Photo: Gondán

SEUS SMART EUROPEAN SHIPBUILDING 2024 REPORT

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GONDÁN SHIPBUILDERS
CADMATIC ULSTEIN
CONTACT Software
NHL STENDEN university of applied sciences
UNIVERSITY OF TURKU
NTNU

Partners


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SARC
MARITIME SOFTWARE AND SERVICES
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SEUS
Smart European Shipbuilding

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Our Vision

SEUS Visions

The Smart Europen Shipbuilding Project (SEUS) project is working to establish a digital framework for European shipyards by building an integrated platform that combines CAE, CAD, CAM, and PDM software. This platform will be tested at shipyards and developed using the expertise of academic and industrial consortium participants. The goal is to create new practices for human-centric knowledge management, data-driven AI design elements, intelligent technology, and the Industry 5.0 concept in shipbuilding.

The aim is to reduce engineering time by up to 30% and assembly and construction time by up to 20% in European shipyards. Improving the flow of digital information and streamlining work processes present opportunities for reducing time and costs, resulting in significant economic benefits for the shipbuilding industry.

Objectives

The main objectives of the SEUS project are:

- Computational tool platform solution for PLM approach in shipbuilding
- Facilitation of digital transformation of shipbuilding,
- Increase in traceability and integration of early design impacts on the design process,
- Competitive advantage for EU shipbuilders through time savings in design and production stages,
- Expansion of shipyard's exposure to ship's life cycle: for retrofit, revitalization, use of data from operation and maintenance,
- Management of shipbuilding knowledge with a focus on human needs,
- EU maritime workforce skills and expertise development.

