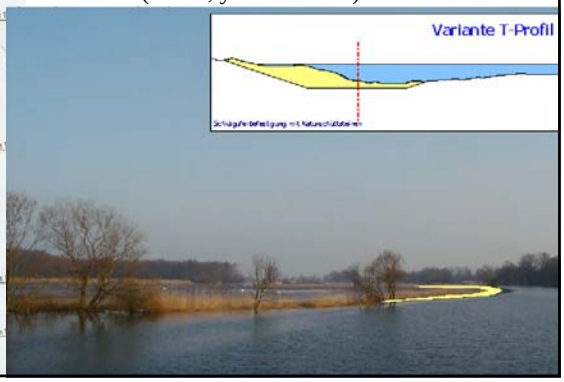
R&D Projects: Inland Waterway Design Studies
Hohensaaten – Friedrichsthal / River segment of Oder

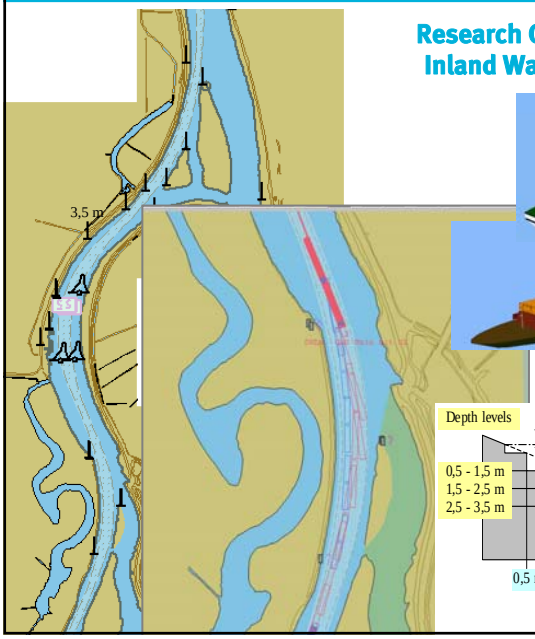




Variants of the Fairway Layout and final Version

- Three Versions for Layout (left) and Final approach (red), based on simplified design procedures
- Segment for Dredging (below, yellow colour)



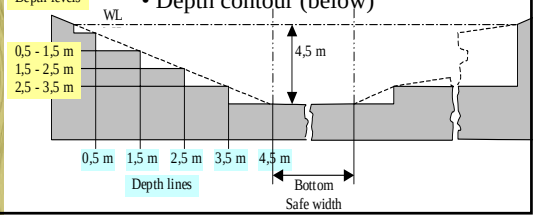


Research Objectives and Projects: Inland Waterway Design Studies

•Double Pushing Barge:
•Lenght 185 m

•Coaster:
•110 m (Ballast)

- Outline of the Waterway section and
- Snapshots from simulations (left)
- Depth contour (below)



Simulator runs (1): View from Simulator Bridges during Encounter situation

Simulator Bridge 2 (left):

Inland Vessel as pusher tug-barge system

Simulator Bridge 1:

Coaster with Containers

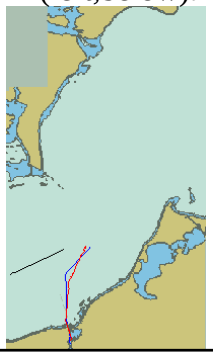
Project BAFEGIS / VTMIS-Net (Tracking Range)

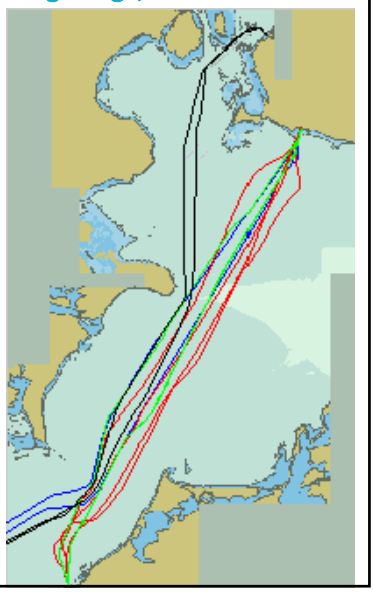
Test of AIS-Transponders (Tracking Range):

Tracking of Ferries in the Baltic Sea in VTS Stations and on board ships:

• normal tracking range, limited by the radar coverage of abt. 24nm (left,below).

