AZIPILOT

Workshop

STC - Rotterdam, 24th of February 2011

WP2 - Marine Simulation

Progress and results

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Overall objectives

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- PHASE 1: Critically **review** existing knowledge and ongoing research in the field of Marine Simulation, specifically related to the modelling and validation of azimuthing control devices.
- PHASE 2: **Summarise** the compiled knowledge in a format that is readily accessible to the crossdisciplinary audience formed by other Work Packages.
- PHASE 3: **Review and assimilate** material compiled and presented by other Work Packages.
- PHASE 4: Identify critical short-comings and thus map out the **landscape for future research** and validation.

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WP2 tasks

Completed

Task 2.1: Review of ability to simulate azimuthing devices
Task 2.2: Review of existing ship simulator capabilities
Task 2.3: Review of ability to simulate azimuthing device interactions
Task 2.4: Review of ability to model bridge systems and human interface

On-going

Task 2.5: Encapsulate knowledge using "task analysis" feedback
Task 2.6: Summarize simulation capabilities
Task 2.7: Assimilate cross-disciplinary knowledge from other WPs
Task 2.9: Publication of dedicated Project Journal

Towards the end of AZIPILOT

Task 2.8: Implement obtained knowledge in development plan

Task 2.10: Map out the landscape of future research

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WP2 participants

- METTLE (France)
- CTO (Poland)
- FORCE Technology (Denmark)
- DST (Germany)
- STC (Netherlands)
- Transas (Ireland)
- SRTC (Poland)
- UNEW (UK)

T2.1 - Review of ability to simulate azimuthing devices

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FOCUS

- From PC-based simulators up to Full-Mission-Bridge Simulators
- Manned models centres

CONTENT

- Survey of existing simulators and capabilities regarding azimuting control devices
- List of subjects specific terminology and definitions
- Discussion of the technical qualities of these simulators taking into account which ship types they can handle, which types of manoeuvres that can be simulated and if they can handle shallow water effects.

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T2.1 - Review of ability to simulate azimuthing devices *Full Mission Bridge Simulators*

- Information and feedback collected from:
  - Maritime Institute of Technology & Graduate Studied (MITAGS)
  - TRANSAS
  - NS 5000 simulator by Rheinmetall Defense Electronics
  - Force, Lyngby
  - Australian Maritime College
  - Development Centre for Ship Technology and Transport Systems (DST) Duisburg

  - MITAGS, Washington Di, USA: 2 Full-Bridge 360 degree view Simulators and Tug simulator.
  - Pacific Maritime Institute, PMI, Seattle, USA: 2 Full-Bridge Simulators and Tug Simulator
  - Marine Engineering School, MEBA, Easton, Maryland, USA: 2 Full- Bridge Simulators and 2 Tug simulators
  - Georgian Great Lakes Maritime College, Canada, 4 Full-Scale Bridge Simulators in Network.

T2.1 - Review of ability to simulate azimuthing devices *Full Mission Bridge Simulators*

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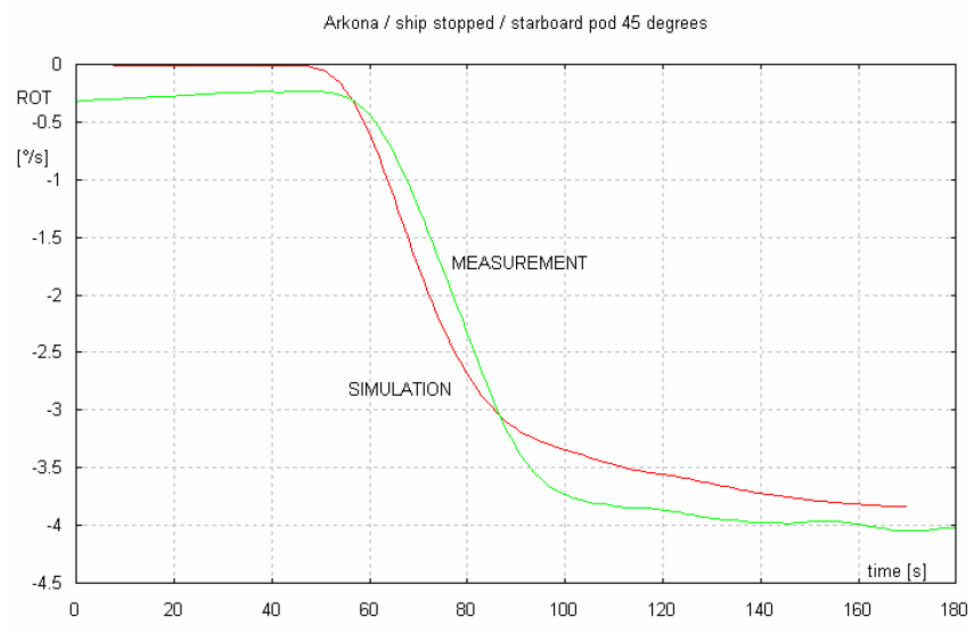
- Effects which are taken into account:
  - Propeller thrust
  - Transverse propeller force
  - Lift and drag forces of the POD body
  - Interaction effects between different POD units
  - Interaction effects between POD and hull,
  - Shallow water effects