Business Areas

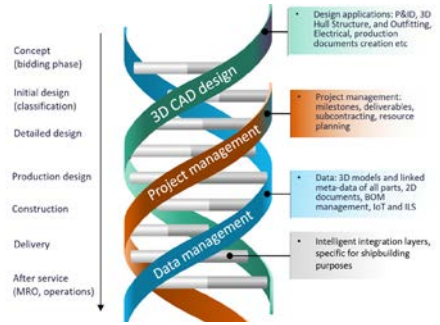
Computational Tools & Data Integration

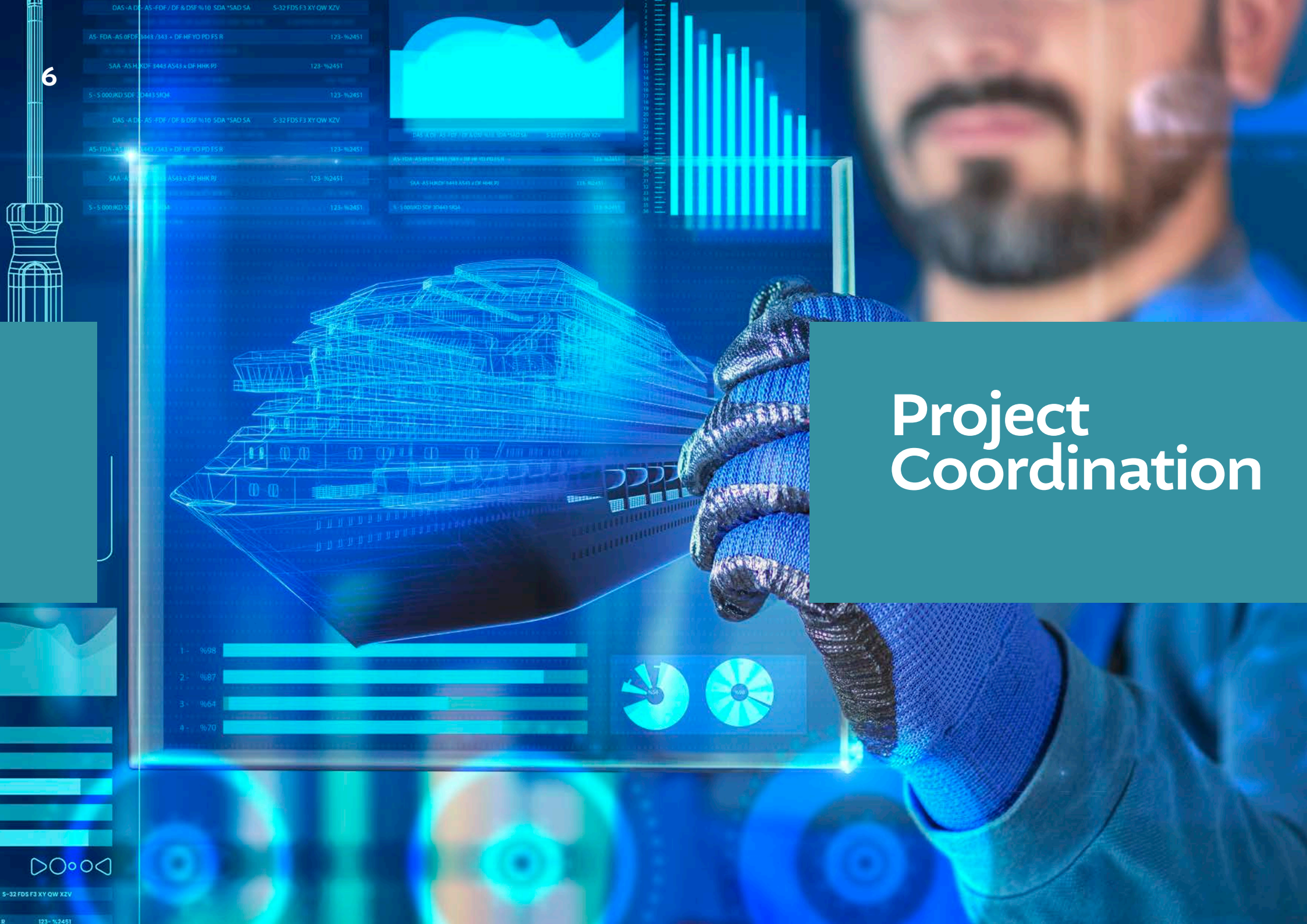

Photo: Gondan

Data Driven Ship Design & Shipbuilding


Photo: Gondan

Knowledge Management





Project Coordination

Henrique M. Gaspar

Photo: Tony Hall

Horizon Europe – Computational Tools for Shipbuilding

The European shipbuilding industry faces many challenges, including increased competition from Asia, economic uncertainty, and a growing demand for more sustainable vessels. However, despite these obstacles, the industry remains an essential player in the global maritime sector. Improving the efficiency and competitiveness of European Shipyards is one of the priorities of the HORIZON program, funded by the European Commission. The proper use of computational tools can accelerate this improvement, given that the shipbuilding industry faces a digitalization gap compared to other manufacturing industries.

The Smart European Shipyard (SEUS) project aims to bridge the digital gap, focusing on integrating available computational tools, and converging into a new platform that enables faster engineering and technical management. This initiative is on the path to provide a holistic approach to product lifecycle management (PLM) for shipbuilding, integrating existing and proven solutions in CAD/CAE with new data-driven technologies to handle shipbuilding knowledge efficiently. The development aims to facilitate the digital transformation of shipbuilding, increasing productivity, collaboration, flexibility, and innovation opportunities.

Digitalization as Efficiency and Innovation Enabler

Diverse commercial, societal and academic actors emphasized the need for European shipyards to focus on innovation and sustainability to remain competitive in the global market. The main argument is that adopting digital technologies is a key factor that will determine the future success of European shipyards.

Digitalization and computational tools have great potential to generate value for stakeholders in the form of cyber-physical systems or digital twins. It requires a significant reshaping of existing tools and practices to be exploited successfully by the European shipbuilding industry. The gains come in the form of increased quality and reduced time required for design, virtual prototyping, estimations of impacts for the use of greening innovative technologies, modularization, flexible data management, interoperability across proprietary tools, cyber security, efficient support for modern robotized fabrication and openness for integration with operational platforms.

Challenges

The SEUS team is engaged to develop, implement, test, and qualify software solutions with an Industry 5.0 mindset for the European shipbuilding market. Smart technology, in terms of digitalization and cyber-physical systems, including humans, are concepts that have never been built from a shipbuilding perspective.

Current solutions used by shipyards include significant parts of manual data handling and are prone to a high level of human error or a fragmented adaptation of PLM from other industries, such as aerospace, automotive, or other discrete manufacturing. The shipbuilding industry uses many computational tools to plan, design, simulate, and build vessels and other marine products, such as offshore platforms or other floating constructions. Consequently, the digital information chains of shipbuilding are more weakly integrated than in discrete manufacturing industries and thus lack support for a digital thread: digital continuity, digital lifecycle management, and digital ship operation support.

