D3.2 Integration of communication

Creation Date: 2013-09-06
Revision Date:
Project: MoveIT!
WP: 3

Responsible: Autena Marine – Mr. Savelkoul

Document Properties

Document Name:	D3.2 Integration of communication
Document Author(s)	Arno Bons
Document Editor(s)	Arno Bons
Date of delivery	2013-04-29
Nature of Deliverable	☐ Report ☒ Prototype ☐ Demonstrator ☐ Other
Circulation	
Security Status	
Document Status	☐ Draft ☒ Final ☐ Approved by SG Steering (or SP meeting type-D) ☐ Approved by reviewer ☐ Acknowledged by MOVEIT! Steering ☒ Issued to EC
Keywords	Economy Planner, water depth, sharing, actual chart, integration of communication
Related MoVeIT! Reports	D3.1 - D3.3 Economy Planner Interface Overview Economy Planner Use Case Overview

Partners involved

No.	Organisation Name	Name	Email
1	MARIN	Arno Bons	a.bons@marin.nl
2	Via Donau	Juha Schweighofer	Juha.Schweighofer@via-donau.org
3	Autena Marine	Desiré Savelkoul	d.savelkoul@autena.nl
4	VNF	Pierre-Jean	pierre-jean.pompee@vnf.fr
5	DST	Cornel Thill	thill@dst-org.de
6	CFT	Steve Labeylie	steve.labeylie@cft.fr
7	TKV	Bé Boneschansker	be.boneschansker@thyssenkrupp.com
8	Helogistics	Viatcheslav.Vdovitchenko	Viatcheslav.Vdovitchenko@helogistics.com
9	Plimsoll	Szalma Bela	szbela@plimsoll.hu

Document history

Version	Date of delivery	Changes	Author(s) Editor(s)	Reviewed by
1.1	06-09-2013		Mr.Bons	Mr. Savelkoul
1.2	09-27-2013		Mr. Bons	Mr. Thill

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1 Executive Summary

1.1 Problem Definition

In order to determine the maximum allowable loading condition and optimal track for inland ships, actual water depth information is required. One of the main goals of the EC Planner is to create an actual electronic chart presenting actual water depths. As local water depth might be subject to sedimentation, discharge of local surface water and many other aspects, the real applicable local depth is not retrievable from charts, even not from most of the electronic charts such as ECDIS. To solve this problem, the real actual local water depths can be updated by gathering the information of all ships equipped with the EC Planner, so other ships may benefit from the findings and experiences of the own ship.

1.2 Technical approach

First, local water depths has to be gathered, from the individual inland ships using the European inland waterways. Ships equipped with the EC Planner will broadcast their measured and corrected water depth, for a certain GPS position and time, to an onshore server from Autena Marine. The local water depth can be determined on basis of the echo sounder signals. Since, echo sounders are not measuring the water depth, but -depending on their programming and transducer position- the under keel clearance, it has to be corrected for initial draft and squat[1]. Finally, the actual water depths will be presented on the ECDIS (Electronic Chart Display Information System) to the skipper.

1.3 Results and Achievements

- The virtual ship as part of the EC Planner determines local water depths on basis of echo sounder signals by using mathematical ship-squat prediction of Ankudinov.
- In addition to the original MoveIt proposal the EC Planner is able to make use of the expected water depth, current speed and passage clearance as calculated by the FEWS model of Deltares.
- The EC Planner is able to create an actual electronic chart based on actual water depths. The actual water depths will be presented on the ECDIS (Electronic Chart Display Information System) to the skipper.

1.4 Contribution to MoVeIT! objectives

The objective of this work package is to reduce fuel consumption by energy efficient ship operation, by developing the EC Planner. This will be done by implementing the following measures in the EC Planner; installing the EC Planner on board of the 4 selected ships of shipping companies involved, developing a system to share water depth information with other ships, determination of the optimal track on the river and development of an optimal autopilot following the track at the least fuel consumption.

Based on the shared water depth information the voyage planner of the EC Planner determines the optimal track. Furthermore, by knowing the actual water depth, the

[1] i.e. the dynamic sinkage of a sailing vessel, which is subject to its shape, speed and the actual water depth and fairway width

skipper is able to determine the maximum allowable loading draft for his voyage. The aim of energy efficient ship operation is to decrease the fuel consumption taking into account the effects of the restrictions of the fairway. The virtual ship of the EC Planner prevents that a unnecessary surplus of energy is used when restrictions occur. The skipper is advised to decrease the number of revolutions to the best value.

1.5 Exploitation and Implementation

The local actual water depth information, as result of D3.2 integration of communication, can be used by ship owners to determine maximum allowable loading condition. Furthermore, the developed EC Planner in MoveIT! uses this information to determine the optimal track, see also D3.3, Optimal Track. In theory other (existing) voyage planners could use this actual water depth information as input for the determination of their voyage plan and/or determination of an accurate ETA.