; 1. Comparison of simulated and measured characteristics of stopping moeuvre ARKONA ship (Ref. 5)

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T2.1 - Review of ability to simulate azimuthing devices *Manned Model Simulators*

- Information and feedback collected from:
  - Port Revel Shiphandling (France)
  - Ilawa Ship Handling Research and Training Centre (Poland)

Fig 2. Model of container vessel with azimuting propulsion (Port Revel Shiphandling)

Table 6 Parameters of the model (PRS)

Parameter	Ship	Model
L_{PP} [m]	261.0	10.45
B [m]	37.1	1.48
Displacement [tons]	75000	4.67
Draft [m]	12.48	0.5
Shaft Horsepower [HP]	52000	-
Block coefficient	0.60	
Model scale	25	

Fig.4. Model of POD driven gas carrier in SHRTC

Table 7.Dimensions of the model used in SHRTC

Dimension	Real ship	Model
Length [m]	277.45	11.56
Breadth [m]	43.2	1.80
Draft [m]	12.0	0.50
Block coefficient [-]	0.79	0.79

T2.2 - Review of existing ship simulator capabilities

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- Review the most common influencing factors that affect ships when operating in close quarters:
  - **Shallow water effect**
  - **Bank effects**
  - **Surface and submerged channel effects**
  - **Ship-to ship interactions**
  - Steering with azimuthing control devices **when towing**
  - Steering with azimuthing control devices **when under tow**
  - **Assisted braking** including the indirect mode
  - **Tugs operating near the stern of pod driven ship**
- **Part 1:** Survey of influencing factors that affect ships operating at close quarters including typical interaction between target ships (azimuthing or otherwise)
- **Part 2:** Survey of capabilities of existing simulators, either Full Mission Bridge Simulators (FMBS) or Manned Models Simulators (MMS) to simulate these effects.

T2.2 - Review of existing ship simulator capabilities

Effects of shallow water

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- When the ship is sailing in shallow water or in a canal then its **resistance is increasing rapidly with increasing of the speed reaching local maximum at speed roughly corresponding to the critical speed.**

Effects of shallow waters or channels:

- Increase of the ship resistance, causing reduction of ship's speed
- Changes of the ship trim
- Increase of the ship draft
- Changes of the manoeuvring characteristics

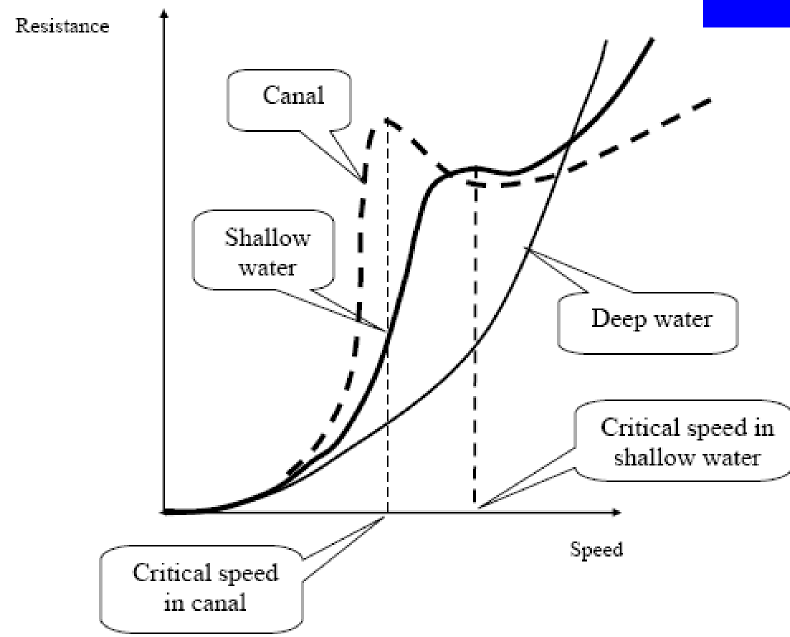

Fig.2. Resistance curve in deep and shallow water and in the canal

- Influencing parameters:
  - depth of the water,
  - depth of the water over draft of the ship ratio,
  - form of the hull,
  - speed of the ship,
  - hydraulic radius or blockage coefficient of the canal