This is an obstacle to gaining efficiency and to implementing new business models based on digital innovations and the development of IT technology. We have set up seven objectives towards a stepwise progress over 4 years:

Photo: NHL Stenden

Photo: Ulstein

Seven challenges for enhancing the current status of European Shipbuilding are currently being tackled by the SEUS consortium:

1. Facilitate rapid early-stage design to support lower-risk bid development, particularly when integrating innovative new technologies
2. Provide better capital cost estimations and performance predictions, particularly showing the improvements expected from the inclusion of new technologies
3. Tools to be integrated with ship construction and production and consider supply chain management and future maintenance and repair of vessels.
4. Address the competitiveness gains provided by the tool(s) in the context of the European shipbuilding sector.


Photo: NHL Stenden

Photo: Ulstein

5. Ensure that the tool is robust and resilient against cyber threats.
6. Identify and address the development of the necessary skills needed to achieve the maximum benefit from innovative advanced computational shipbuilding tools.
7. Develop business cases to quantify the added value from the developed tool to the shipbuilder concerned and within the context of the wider European shipbuilding sector

Ready to Action

The technology readiness level (TRL) targeted by the project is 8-9, corresponding to the maturity level of a completed and qualified (tested in a large-scale pilot installation) platform, ready for a commercially competitive operational environment. The current release of the cloud solution in in the process of integrating existing computational tools with TRL 9, commercially exploited in shipbuilding. It will later incorporate Industry 5.0 concepts (human-centricity, sustainability, and circular economy) and progress through the process of maturing TRL from level 4 (initial technology validated by combining existing software parts, including AI and ML) to level 7-9 (integrated platform with developed use cases, tested in shipyards)

Consortium

A strong point of SEUS is its consortium, a balanced partnership composed of academics, software developers, and shipbuilding partners representing 5 countries from Europe, which is fully dedicated to bridging the knowledge in its communities and facilitating the uptake of the main results. SEUS's partners are experienced in customer implementation, dissemination, and communication activities in their home countries and internationally, and this experience will be enormously beneficial for achieving the objectives here proposed. Therefore, the consortium is committed to disseminating SEUS's approaches and outcomes, while simultaneously staying focused on the identified target groups and reaching the objectives of development, dissemination, and exploitation.

This report is an example of it. It summarizes the developments of the second year of the project (2024), with an overview of the partners and work packages. In this context, peer and stakeholder engagement support is an imperative set of activities integrated with the SEUS communication strategy. Besides sharing the results and findings of the project with a broad audience, the consortium welcomes external collaboration. With the ultimate target of supporting European shipbuilding, many projects can benefit from joining efforts and sharing findings in the industry's best interests.

Innovation Actions (IA)

Photo: Ulstein

Photo: Tony Hall

Hans Petter Hildre

Maritime Innovation

Europe has been a global leader in maritime business for centuries but is facing challenges – globalisation and very tight profit margins. During the last 7-8 years the world fleet has expanded by more than 20%. Europe has historically been dominant when it comes to ownership, and still almost half the world fleet is under European control. On the other hand, operations have increasingly moved away from Europe and today many Asian cities are more important for operations than traditional European centres. We also see that European ownership dominance is falling, as Asian shipowners have taken most of the growth in the last few years.

Energised by changes in technology and mobility, globalisation has greatly changed economies and has made our world more interconnected. The speed of globalisation is relentless. Global trade is growing, and international regulations stimulate mobility of services, capital, and labour.

How can Europe still be a global maritime leader? Innovation is a crucial factor in enabling European maritime industries to handle these challenges. Research, competence development and collaboration are important to support and stimulate such innovation. Cluster collaboration and innovation can be a way for maritime industries to work together to promote sustainability while fulfilling the demands of markets.

Maritime Clusters are geographic concentrations of similar or related companies and organisations - such as offshore, wind services, seafood, shipping, equipment, and port operations - that share common markets. Larger companies use these networks to improve their efficiency and engage a networked economy. At the core of the clusters are companies producing key products, such as vessels built by the shipbuilding industry.

Maritime clusters create competitive advantage by facilitating mutually beneficial relationships between the companies in the cluster. Regions with good maritime education and training combined with surrounding industrial clusters of advanced companies will have a precondition to develop new competencies for the maritime industry. Hence, close links between universities, shipowners, ship builders, and equipment manufacturers are critical for the strength of such a R&D development strategy.

In the long term, the competitiveness of maritime companies is shaped by the cluster dynamics, that is, by relationships between the different players. University industry collaboration refers to the interaction between any parts of the higher educational system and industry aiming mainly to encourage knowledge and technology exchange. The collaboration between universities and the industry is increasingly perceived as a vehicle to enhance innovation through knowledge exchange. The quality and variety of maritime education institutions, as well as industrial clusters with the necessary density of companies, are key to increase competitiveness. Clusters of companies, competing and cooperating, support innovation, entrepreneurship, and access to talents.