• extended tracking range of about 80 nm between Warnemuende and Sweden, using AIS and repeater stations (right).

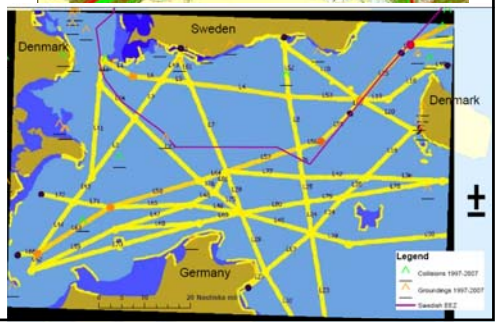




Project IWRAP International Port and Waterway Risk Model of IALA

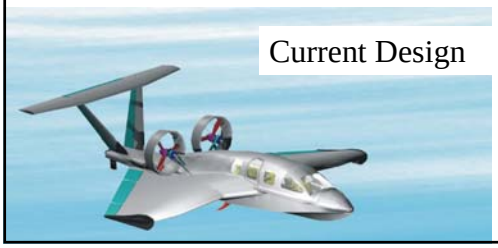
A working group within IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities) has established software tools to calculate the risks due to ships traffic as e.g. collisions, groundings.

Results of investigations and experiences with the software will be shared among partners.



R&D Project TEBEF: Super Fast Wing-Ship Development

Future Goal



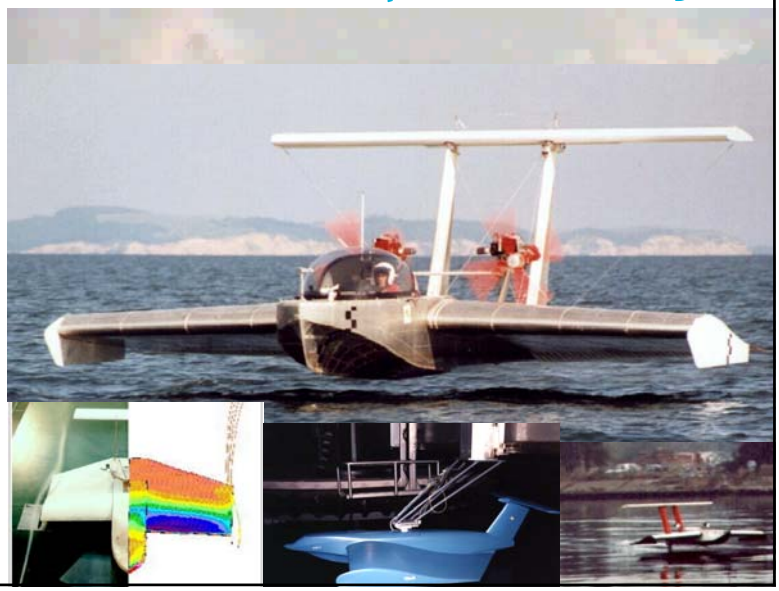
Current Design

State of the Art:

- New High Speed Crafts under development for civil use, based on the Wing-in-Ground Effect
- WIGs are operating with speeds of up to 250 kts.
- Current R&D project is mainly focussing oan design and construction of crafts
- to overcome the economic shortcomings of high power consumption in transition phase by new take-off means

HYDROWING VT 01 Development and Tests 2003

- Simulation of ship forces & motion
- Towed and free running models as well as wind-tunnel tests
- Test craft successfully tested.



