NAVAIS
New Advanced Value Added Innovative Ships

NEWSLETTER
MARCH 2022 - Volume 05

NEW, ADVANCED AND VALUE-ADDED INNOVATIVE SHIPS

The fifth NAVAIS project newsletter provides an overview of the activities executed since end 2021. NAVAIS develops a platform-based modular product family approach supported by **3D**EXPERIENCE® integrated business platform. This concept will increase efficiency in vessels design and flexibility in production networks. NAVAIS focusses on passenger/road ferries and multi-use workboats integrating sustainability in the design of ships. NAVAIS supports the transfer from an engineered-to-order business model to 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 last Newsletter, the project has progressed in a series of aspects: the implementation of the complete RFLP definition for a number of different class and client requirements; calculation for evaluating the vessel performances and their implementation in the Dassault Systèmes **3D**EXPERIENCE®; development of cavitation noise models; and development of Use Cases as a **3D**EXPERIENCE® oriented guideline.

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 due to emissions, are an important element for defining requirements in NAVAIS.

We have completed the intermediate assessment in May 2021. This assessment is in between two key assessments:
• The Go-No go or interim assessment, where the focus was on the new design process, the implementation of this process in the Dassault Systems software and the set-up of a production approach to validate this
• The final assessment (Due in March 2022) where the focus is on establishing that all key results are achieved, though with a larger focus on the potential success of the modular, low-impact designs of a workboat and ferry. The intermediate assessment therefore assesses the status of all key results, but with a stronger focus on those related to the process and implementation.

For each key result, the status was collected and shared with a number of experts. This was followed by a full day of discussion on the required achievements, relevance of the examples as proof of this and how to ensure timely execution. The result was clear list of requirements, link to clear actions and a confirmation of the creation of Task 5.8 as a coordinating role in all of this.

The key takeaway was that we do feel able to complete the project successfully in the remaining year.

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 simulations of the production process.

NAVAIS is in the final phase for WP2. With the first three deliverables of WP2 finalised, the amount of completed work has significantly increased in the past six months. The first three deliverables described the requirements and provided the boundaries for the rest of the work within work package 2.

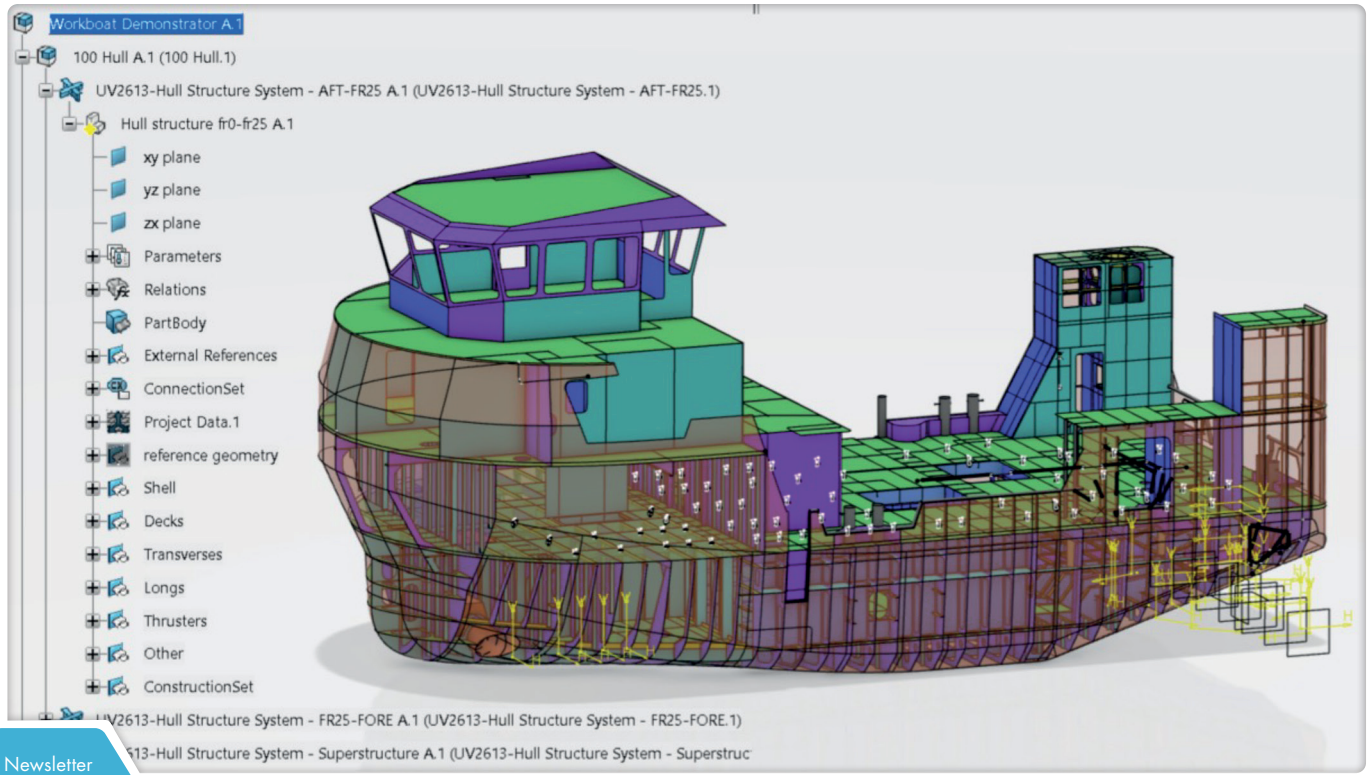
The specific boundaries of modules within this approach have been defined to suit both flexibility and re-usability between different platforms, but on the platform itself as well. With this all in place, WP2 has been working on the implementation of the complete RFLP (Requirements-Functional-Logical-Physical) definition for a number of different class and client requirements. The implementation significantly improves the traceability, resulting in improved information sharing. Even without the final implementation at the moment, the defined RFLP process already shows significant benefits for our current day-to-day work. The final implementation for deliverable D2.4, proving the modular principles, is in the final phase. Next to that, deliverable D2.5, explaining the modular electrical system, is in review for final submission. Very interesting outcomes are a newly, developed charging connector and a general interfacing description between different modules.

