NAVAIS
New Advanced Value Added Innovative Ships

NEWSLETTER
MAY 2020 - Volume 03

NEW, ADVANCED AND VALUE-ADDED INNOVATIVE SHIPS

This third edition of the Newsletter of the NAVAIS project, provides an overview of the activities executed since October 2019. NAVAIS develops a platform-based modular product family approach supported by the **3D**EXPERIENCE® integrated business platform. This concept will increase efficiency in vessel design and flexibility in production networks. NAVAIS focusses on passenger/road ferries and multi-use workboats integrating sustainability in the design of the ships. NAVAIS supports the transfer from an engineered-to-order business model to an assemble-to-order business model, which allows shorter process lead-times, constant quality, reduced design and production costs and better integration of the SME supply chain, thereby increasing competitiveness of the European shipbuilding industry. Since the newsletter of October last year, the project progressed in the execution of a number of aspects, like the breakdown of the most important requirements and functionalities of Road Ferries, the functional decomposition and the creation of functional modules for the platform based workboat family, the creation of a technology selection tool, the definition of a theoretical scenario for the class approval of the functional module design and the preparations of a NAVAIS seminar on 29 October 2020 in Brussels.

AREAS OF INTEREST

NAVAIS works on six areas of attention throughout the lifetime of the project to achieve its goals

1 REQUIREMENTS AND ASSESSMENTS

setting and aligning the detailed requirements, ensuring the different work packages remain aligned, validating and verifying the project results. Cost-benefit, including societal costs, are an important element for defining requirements in NAVAIS.

A key element of NAVAIS is designing new processes for the design, engineering and building of ships. These processes are based on three key elements: ① a design process based on systems engineering and modularity, ② an implementation of these processes in the Dassault 3DExperience® platform software suite and ③ the creation of simulations of the production aspects to validate these approaches. In April 2020 a key point in the project was reached. The process developments were completed by a final assessment and for the next two years, the project will focus on the creation of the low impact ferry and workboat demonstrators, using the methodology designed. Before we could confirm this, an assessment has been executed to validate our processes.

This started with the creation and delivery of an assessment report for each of the processes. In this assessment report, NAVAIS followed the System Engineering approach. The first step is Needs Validation, where all requirements (or Measures of Effectiveness/Measures of Performance) are identified for each process. The second step is concept exploration, where different concepts have been considered. This is followed by concept selection and finally concept validation by setting up a test plan to prove that all requirements are met (if need be at total system and sub-system level). These reports have been discussed in three separate expert sessions, to ensure all requirements are identified and all tests are relevant and do justice to the requirements. Finally, the results of these sessions and the updated assessment reports are shared with the entire consortium to allow a consensus agreement to be reached.

NAVAIS is happy to announce that the processes designed are deemed effective, though some extra work is expected to ensure a smooth application. We will now continue with further validation through the application of the processes to the design and engineering of the low impact modular ferry and workboat families and at the same time create these new ship families.

The project has received funding from the European's Horizon 2020 research and innovation programme (Contract No.: 769419)

2 PLATFORM BASED FERRY PRODUCT FAMILY

creating a platform based modular ferry product family and creating a digital twin to verify by simulations the design and production process

The first two deliverables regarding platform based ferry product families have been completed, where the initial breakdown of the most important requirements and functionalities of Road Ferries has been made. The last couple of months have been spend on creating the initial corresponding suits of functional modulus and scaling ranges. The newly formed initial double-ended road ferry platforms are of an open, semi-closed and closed type. Their scalability is flexible within the database of the hull modules which is under development and will match requirements of the client with the appropriate vessel type.

Additional topics under development are a modularized solution for the charging systems and the electrical propulsion system on the vessel. This will at the end of the project result in a ferry family which fits a large spectrum of requirements.

3 PLATFORM-BASED WORKBOAT PRODUCT FAMILY

to develop a platform-based workboat family for a wide range of customer demands. The concept is based on the analysis and redesign of standards and scalable functional modules often present in the workboat industry.

At month 20 of the project, the activities related to platform-based workboats are very well on track. Having completed the first two tasks, the work package has dived into the functional decomposition and the creation of functional modules for the platform based workboat family. A careful analysis of vessel requirements, on the basis of the market analysis of the previous tasks, is being carried out together with a mapping of the functionalities of a proper workboat.