New Development and Tests: Sea Falcon 2008

MALCOM

Bodeneffektfahrzeug „Seafalcon 08“ in Warnemünde/Hohe Düne

Current Design - Test in Rostock Port

Research Project MarSpeed 2009

MARSPEED - Training simulator for maritime High Speed Crafts

Area	Task	Scenario Requirements	Conditions, Pecularities	Training elements acc. to IMO
Open sea (without constraints)	Navigation in open seas	Communication with other targets, VTS and Authorities; use of navigation equipment	day and night; good and restr. vis.; seastate, wind	manoeuvring in restricted fairways, collision avoidance
Coastal waters (with and without constraints (TSS, special navigating areas)	Küsten-navigation	Communication with other targets, VTS and Authorities; use of navigation equipment	day and night; good and restr. vis.; seastate, wind	Manoeuvring in restricted fairways, collision avoidance

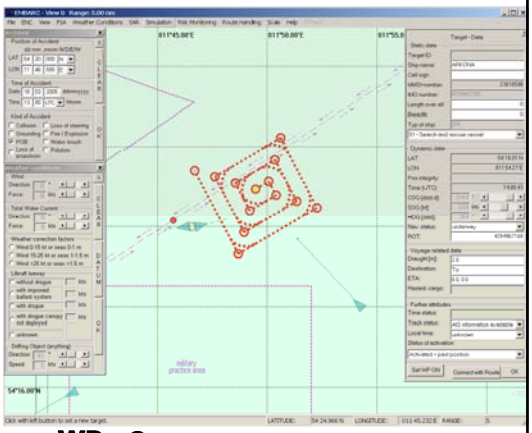
Wing Ship Implementation and Tests for Scenario Design

Test of Simulator Model in Ship Handling Simulator

EU – Research Project EMBARC

EMBARC – European Maritime study for Baseline and Advanced Regional and Coastal traffic management

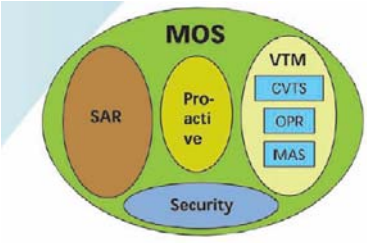
- Investigations to enhance a European Sea traffic Management (RD-project in 5. EU-FRP) using simulation for new functions as ECDIS and AIS



WP 08 Simulation of a RTI:
SAR- Monitoring Support<u>SAR-Functions:</u>
Monitoring approach of SAR Vessel to the search area Square-pattern to search, find and rescue a person after a person over board accident

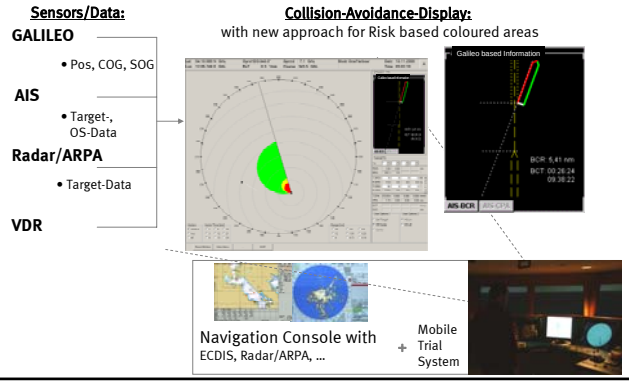
EU Research Project MarNIS

- **MarNIS** – Maritime Navigation and Information Services: Integration of on board sensors and shore-based Information for safe and efficient Navigation (RD-project in 6. EU-FRP)
- **Objectives and Deliverables:**
  - Concept for enhanced communication infrastructure (e.g. MOS-Centre to coordinate safety-related actions, National single window for simplified clarification procedures and information flows, …
  - Development of POADSS, Risk Indexes, Risk areas