T2.2 - Review of existing ship simulator capabilities

Bank or wall effect, surface and submerged channel effects

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- In proximity of the bank:
  - Velocity increases
  - Static pressure drops
  - Water level drops

  => Suction force that draws the ship closer to the bank

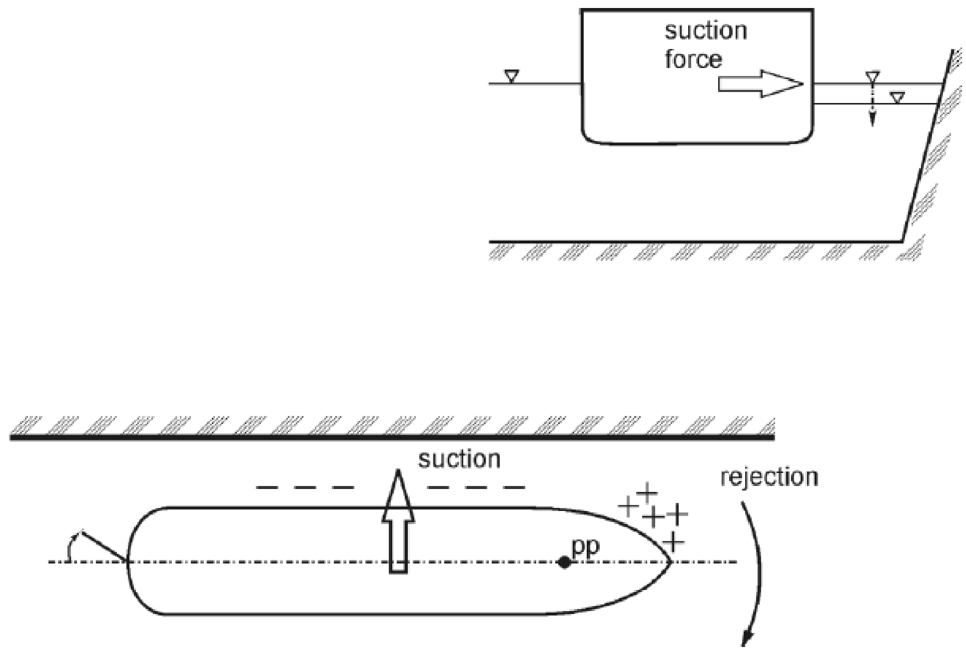

Fig. 4. Effect of proximity of the bank

T2.2 - Review of existing ship simulator capabilities

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- **All special hydrodynamic effects are covered from the simulators investigated.**
- The magnitude of the effects is sometimes very different.
- The expectations from theory are satisfied mostly.
- The **development of the shallow water effect with decreasing water depth** is not always modeled correctly.
- The **magnitude of the bank effect** is very different on the simulators investigated.
- The ship-ship-interaction effect shows reasonable development with the passing distance but some doubtful results during the time of the manoeuvring.

T2.3 - Review of ability to simulate azimuthing device interactions

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- Capability and validity of the modelling used for the most common situations:
  - Effects of hull-form on azimuthing control device performance;
  - Non-linear effect in azimuthing control device performance;
  - Review of operational models and effects on interactions.

Most existing simulator modules for podded propulsive drives do take into account propeller thrust, transverse propeller forces, and lift and drag forces on the pod body.

Adequate modelling of the interaction effects between different pod units, and shallow water effects on podded vessels.

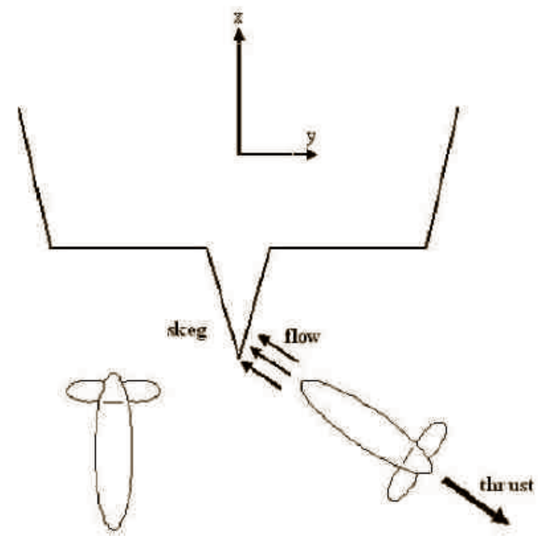

Fig.3: Example of pod / hull interaction

T2.3 - Review of ability to simulate azimuthing device interactions

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Results of a **survey of pod manufacturers and operators:** ability of simulators to replicate interactions between multiple azimuthing control devices, and between ACD and ship's hull.