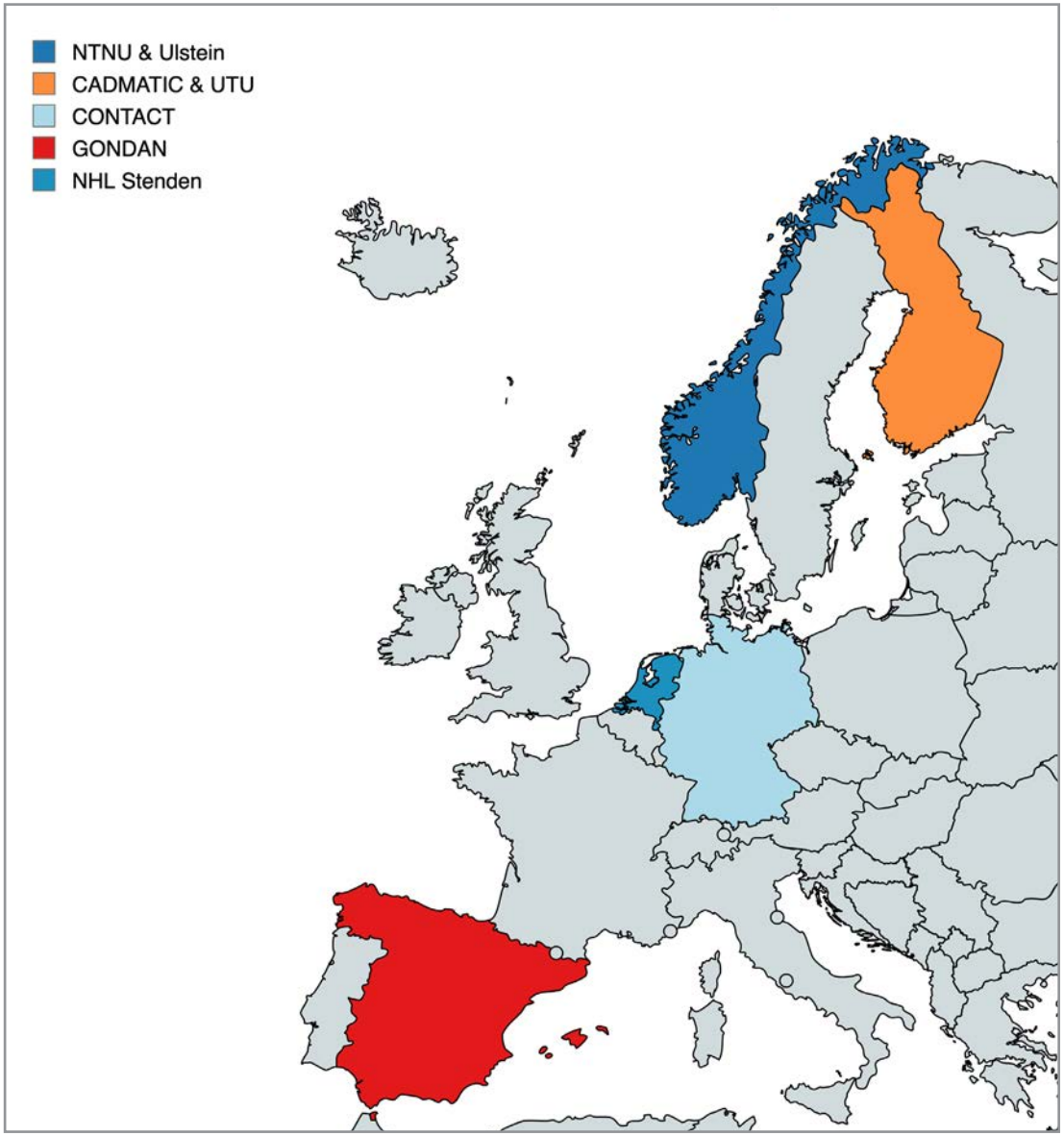
New business and research areas are undergoing strong growth and development. The future maritime activities will integrate people in a way that can digital technology transform how we design, build, and operate ships.

The consortium in the Smart European Shipbuilding (SEUS) do have very strong local and national industrial clusters and universities. If we can cooperate effectively, we will create cluster of clusters with shared mutual interests.

Computational tools have a great potential to generate value for our shipbuilding industry and corresponding maritime clusters. A common smart framework will strengthen all partners. Openness and information-sharing are particularly important, both for reducing transaction costs and more importantly for knowledge flow and innovation.