In the next couple of months, WP2 will finalise the implementation of the main systems defining an electrical Road Ferry, being the hull, ramp, the complete electrical system, and the most important safety-related systems. All contributing to the modular ferry product family towards the end of the project.

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.

Having completed the first four tasks, WP3 has proven, through a demonstrator member of the product family, the main ideas of the project. Following the definition and implementation of the main systems, of which make up a workboat, in all of the four domains (Requirement, Functional, Logical and Physical) task 5 of the WP3 is focusing on stepping into the creation of the bill of material and production simulations.



Current works consist of:

- Investigating the producibility of the workboat modules,
- Defining the production performance indicators such as cost, lead-time, resource utilisation etc. for the production of the workboat,
- Creating, testing, and evaluating the selected simulation tool for suitability regarding production network, modules, performance indicators and scenarios,
- Performing simulation studies according to the defined scenarios, and select the best production network i.e. the best match between product and production facilities.

On a parallel line, WP3 is working on the necessary calculation routines for evaluating the vessel performances (e.g. speed) and their implementation in the Dassault Systemes **3D**EXPERIENCE® platform.

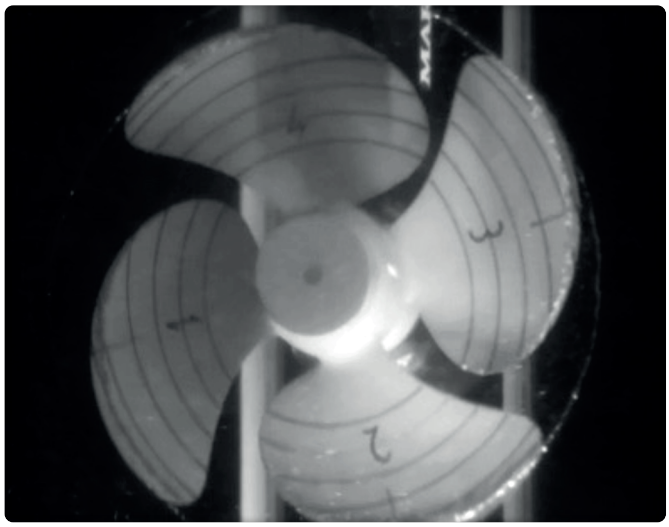
The above discussed work is currently in progress with the relevant partners of the NAVAIS consortium and it is expected to be completed on time.