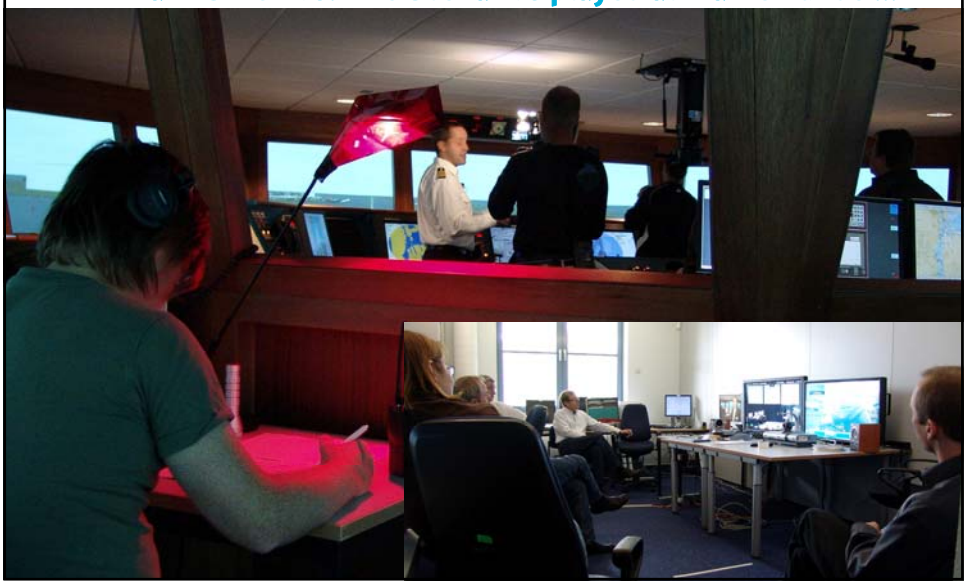


EU Research Project MarNIS – Contribution HS Wismar

- WP-Leader "Integration of AIS, Radar/ARPA, Galileo, ECDIS and Voyage Data Recorder"
- Potential enhancement of on board integrated navigation systems for collision and grounding avoidance



MarNIS-Demos: Live Scenarios played at Warnemünde ...



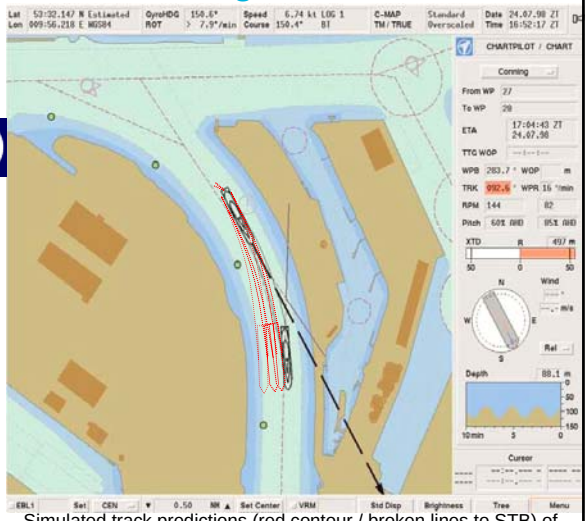
MarNIS: ...Live Scenarios presented in Genova for EU-Commision

Project ZuManz – Concept for Manoeuvring Prediction in ECDIS

Project : Condition based Manoeuvring Prediction for Ship operation (within initiative "Maritime Safety Assistance Rostock")

Objective:

- Concept and test of an "On-line-Manoeuvring-Assistant as Decision support component for ship handling
- to inform about manoeuvring capabilities by means of simulated dynamic predictions of steering and stopping characteristics according to the current commanded steering handle
- Status of engine is taken into account by analysis with diagnosis system



Simulated track predictions (red contour / broken lines to STB) of steering characteristics according to the current steering handle position/rudder angle as ECDIS overlay compared to conventional prediction (black contour / solid lines)

Project ZuManz – Concept for Manoeuvring Prediction in ECDIS: Test set up on SHS Bridge

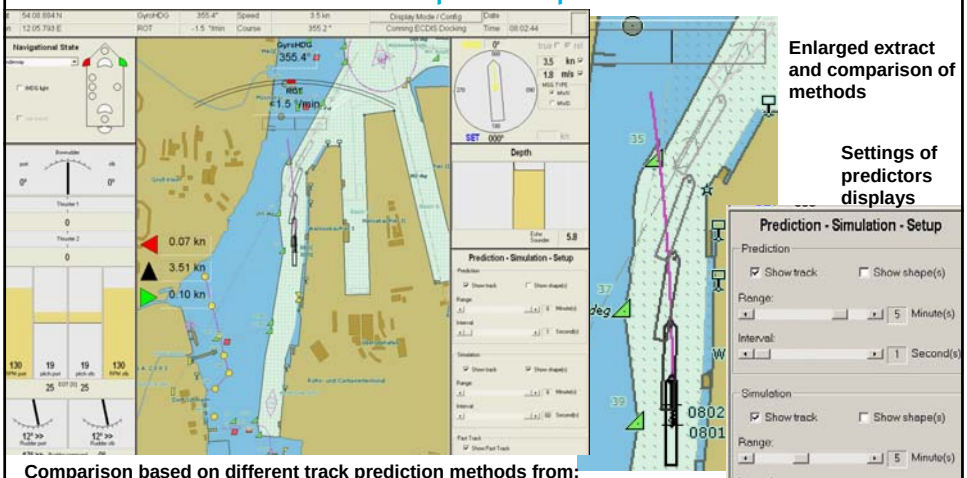
Fig. 8: Test setup for new Conning / ECDIS Display on Bridge 1 in Shiphandling Simulator