Based on the vast experience available within the NAVAIS consortium, the requirements and functionalities identified are finally linked to proven logical and physical solutions taking care of the right sizing and approval procedures.

During the next months, few examples of RFLP (Requirements, Functional, Logical and Physical) will be given proving the feasibility of the NAVAIS project.

4 LOW-IMPACT DESIGN & OPERATIONAL PRINCIPLES

to provide guidelines and goals for low-impact design of vessels.

How to select the most effective and efficient combination of equipment for reduction of emissions of your ship? To assist ship designers with this question, a technology selection tool has been created. Based on a ship's operational profile, it proposes several combinations of emission reducing technologies. These solutions can then be compared on a cost basis where the impact to the environment is expressed as a monetary value using the cost-to-society concept. By comparison of those "emission costs" (external costs) with the investment plus operational costs (internal costs), the most effective combination of emission abatement technologies can be selected, see Figure 1.

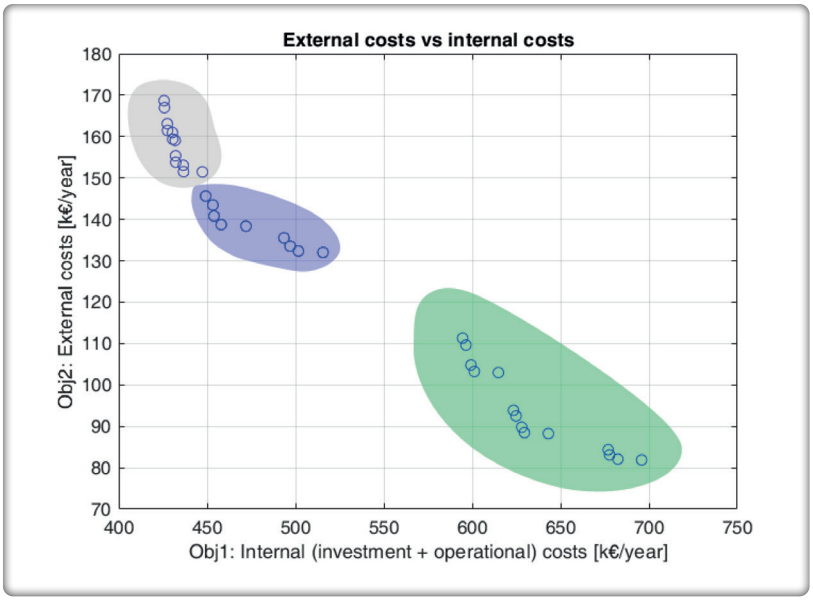

Figure 1 – Results of case study for emission reduction for a workboat. Each blue circle is a unique combination of emission-reducing technologies.

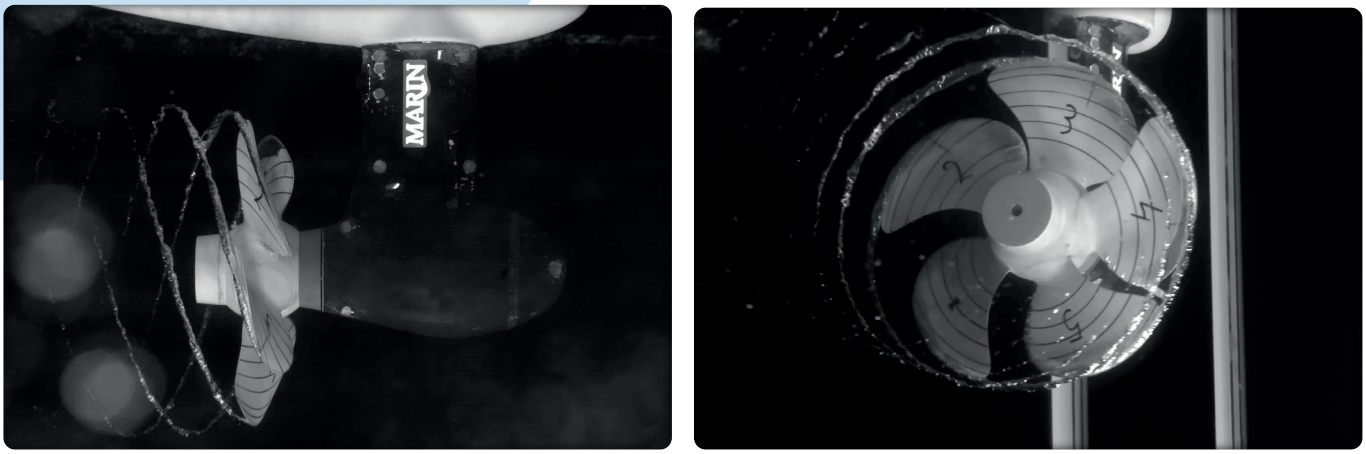

Figure 2 – High-speed video observations of a propeller with so-called pressure side cavitation (representative for a road ferry during deceleration)

