

Ship handling Simulation Dedicated to Channel and Harbour Design

1. Historical background - Definition of the problem

For three decades there is one common element in discussions, analysis and reports on harbour and channel design: the ever increasing size of the ships as well as the increasing variety of different types with very different manoeuvring capacity and behaviour. Today, a situation is reached where it is not uncommon to even optimize and practice a turning manoeuvre in harbour basin after a new bigger sized vessel is announced for arrival and accommodation but before construction commences.

The tool of choice to validate a harbour layout or a channel design as well as to optimize a manoeuvre with an unfamiliar ship size or to access limiting operating conditions is the Shiphandling Simulation. Providing a virtual reality, this approach combines the advantages of full scale experiments with availability in advance, before the situation to be examined becomes real. This tool becomes additionally superior due to no inherence of risk and the comparatively low costs.

Therefore all parties involved should be encouraged to constantly improve the application of this tool to bridge the still remaining gap to virtual reality. All elements included in a simulation study need to be analysed for revision and improvement such as, the set-up of a simulation, the audio-visual presentation and, possibly the most complex and elaborate task, the mathematical manoeuvring model of ships in waterways and shallow water, in order to provide a tool that is consistent with the fleet of vessels to be designed for.

2. Objectives of the Working Group

The objectives of the Working Group will be to review, update and, where appropriate, expand on the report of Working Group 20 on "Capability of Ship Manoeuvring Simulation Models for Approach Channels and Fairways in Harbours", Supplement to Bulletin N°77, of 1992.

The Working Group will focus on the recent developments in terms of technological progress for simulators and experimental sensors, improved nautical tactics in harbours as well as progress in psychological aspects concerning human factor. It is very likely that more detailed studies (as a supplementary amendment) on single parts in the report may turn out to be worthwhile and will therefore be in the scope of the WG as well.

The specialized matters that will be addressed do not have a direct connection with climate change. Nevertheless Shiphandling Simulation will certainly be an excellent tool in the further future for addressing the effects of climate change impacts on navigation (e.g. **due to wind and waves**).

3. Earlier reports to be reviewed

- WG 20 – Capability of Ship Manoeuvring Simulation Models for Approach Channels and Fairways in Harbours, Supplement to Bulletin N°77, 1992
- WG 49 – Harbour Approach Channels Design Guidelines, will be published in 2013
- IALA Guideline No. 1058 – The Use of Simulation as a Tool for Waterway Design and AtoN Planning, Edition 2, June 2011

4. Matters to be investigated

The Working Group should consider the following issues and items:

- Simulation study set up, concepts and methodologies appropriateness
- Task oriented planning of a simulation study
- Aspects of human factors in simulator situation
- Requirements on accuracy of environmental data (e.g.: wind, waves, bathymetry)
- Experimental determination of manoeuvring characteristics, of shallow and restricted water effects as well as effects due to wind, current and waves
- Numerical determination of manoeuvring characteristics, of shallow water effects as well as numerical calculation of wind, current and wave forces
- Application of simplified models to make them compatible with real time and keep them reliable
- Mathematical models for coupled bodies behaviour characteristics (Tugs and Ship interaction including the line and windlass characteristics) and for ships passing each other
- Technological aspects in 3D presentation of the surrounding channel areas and scenery
- Technological aspects of controls and instrumentation in the simulation, including appropriate design of generic instruments.
- Aspects of manoeuvring model validation based on expert rating and comparison to experimental data.
- Effect of fluid mud and concept of “navigable depth”

After constitution, the Working Group will take into consideration the possibility of including in its scope of works the simulation applied to inland navigation vessels.

5. Method of approach

- Collation and review of recent developments in technology (such as mathematical and physical modelling, presentation methods in the view system, equipment and instrumentation, available Shiphandling Simulators).
- Review and, where appropriate, update the report of PIANC-Working Group 20, Supplement to Bulletin N°77, published in 1992.

6. Suggested final product of the Working Group

The final report of the Working Group will provide guidelines and recommendations on the application of Shiphandling Simulation to verify design of approach channels to harbours and terminals, and the manoeuvring areas within harbours, as well as to check manoeuvre tactics in a safe manner beforehand. The report will give a detailed view on the state of the art and is expected to serve as a best practice guide on Shiphandling Simulation in channel design process.

The final report should be presented as an update to the PIANC-Working Group 20 "Capability of Ship Manoeuvring Simulation Models for Approach Channels and Fairways in Harbours", published in 1992, but be a standalone document presenting the state of the art.

7. Desirable disciplines of the members of the Working Group

It is proposed this working group be composed of:

- Operators of Shiphandling Simulators
 - Naval architects (desirable with an emphasize on manoeuvring)
 - Modellers in virtual reality
 - Specialists of numerical simulation
 - Port authorities
 - Port engineers and civil engineers
 - Ship pilots
 - Tug operators

8. Relevance for countries in transition

The guidelines and recommendations on the application of Shiphandling Simulation will help countries in transition to get used to this approach in channel design process. It combines the advantages of full scale experiments with availability in advance, before the situation to be examined becomes real. This tool becomes additionally superior due to no inherence of risk and the comparatively low costs.