2 Integration of communication

One of the main goals of the EC Planner is to create an actual electronic chart based on actual water depths. This will be achieved by gathering local water depths as measured by individual inland ships using the European inland waterways. Ships equipped with the EC Planner will broadcast their local water depth, for a certain GPS position and time, to an onshore server from Autena Marine. The local water depth can be determined on basis of the echo sounder signals. Since, echo sounders are often not measuring the water depth, but under keel clearance, it has to be corrected for initial draft and squat.

2.1 Determination of squat

Squat is the reduction in underkeel clearance between a vessel at-rest and underway due to the increased flow of water around the moving hull. The sailing ship displaces the water. As this displaced water is also bounded by the cross section of the fairway, the water needs to be accelerated, as it has to pass the reduced available cross section area in the same time than the flow would have using the full cross section area without a ship. The velocity field produces a hydrodynamic pressure change along the ship (Bernoulli effect). The weight of the ship is carried by this reduced hydrodynamic pressure, such that equilibrium can only be reached when the ship is sinking deeper to be exposed to higher pressures. This equilibrium is found at an usually increased sinkage (positive downward) and at a different trim (positive bow upThis combination of sinkage and change in trim is called ship squat [1].

The initial draft of the ship is known at the beginning of the voyage and can be automatically retrieved from the loading computer of the ship. The virtual ship, as developed by Marin calculates squat, based on the mathematical ship squat predictions of Ankudinov [1].

[2] Corrected for squat and trim effects and effects oft he local installation of GPS and eco sounder transducer position aboard

Also the contributions of Prof. E.O. Tuck to the field of mathematical ship-squat prediction [4] is considered. Both methods for calculating sinkage and trim coefficients, using easily obtainable ship parameters. These parameters have to be set once during the installation of the EC Planner. Nowadays, squat coefficients are checked by systematic CFD calculations at Marin. At this stage the ship squat predictions of Ankudinov seems to be the most promising. The correction method developed by DST could be implemented once the test of the EC planner V1.0 shows a need for this.
Please note, the results of the measurements are required to calibrate and further improve the methods as implemented in the Virtual Ship of the EC Planner. The contribution of squat to the total sinkage and trim of the ship can be substantial, especially in shallow water. An example for a typical inland ship is given in the pictures below. In here you can see the theoretical influence of ship speed and water depth on the ship's sinkage and trim.