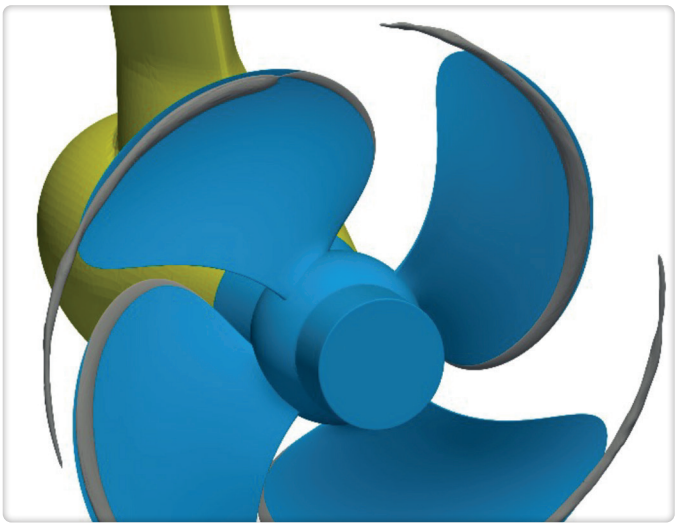
4 LOW-IMPACT DESIGN AND OPERATIONAL PRINCIPLES

to provide guidelines and goals for low-impact design of vessels. To develop tools for assessing the environmental impact of a ship design including underwater radiated noise.

One of the environmental impacts considered in NAVAIS is underwater radiated noise (URN). Cavitation-induced URN during deceleration and during dynamic positioning are under consideration since these are operating conditions that occur regularly for road ferries and workboats respectively. For these so-called off-design conditions, no URN prediction models were available, motivating their development in NAVAIS. Models for estimating the URN from ducted propellers, which are often used as the main propulsion of workboats, will also be needed to be developed. The contribution of vibrating machinery inside the ship to the total URN also was taken into account.

The first step in developing the cavitation noise models was the execution of a model test campaign, see the figure below (left). Computation Fluid Dynamics (CFD) computations have been carried for a few of those cases as shown in the figure below (right). The results of the model tests and CFD computations have been combined to expand and tune existing theoretical and semi-empirical models. That has resulted in new, detailed, semi-empirical models for URN from various forms of cavitation such as pressure-side sheet cavitation and leading-edge vortex cavitation.



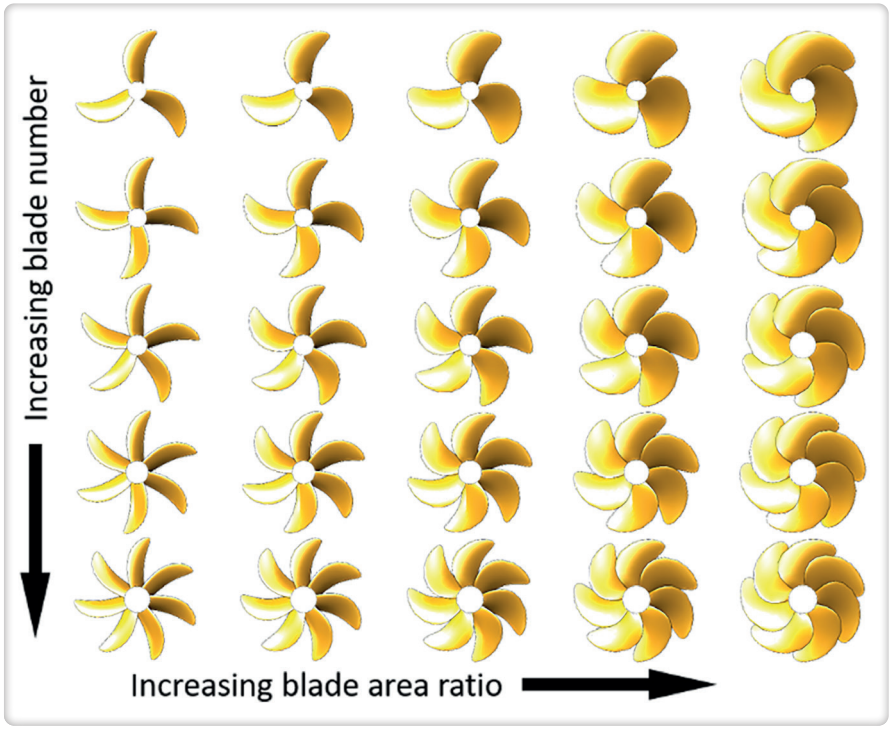


These detailed models have been used to compute the URN of a large collection of automatically generated propeller designs from the Wageningen CD-series[1] and F-series[2]. These propellers have different numbers of propeller blades, different blade area ratios, and operate at various conditions, including variation of blade pitch angle for the controllable-pitch propellers of the C-series. Some examples of the propellers are shown below. The computations for the ducted D-series propellers were done using a 19A duct, which is a commonly used design.