Project ZUMANZ: Result of tests and discussion (1)

Test trails in Shiphandling Simulator for new Prediction Display:

- Test area is sea port of Rostock in ECDIS presentation with scenario track of approach, turning manoeuvre and astern motion into ferry basin
- The following series of figures will indicate the effect of the dynamic predictor and its advantage compared to the simplified look ahead predictor.

Project ZUMANZ: Layout for Manoeuvring Prediction in ECDIS and comparison of prediction methods



Enlarged extract and comparison of methods

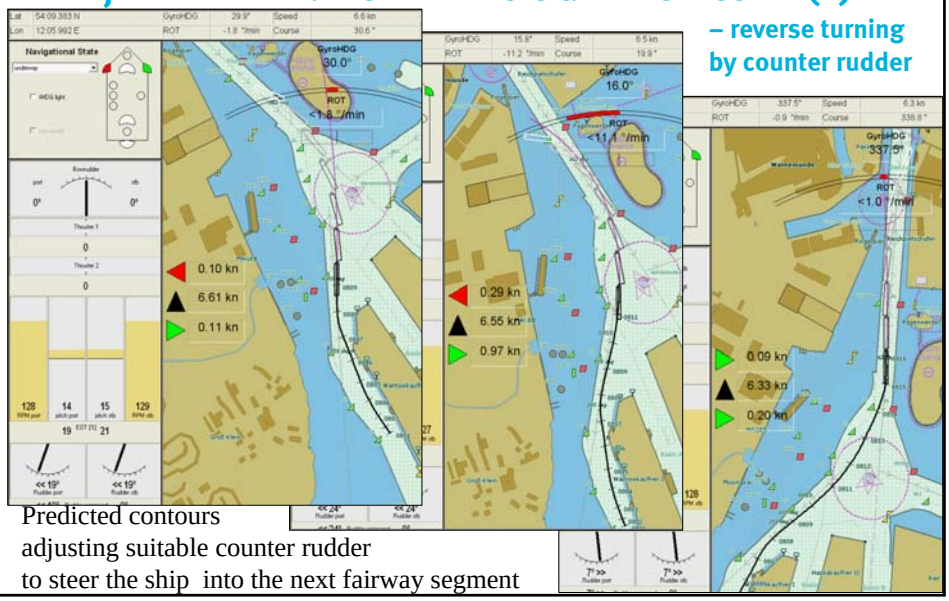
Settings of predictors displays

Comparison based on different track prediction methods from:

- **Simplified prediction from integration of current constant motion parameters (right magenta track with small STB turning) and**
- **Sophisticated prediction based on full math model considering the dynamic change of parameters due to rudder command to PT (left blue track to PT)**

Project ZUMANZ:Result of tests and discussion (2)