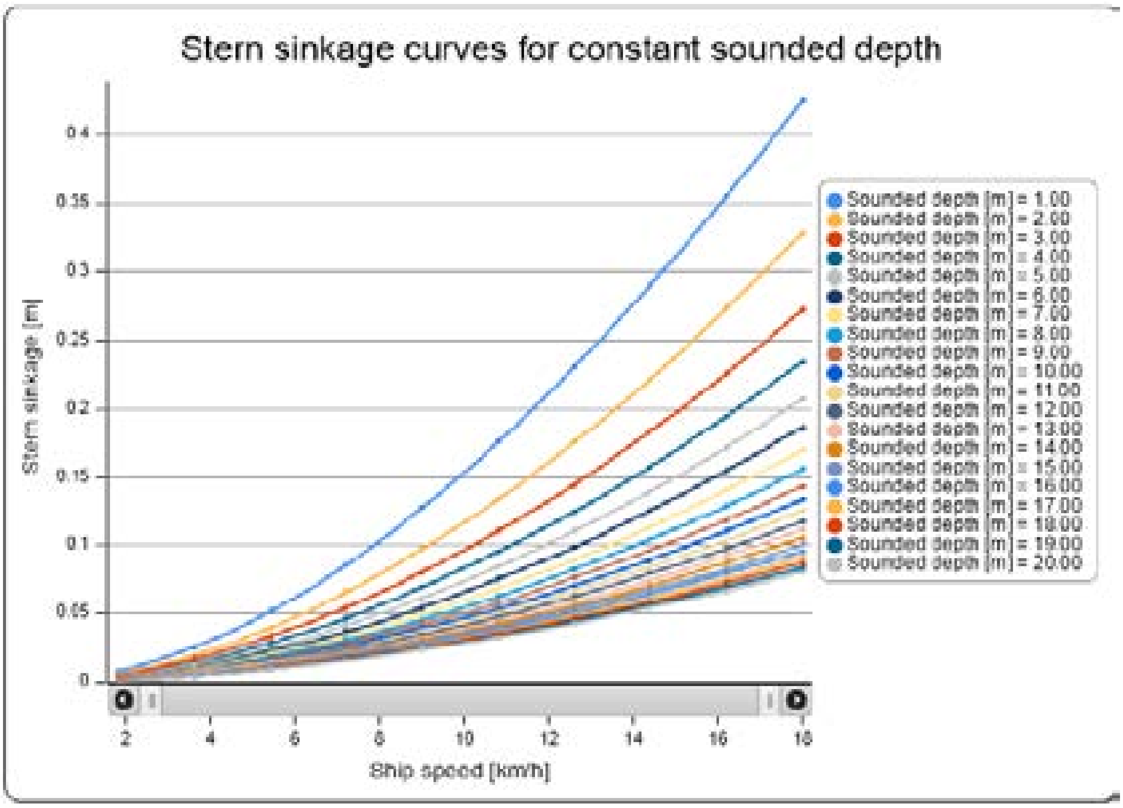

Figure 1: Stern sinkage curves for constant sounded depth

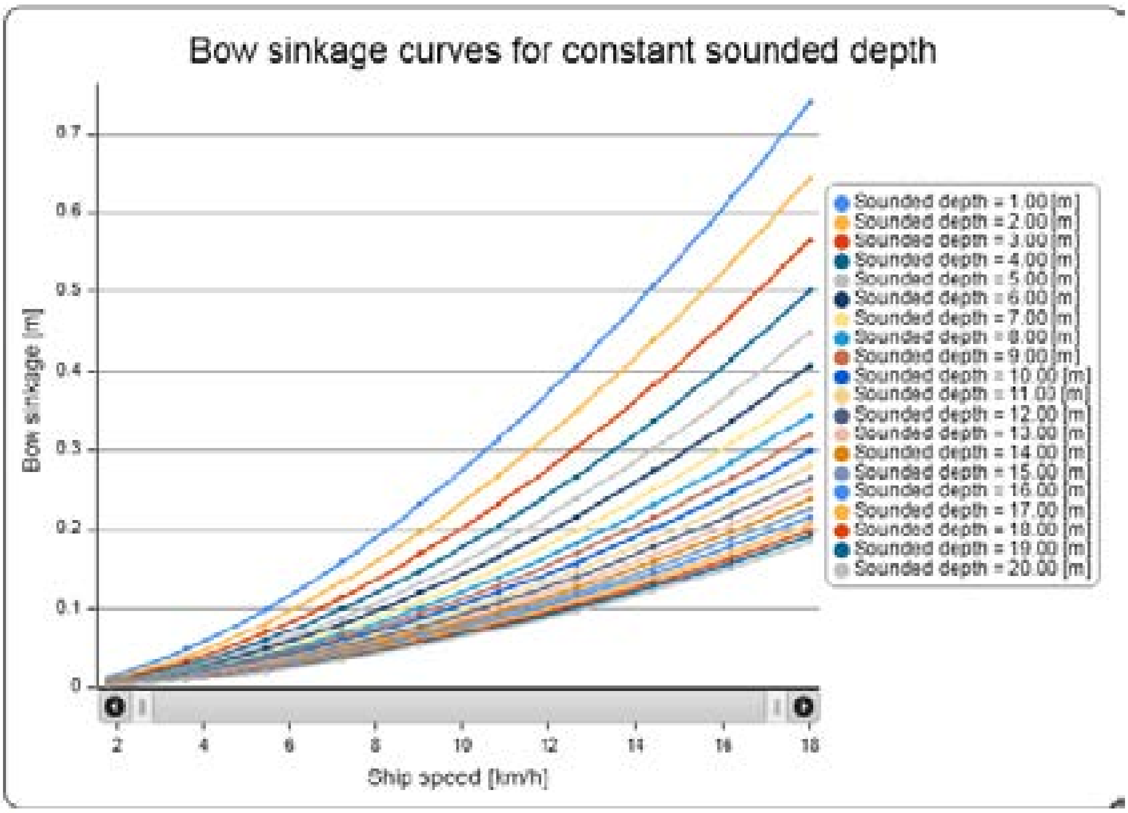

Figure 2: Bow sinkage for constant sounded depth

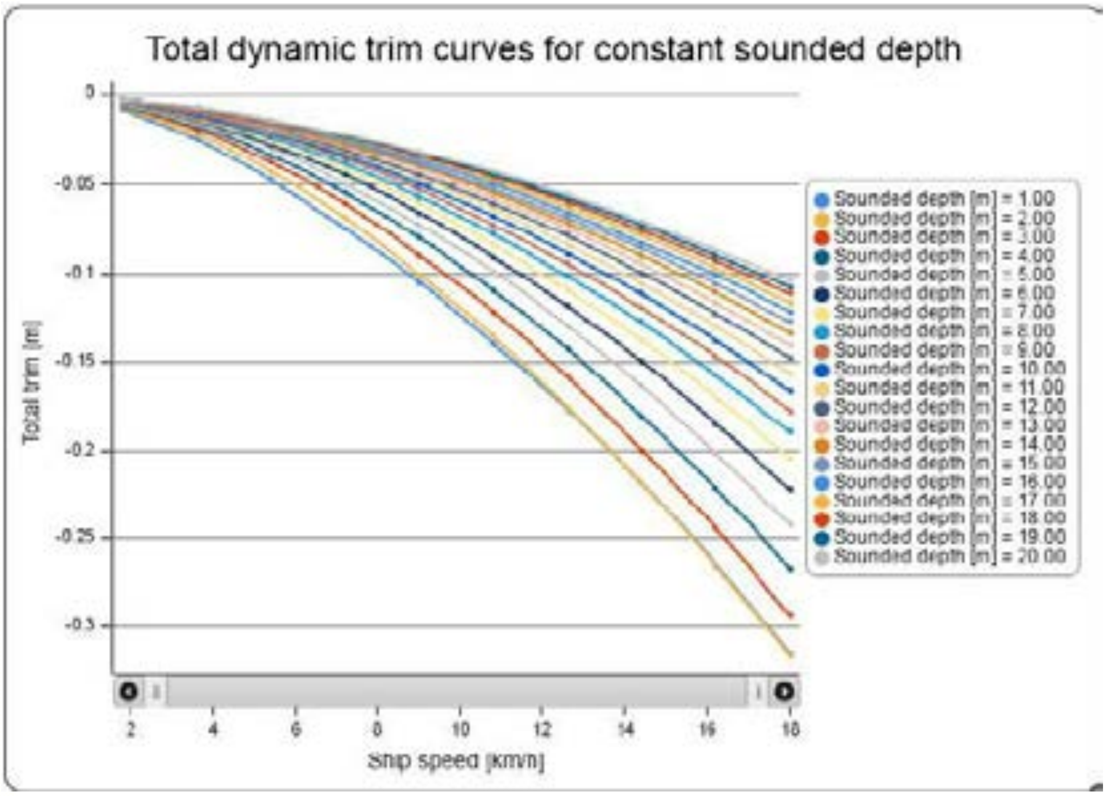

Figure 3: Total dynamic trim curves for constant sounded depth

2.2 Gathering data

Autena Marine has configured an on shore server for gathering data from the inland ships. For this MoveIT! project the server will gather data from the 4 selected ships.

As explained before, the EC Planner integrates both static and dynamic information of both current and upcoming situation. An important role within current the system architecture of the EC Planner is played by Deltares [5]. Deltares is responsible for the calculation of the expected water depth, current speed and passage clearance, which can be performed by their hydrological forecasting system FEWS [6] (Flood Early Warning System). More information about this forecasting system can be found on internet. The calculation of the expected values takes up to eight hours and be performed onshore. The EC Planner on board will download the most up to date data from the Deltares server onshore. More detailed information about the interface description of the data to be exchanged can read in “Economy Planner Interface Overview” [2] or in the appendices of deliverable D3.1 “Implementation of EconomyPlanner”.

2.3 User interface