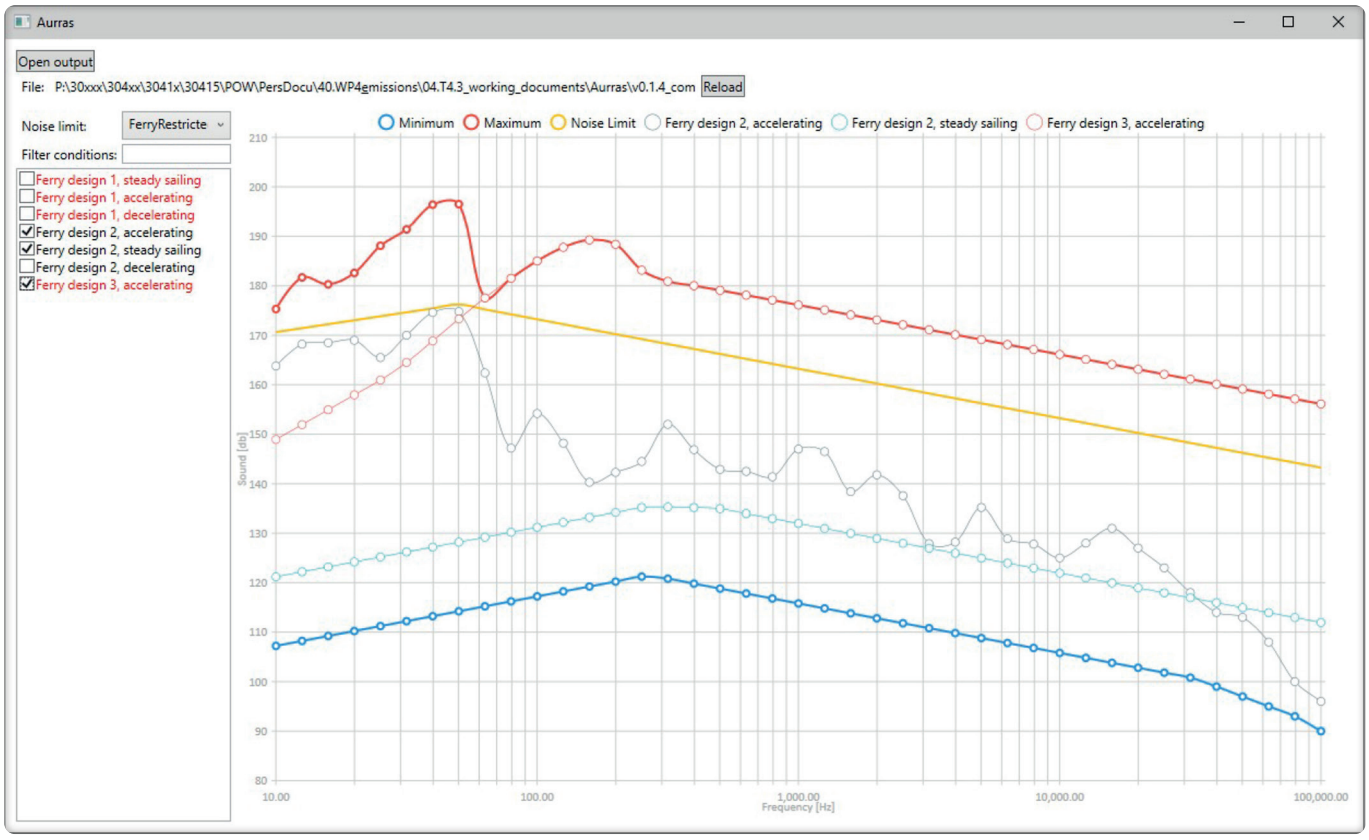
1) https://www.marin.nl/en/jips/wageningen-cd-propeller-series-extension

2) https://www.marin.nl/en/jips/wageningen-f-series

These computations – about 24,000 in total – have been done for open propellers, which are typical for ferries, and for ducted propellers, which are typical for workboats. The results of these computations have been used to create regression-based models to predict URN based on parameters such as propeller diameter, number of propeller blades, propeller rotation rate, ship speed, etc. However, it is impractical to directly estimate the complete URN spectrum with the regression model. Therefore, the regression model is used to provide the diameter of the cavitating vortex and the area of the propeller blade covered by cavitation. Those two parameters are then used to construct the noise spectrum.