But not only emissions from the exhaust are considered in the NAVAIS project; also the emissions of underwater radiated noise (URN) will be evaluated and optimised during the ship design process. There are different mechanisms by which a ship radiates noise into the water. The two main factors are noise radiated by the hull due to vibrations caused by machinery inside the ship and noise radiated by the cavitating propeller. For the machinery-related URN, tools are already available and they will be coupled to the 3DEXPERIENCE® platform. Prediction methods are also available for noise from cavitating propellers in normal operating conditions; sailing ahead at a constant speed. The ships considered in NAVAIS, however, are operating at atypical conditions. The workboats are operating in dynamic positioning mode for a large part of the time for which they use azimuthing thrusters. Road ferries sail relatively short distances and acceleration and deceleration forms a relatively large part of their operational profile. For these conditions – dynamic positioning and deceleration – no tools exist for the predicition of URN of propeller cavitation. These tools are being developed in the NAVAIS project. This development is based on available theoretical models, computational fluid dynamics (CFD) computations and data from model tests. The first step for the CFD computations is to generate a grid of the azimuthing thruster including the propeller. An example of such a grid on the surface of an azimuthing thruster (without propeller) is shown in Figure 2. This is only the projection of the grid on the surface of the thruster; for the computation the whole flow domain is modelled by a grid. The model tests to obtain validation for the theoretical models have been carried out between August and December 2019 in MARIN's Depressurised Wave Basin. Five different propellers have been tested in about 100 different conditions. During these model tests not only the URN was measured but the cavitation patterns were recorded by high-speed video, see figure 3. Those videos can be used to link noise characteristics to specific forms of cavitation, to check the results of the CFD computations and to determine the size of the cavitation vortices, which can be used to check the theoretical models.

The analysis of the URN measurements is currently in progress. In the coming few months, the theoretical models will be formulated and checked. Thereafter, these models will be used to compute the noise of many different (automatically-generated) propeller designs. By studying the trends of the noise of those different designs with respect to number of blades, propeller loading, etc. prediction models for the early-stage design will be created, which will be linked to the **3D**EXPERIENCE® platform.

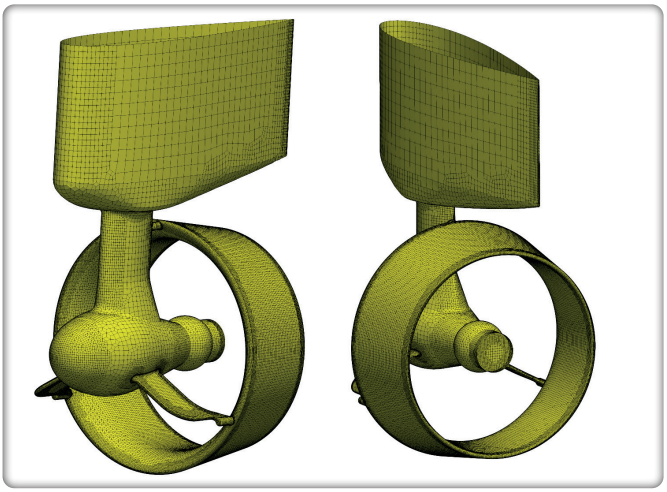

Figure 3 – Example of computational grid for an azimuthing thruster (without propeller)

the principles and guidelines for modularization (design process and re-use library), for platform-based product families definition, for modular production concept and simulation and finally for approval thanks to the **3D**EXPERIENCE platform added value.

Implementation of the 3DEXPERIENCE "On the Cloud" environment allows developing the NAVAIS users' skills.