- **Importance of interaction** between two or more podded propulsors.
- **Strong influence** on the maneuvering characteristics of a vessel in certain modes of control.
- It is not known if, and how, this effect is taken into account in **computer programs** used in real time simulator facilities.
- When using large **manned models** for training this effect is automatically taken into account.

Availability of data on the interaction between a pod and the form of the ship's hull, in particular on the effect of skegs and fins.

Non-Availability of data on wake and form coefficients for ships with podded propulsors

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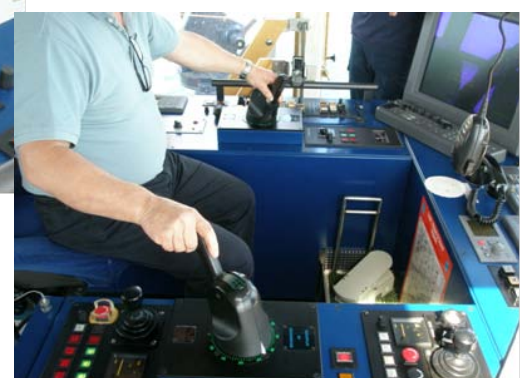
T2.4 – Review of ability to model bridge systems and human interface

- ***On-going work:***
  - Review of the ergonomics of various control systems that are commonly used in conjunction with azimuthing control devices.
  - Discuss Bridge and operational information systems.

Onboard Svitzer M class tugs

Close up photo of push buttons for taking control from levers to push buttons



The operation and handling through the controllers for the azimuthing propulsion system is seen as an **overload situation** because it needs **constant vigilance and manual adjustments** by the operator.

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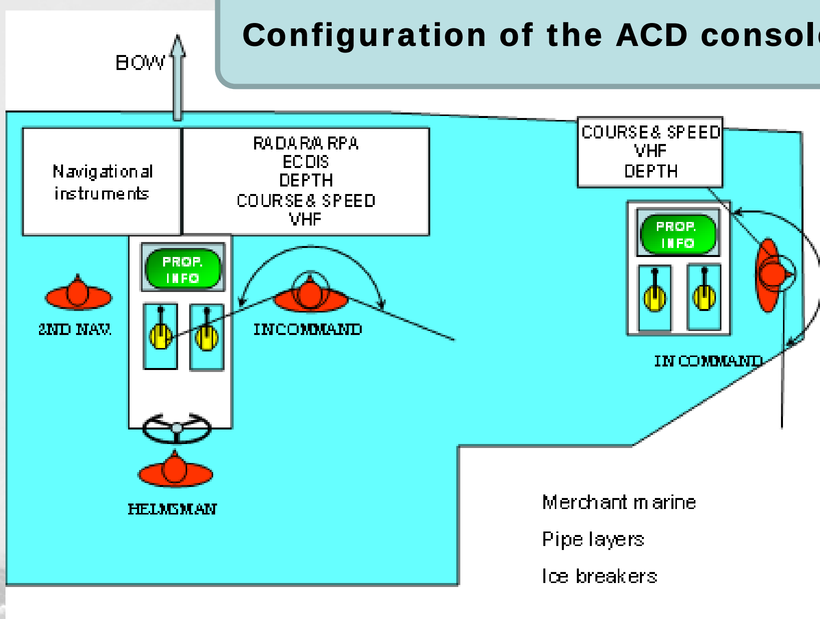
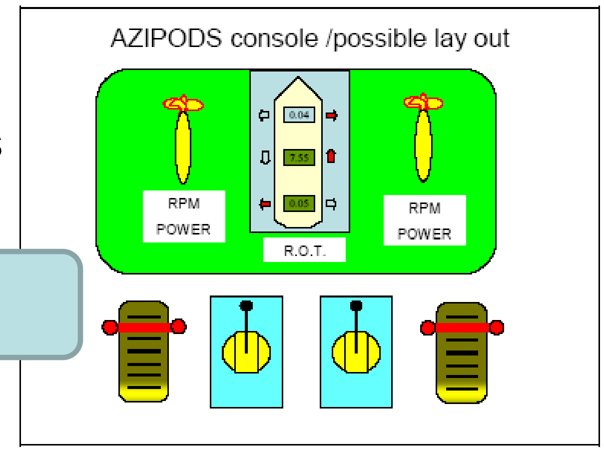
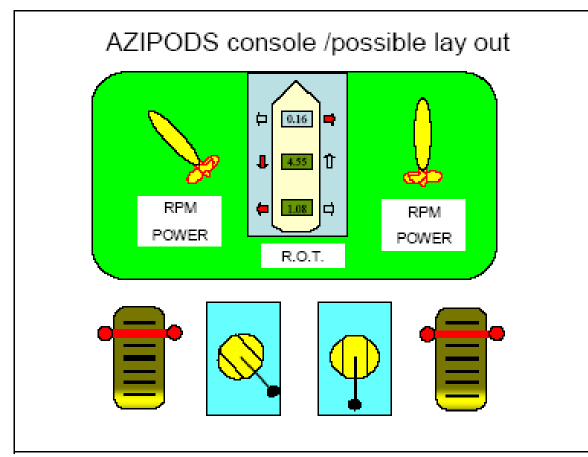
T2.4 – Review of ability to model bridge systems and human interface