These regression models and the procedure to construct the noise spectra have been implemented in a software tool. The design information, such as engine type, propeller diameter, etc., required for the noise estimation will be available from the **3D**EXPERIENCE® platform. The operational conditions (ship speed, propeller rotation rate, etc.) will be computed by Bureau Veritas' SEECAT tool (which will also compute the emissions to air and the fuel consumption). For every time step of a complete voyage computed by SEECAT, the URN will be computed using the data from that part of the voyage. An example thereof is shown in the following figure, which shows the noise spectra of a few different ferry designs at various operating conditions (accelerating, steady sailing and decelerating). The yellow line indicates the noise limit of the ferry; the noise of the ferry should be below this limit for all operating conditions to be a valid design.



5 PLATFORM BASED MODULAR PRODUCT FAMILY DESIGN & PRODUCTION

will develop the principles and guidelines for modularisation (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.

In line with the actions we initiated previously (please refer to newsletter #4), we made significant progress on the implementation of the e-ferry (WP2) and workboat (WP3) demonstrators.

3DEXPERIENCE Use Cases guidance

Based on the defined User Stories , which identify agnostic scenarios that are relevant to address the NAVAIS challenges, we delivered Use Cases as a **3D**EXPERIENCE® oriented guideline.

The Use Cases approach is the following:

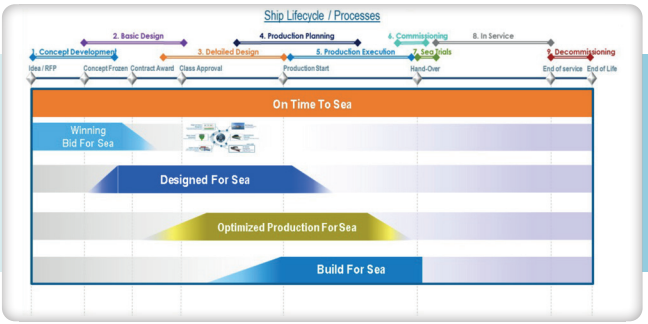
1. Use Case deals with one or more User Stories.

	As a	I want to	So that	Owner	Priority
9	arrangement engineer	create a tank plan	I can store consumables	Create tank plan	MUST HAVE
11	arrangement engineer	create a watertight compartment plan	I can guarantee the buoyancy and stability safety	Watertight compartments plan	NICE TO HAVE
21	Design and Proposal engineer	I want to quickly estimate the required areas and volumes based on coefficients	so that I have a good indication of the required dimensions of the ship	Estimate Surface area and volume	MUST HAVE
41	Design and Proposal engineer	I want to define the main dimensions of the ship	so that I have a good starting point for the hull design	Estimate main dimensions	NICE TO HAVE
59	Design and Proposal engineer	I want to generate a hull structure	so that I have an indication of the structure and light ship weight in an early stage of the design	Rule based structural design	NICE TO HAVE
120	Vessel Architect	Define the Geographical Breakdown Structure for engineering systems and sub-system modules (GBS-E) within the structure of the vessel (GBS-M), for a given product platform	I can define and visualise block /section structure against outfitting system design and installation, to identify module space allocation / interfaces points and get consensus with Production Engineerin structure and	Create geographical breakdown structure	MUST HAVE

2. Use Case is **3D**EXPERIENCE® platform oriented as a guidance to the User Story

3DEXPERIENCE®

3. Use Case is mapped to the Dassault Systèmes Solution portfolio, specifically with Marine & Offshore Industry Solution Experiences. Each Industry Solution Experience covers a set of specific Marine & Offshore business processes, described as Industry Process Experiences.



4. Use Case is related to a specific Marine & Offshore Industry Process Experience

5. Use Case is a sequence of tasks performed using **3D**EXPERIENCE® platform roles.

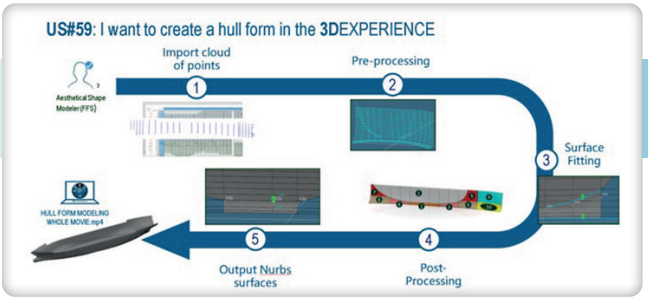


Figure: the Use Case approach

Finally, the objective of Use Cases is to provide a single document that can serve as a reference guide by synthesising the following information:

- Which User Stories are addressed by the Use Cases
- Which Marine & Offshore Industry Solution Experience is linked to the Use Case
- Which dedicated Marine & Offshore Industry Process Experience is linked to the Use Case
- What the added value and benefits of the focused process are
- What the process flow looks like in terms of main sequences, dedicated roles and main applications
- What the Process core roles are in Dassault Systèmes product portfolio
- Which training courses from the Educational Space are associated to the process
- Which additional media illustrate the process flow sequences