DASSAULT SYSTÈMES provided an online working environment in order to help NAVAIS users to train, develop, test and validate new methods. The **3D**EXPERIENCE platform "On the Cloud" has been available for forty-two users since December 2019. The **3D**EXPERIENCE user's roles have been identified according to the tasks and deliverables they are working on within NAVAIS. These users have access to a dedicated NAVAIS **3D**EXPERIENCE platform environment on the web and to a public web platform. The first environment is private and allows users to exchange information, to ask questions within the NAVAIS community and to launch the Information Intelligence, Social and Collaborative, 3D Modeling, and Simulation applications from the Compass. While the public web platform allows users to navigate through the existing communities, learn tips and tricks, and share information with other **3D**EXPERIENCE users.

Every user also has access to the Dassault Systèmes' online training courses library (figure 3).

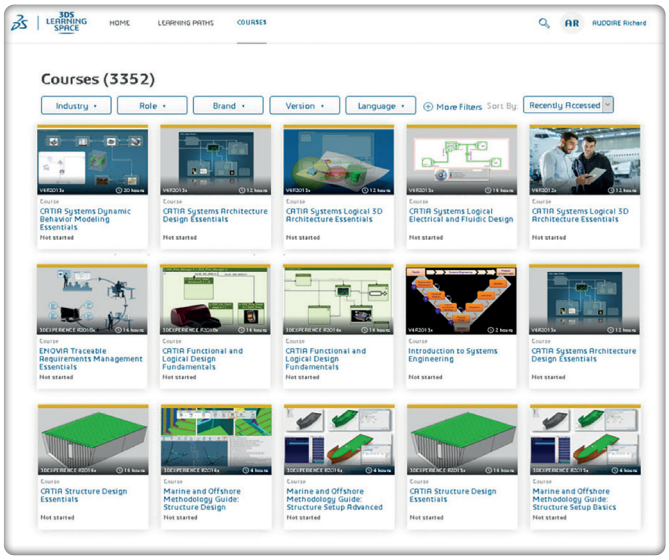

Figure 3: Examples of online training courses

Acceleration of the workboat virtual twin design phase in the 3DEXPERIENCE platform

In accordance with WP3 specifications and following Dassault Systèmes Model Based System Engineering (MBSE) approach named "RFLP" (Requirements, Functional, Logical and Physical), four main representative systems are prototyped: the electrical power system, the bilge system, the fuel oil system, the heating ventilation, and air-conditioning (HVAC) system and the firefighting system. (Figure 4).