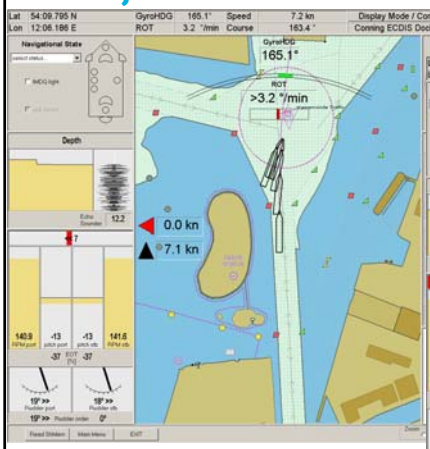
– reverse turning by counter rudder



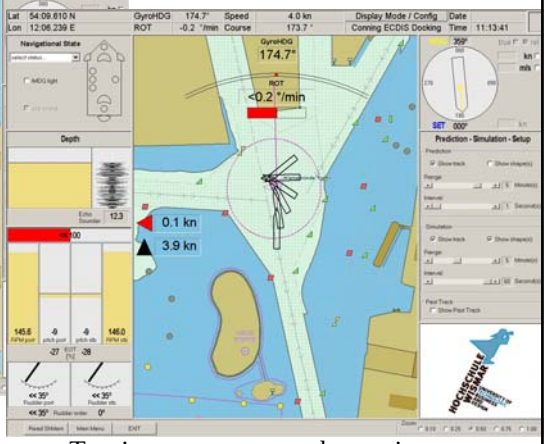
Predicted contours
adjusting suitable counter rudder
to steer the ship into the next fairway segment

Project ZUMANZ: Result of tests and discussion (2)

– combined stopping and turning



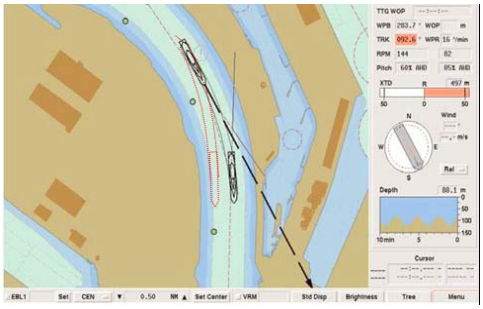
Predicted contours show the stopping distance and even the consequence of going astern if the engine will kept reversed operation too long



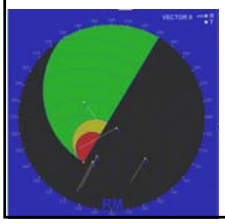
Turning manoeuvre at the turning area: the ship is using rudders and bow thruster according to the indicators on the left side

Lookout: Strategic approach for developing and applying simulation on board ships

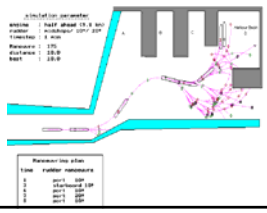
Three samples: for new approaches which are under development where we are trying to:



1. Prediction of manoeuvres: Improve the simulation quality (red contour) using enhanced methods and technologies for estimating the parameters in the differential equation of motion

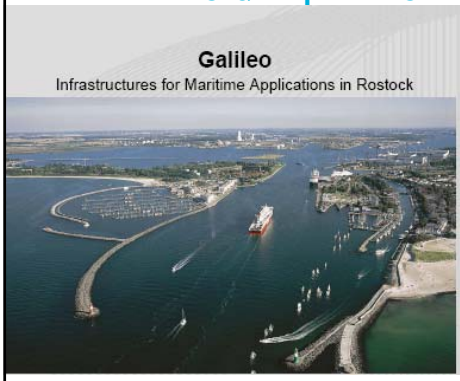


2. Collision Avoidance: Applying simulation to calculate actual manoeuvring data for counter measures

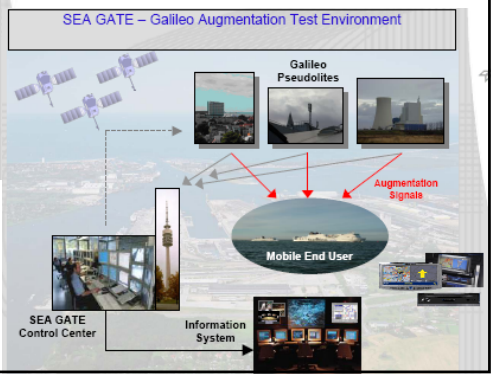


3. Manoeuvre Planning: Applying Search methods to bring the ship into a harbour basin by generating sequences of elementary manoeuvres

Outstanding resources for research & development due to "Research port Rostock" infrastructure in 2008



Installation of GALILEO Satellite test bed infrastructure in Rostock port area provides unique potential for maritime applications



Future projects: Parameter estimation technologies for ship dynamic models and tests of all other subjects for collision avoidance, navigation and shiphandling…

Thank you for attention.

Prof. Dr.-Ing. Knud Benedict
Hochschule Wismar, University of Technology, Business & Design
Department of Maritime Studies
Maritime Simulation Centre Warnemunde /MSCW
E-Mail: knud.benedict@hs-wismar.de
www.sf.hs-wismar.de