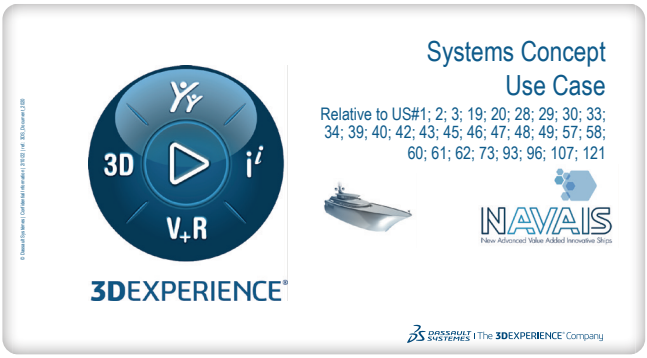


Figure: Example of a Systems Concept Use Case

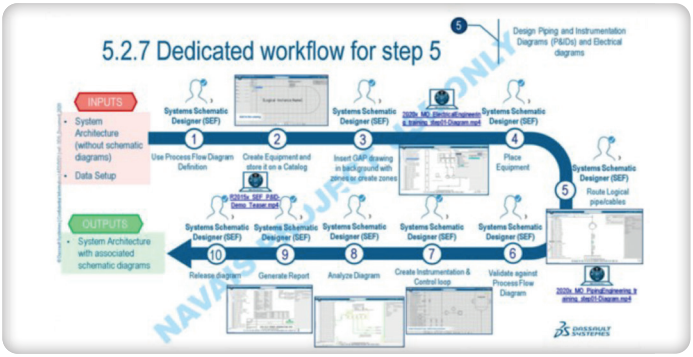


Figure: Example of a Use Case process flow

NAVAIS 3DEXPERIENCE® R2020x environment complement

In order to better address User Stories, we upgraded the NAVAIS **3D**EXPERIENCE® platform environment with some additional applications from the Dassault Systèmes portfolio, namely CATIA Magic, Reqtify and Ortems. The figure below describes the NAVAIS environment that is now being used.