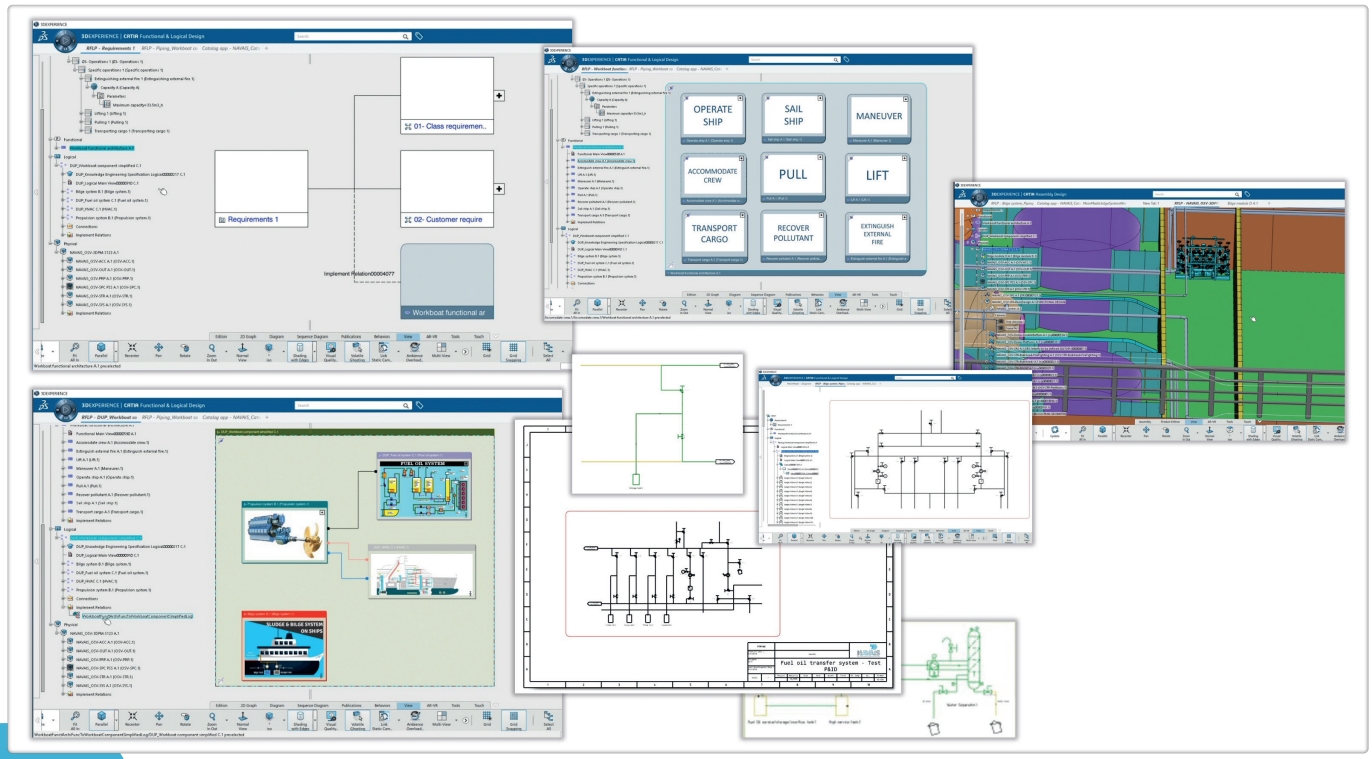

Figure 4: RFLP workboat digital twin overview

In addition to the RFLP approach, NAVAIS created a behavior model in Dymola for each main system. This model has been attached to the specific system Process & Instrumentation Diagram (P&ID) logical view. Let's use the main propulsion system as an example: NAVAIS created a configured logical propulsion system with two variants, as a conventional shaft line architecture and as an azimuth thruster architecture. Then we attached a Dymola behavior model to these two Logical variants as well as the other Logical systems.

From left to right, figure 5 below describes the Logical main view of the four systems with the azimuth thruster configuration, the bilge system P&ID, and the associated Dymola Behavior Model. We study the Dymola Behavior Model in order to check some parameters against the initial Requirements. Once this check is done, the Requirements can be validated (or not) based on the results of the Dymola Behavior Model.

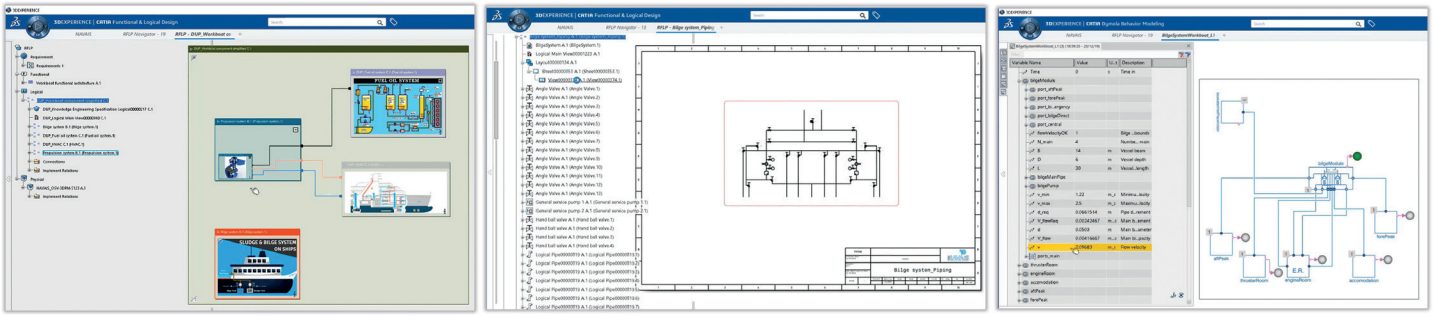

Figure 5: Overview of all the Logical bilge system views

Definition of a theoretical scenario for the approval of the functional module design

Thanks to investigations led by Bureau Veritas jointly with Damen and Dassault Systèmes, NAVAIS drafted a functional module pre-approval process during the basic design phase, before entering the usual class approval process of the detailed design engineering phase (figure 6).