Finally, the current water depths are used for the creation of the actual map that will be presented on the ECDIS (Electronic Chart Display Information System) to the skipper, see Figure 4. A prototype of a user interface of the EC Planner is given in Figure 5. Both the current and upcoming water depths will be used by the virtual ship of the EC Planner for the determination of the optimal track. More information about the determination of the optimal track can be read in deliverable D3.3 Optimal Track.

Figure 4: Optimal track presented on ECDIS, based on actual water depths


Figure 5: Prototype User Interface EC Planner

3 Bibliography and References

1. Ankudinov, V., Daggett, L. Huval, C., and Hewlett, C. 1996. "Squat Predictions for Maneuvering Applications, International Conference on Marine Simulation and Ship Maneuverability," MARSIM' 96, Balkema, Rotterdam, The Netherlands.
2. Molenmaker Kor, MARIN, Economy Planner Interface Overview, September 2013
3. Molenmaker Kor, MARIN, Economy Planner Use Case Overview, September 2013
4. Tim, Gourlay, A brief history of mathematical ship-squat prediction, focussing on the contributions of E.O. Tuck, Volume 70 (1) Springer Journals – Jul 1, 2011
5. Deltares, http://www.deltares.nl
6. FEWS, http://www.deltares.nl/nl/software/479962/delft-fews

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4.2 *List of Abbreviations*

ECDIS	Electronic Chart Display Information System
EC Planner	EconomyPlanner
ETA	Expected time of arrival
FEWS	Flood early warning system
GPS	Global positioning system