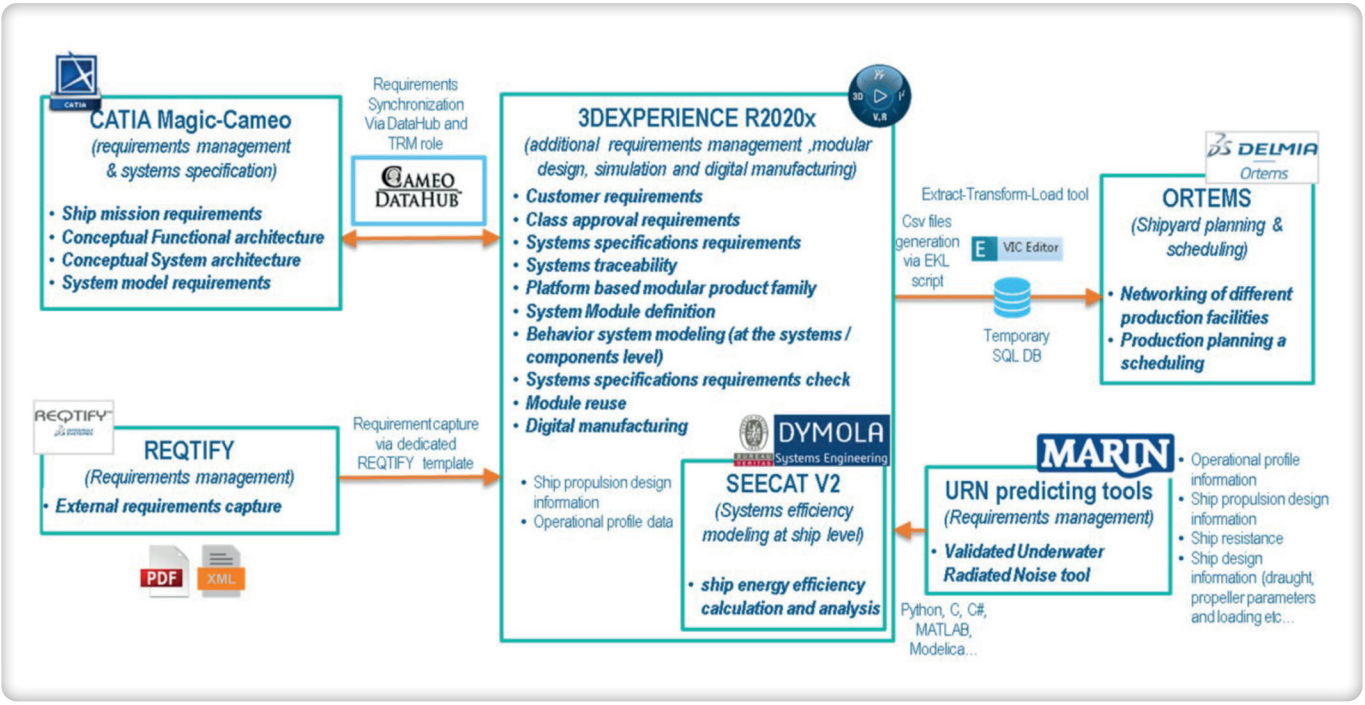
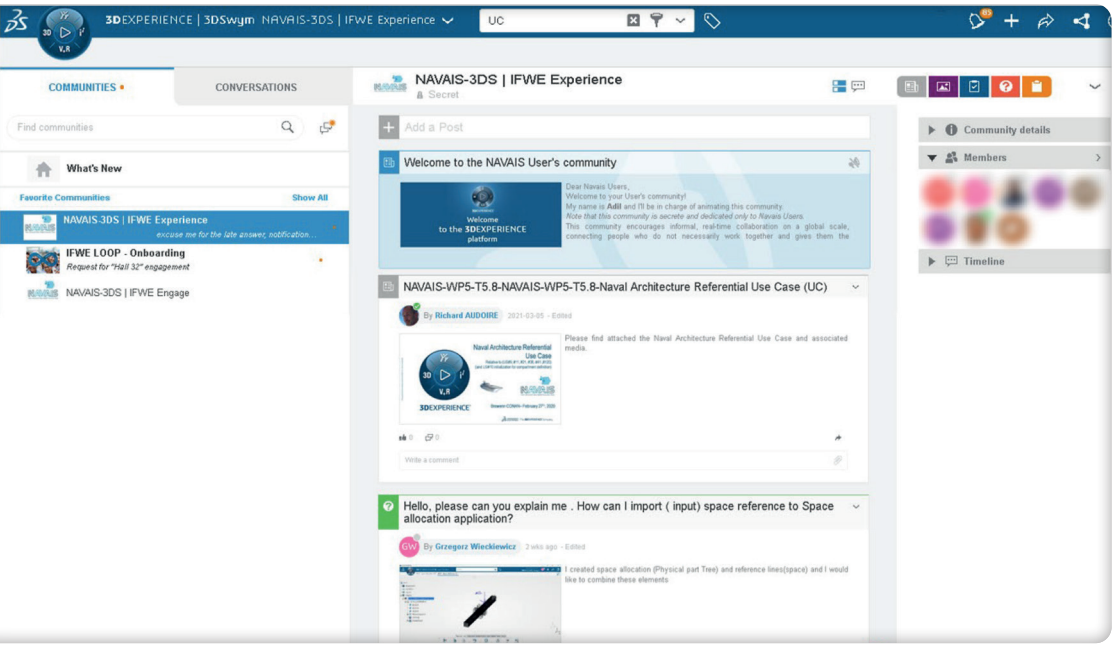


Figure: High-level overview of the NAVAIS environment architecture

NAVAIS User's community to support users



All users are now fully on-boarded on the **3D**EXPERIENCE® platform thanks to dedicated sessions and specific online access to the Educational Space. In addition, the NAVAIS-3DS I IFWE Experience community is playing a key role, leveraging the social network capabilities of the **3D**EXPERIENCE® platform to propose support from experts with questions and comments being handled daily.

Figure: NAVAIS-3DS - IFWE Experience community

SEECAT V2 demonstrator fully integrated in the 3DEXPERIENCE® platform

While WP2 (e-ferry) and WP3 (workboat) are dealing to create data in the platform for their upcoming demonstrators, partner Bureau Veritas started to develop a new version of their Ship Energy Efficiency Calculation and Analysis (SEECAT) tool. SEECAT allows modeling the systems at the ship level And performing energy efficiency assessments such as: energy (fuel and electricity consumption, steam, cooling water, etc.), design comparison (engine and propulsion, machinery…), emissions (CO_2, SO_x, NO_x, PM…) and operations comparison (operational profiles, electrical power generation…).