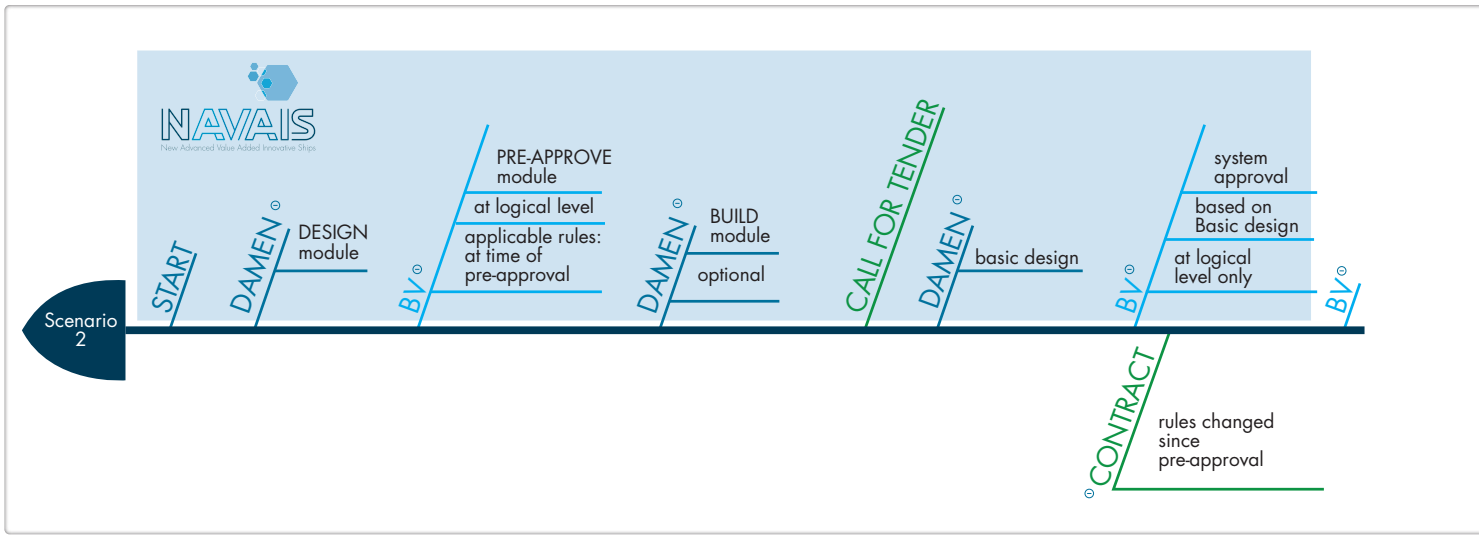

Figure 6: Pre-approval process proposal for a functional module at early design stage

NAVAIS started prototyping this pre-approval process for the bilge system by defining the related system requirements of the Bureau Veritas Rule Note NR566 in the 3DEXPERIENCE platform. In parallel, we have defined a system-engineering framework using Dassault Systèmes RFLP system engineering approach to draft the bilge system requirements of Bureau Veritas Rule Note NR566.

6 DISSEMINATION AND MARKET-UPTAKE

are key to maximize the impact of the NAVAIS project, involve the SME supply chain and to pave the way to market uptake of the project results.

The activities in the framework of dissemination and market-uptake are executed in four interrelated domains:

① The development of a strategy for dissemination and exploitation of the project results, which has been completed in the previous period.

② The development of dissemination and communication measures and tools, the organisation of events, and the facilitation of the involvement of the SME supply chain are key to ensure a proper dissemination and exploitation of the project results. In the past couple of weeks, we have started the development of a corporate movie. In addition, the preparations of a NAVAIS seminar started. This seminar will be organized on 29 October 2020 in Brussels, and additional information will follow in due time;

③ Implementation, monitoring and assessment of the implementation of the strategy and tools developed to ensure the strategy and tools meet the expectations of the target audience, thereby ensuring the maximization of the impact of NAVAIS;

④ The set-up of the involvement of the (SME) supply chain, to facilitate the adaptation to new business models. An SME forum will be created to ensure the supply chain of shipbuilding companies is aligned during the execution of the project.

Any relevant stakeholder that would like to participate in the SME-forum that will be initiated, please contact the project by sending an e-mail to: info@navais.eu

For next issues of the NAVAIS newsletter, please register by using the link on the NAVAIS website:

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Willemswerf
Boompjes 40
3011 XB Rotterdam +31 88 44 51 064
The Netherlands +31 183 63 99 66

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