- ***On-going work:***
  - Review of similarities between different (sister)ships when considering bridge lay out and manoeuvring operations
  - Review optimum layout for each expected task
  - Discussion about optimal layout
  - Interviews from users and some of their concerns

Configuration of the ACD consoles, per ship types







T2.4 – Review of ability to model bridge systems and human interface

Identification of maneuvering situations:

- Open sea
- Confined waters
- Anchor areas
- Narrow channel / rivers Port basins
- Terminal approach
- Open sea off shore
- Short track ferry
- Tug assistance

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	TYPE OF SHIP								FEATURES											
	Merchant marine	Navy	Harbour tugs	Inland ferry	Offshore supply vessels	Pipelayers	Icebreakers	sea going tugs	automatic / manual	coupled (C) / uncoupled (UC)	change to other console	in combi with other thrusters	position shiphandler relative to azipod console	ENVIRONMENTAL VIEW at azipod console	Observation of RADAR/ARPA from Azipod console	Observation of ECDIS from Azipod console	Observation of COURSE&SPEED from Azipod console	VHF at the AZIPOD console	Depth information at the AZIPOD console	Intensity of manoeuvring
Open sea	X	X				X	X	X	auto	C	No	No	A	A	Yes	Yes	No	No	No	
Confined waters	X	X				X	X	X	auto/man	C	No	No	A	A	Yes	Yes	Yes	No	No	
Anchor areas	X	X			X	X	X	X	man	C / UC	N							No	No	
Narrow channel / rivers	X	X	X	X	X	X	X	X	man	C/UC	No	No	A	A	Yes	Yes	Yes	Yes	Yes	
Open sea offshore					X				auto/ man	C / UC	Yes	Yes	A/B/C/D	A/B/C/D	Yes	Yes	Yes	Yes	No	
Port basins	X	X	X	X	X	X	X	X	man	UC	Yes	No / Yes	B/ C	A/B/C/D	Yes	Yes	Yes	Yes	Yes	
Terminal approach	X	X	X	X	X	X	X	X	man	UC	Yes	No/ Yes	B / C	A/B/C/D	No	No	Yes	Yes	No	
Short track ferry				X					man	UC	No/Yes	No	A/D/E	A/B/C/D or E	Yes	No	Yes	Yes	No	
Tug operation			X						man	UC	No	No	E	E	Yes	Yes	Yes	Yes	No	

On-going and remaining activities in WP2

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- **Recommendations for best-practice** when selecting and specifying bridge systems.
- **Guidelines for the selection of appropriate controls** for different types of azimuthing devices and provide guidance on their use.
- **Sum-up existing Marine Simulator capabilities** with respect to their capabilities regarding azimuthing devices and their application and including their validation and limitations.
- **Recommendations for the improvement of the technology**; specifically when dealing with ships equipped with azimuthing control devices.
- Creation and publication of a **dedicated project "Journal of Marine Simulation".**
- Landscape of **future research and development within the field of Marine Simulation;** and specifically with respect to the application of marine azimuthing control devices.

Intuitive operation
and pilot training
when using marine
azimuthing
control devices

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