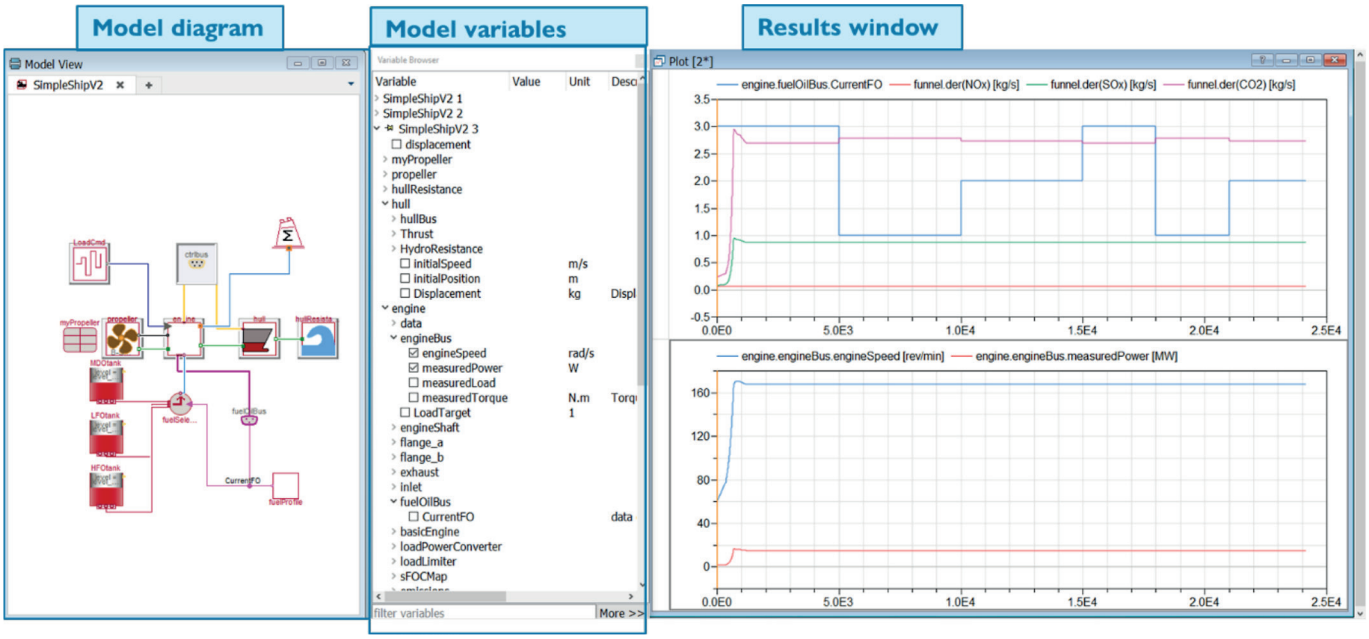


*Figure: SEECAT V2 is running in the **3D**EXPERIENCE® platform*

While SEECAT V1 was running on the SimulationX development environment, the V2 version is now based on the Modelica scientific programming language running within the **3D**EXPERIENCE® platform and is fully compliant with all the behavior components libraries available from the Dassault Systèmes portfolio.

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 outbreak of COVID-19 had a huge impact on the dissemination activities of the project. Despite this, WP6 continued its activities:

① The mid-term conference was executed in the form of webinars. Four webinars were organized in which an audience of nearly 100 participants was informed about the latest developments on how to apply Model-Based Systems Engineering (MBSE) in a shipbuilding environment, how to integrate innovative emission reduction technologies, and the ship production impacts of NAVAIS methods.

② Following the COVID-19 crisis, the NAVAIS project began a social media campaign, publishing five mini-videos made by NAVAIS experts to explain, step-by-step, the project's goals and progress. The five videos are now available on the NAVAIS LinkedIn page, check them out: https://www.linkedin.com/showcase/navais

③ In addition to the mini-videos, the NAVAIS team is finalising the NAVAIS promotional video, which will be available and posted soon.

④ One of the main tasks of WP6 is to set up supply chain involvement (SMEs), and to facilitate adaptation to new business models. In March 2022, we will organize a workshop and some interviews to gather input from the supply chain and to ensure that the supply chain of shipbuilding companies is aligned with the project outcomes. If you are interested in participating in the SME workshops and/or interviews, please email info@navais.eu

⑤ Finally, the NAVAIS project is coming to an end, so we are organising the final conference that will take place at the end of May. To receive more information about the final conference and the NAVAIS project follow us on our LinkedIn page and on our website.

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:

https://www.navais.eu/news

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

NAVAIS
New Advanced Value Added Innovative Ships