If the partners in SEUS, together with their maritime clusters, can cooperate together than a significant momentum for improved competitiveness can be achieved.

I would like to take this opportunity to express my gratitude to the partners, CADMATIC, CONTACT, Ulstein, Gondan, SARC, NHL Stenden and University of Turku, and NTNU, who are contributing to our common goal - improving competitiveness in the European shipbuilding industry.

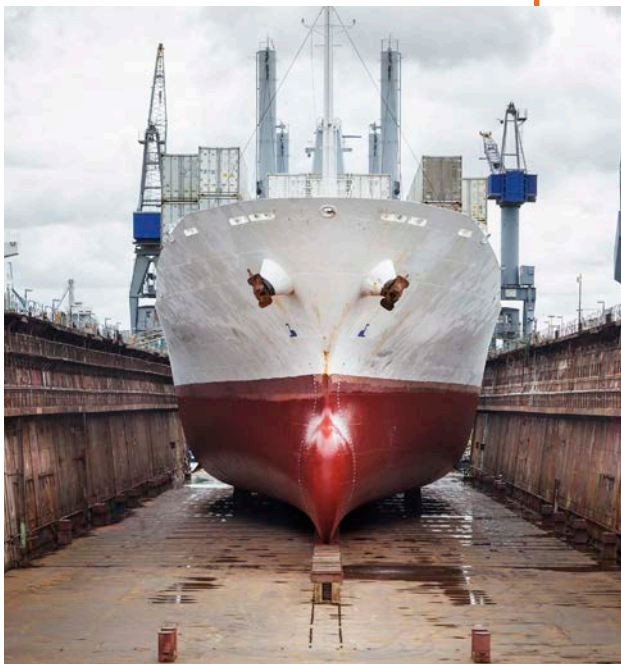


Partners

The SEUS project is a collaborative effort between eight international partners from Germany, Finland, Norway, Netherlands, and Spain aimed at improving shipbuilding processes. The partners collaborate to **develop a new computational toolset** that considers the target user groups' needs, new research in industry and technology, integration and interoperability aspects of the platform, the novel human-centric approach, and the required support processes for project management and dissemination.

NTNU leads the project and is responsible for **researching and evaluating a new PLM approach,** while UTU focuses on **human-centricity.** CADMATIC, Sarc, and CONTACT are responsible for **software development**. Ulstein and Gondan shipyards will **implement the platform and provide feedback** on its development. Finally, NHL Stenden ensures that the project is **visible** and that it shares relevant information about its objectives, undertakings, and outcomes with the appropriate stakeholders and scientific communities. This approach promotes the engagement of the target audience in SEUS activities.

In general, the SEUS project aims to develop a unified data exchange standard for shipbuilding, improve stakeholder communication and cooperation, and identify gains from PLM implementation. The project addresses **multiple aspects of the shipbuilding process, from research to software development and implementation.**



NTNU

Photo: Sissel Basso

Knowledge For A Better World

Norwegian University of Science and Technology (NTNU) is a globally focused university with main campuses in Trondheim, Gjøvik, and Ålesund. The university strongly emphasizes science and technology, offering a range of professional study programs and a wide breadth of academic subjects, including the humanities, social sciences, economics, medicine, health sciences, entrepreneurship, and artistic activities.

In 1996, the NTNU was established through the merger of the University of Trondheim with other higher education institutions. These institutions have a rich history that dates back to the 1760s. Since then, NTNU has also included a few former university colleges and grown to become the largest university in Norway.

The Department of Ocean Operation and Civil Engineering (IHB) of NTNU is located in Ålesund. With the close industry ties with the maritime cluster in the region, IHB offers a unique education and experiential learning experience to students and researchers hoping to find synergy between technology, human factors, and business. Providing this unique industrial connection, IHB aims to be a global hub for knowledge and innovation in maritime operations.

Mission

NTNU is a university that conducts primary research and educates outstanding graduates. They offer research-based education at all levels and have expertise in nature, society, people, and technology, which they share with a strong commitment. The university promotes cultural values and innovation in business and public administration and contributes to cultural activities. The university aims to use its knowledge to help people and solve global challenges. The activities of NTNU are to promote human rights, development, and intercultural dialogue.

Link: www.ntnu.edu/ihb

CADMATIC

SEUS Project at Cadmatic :

First release of the functionality and rising interest from the potential users

Since the beginning of the SEUS project in 2023, Cadmatic's aim has been to establish scalable software development and implementation teams for the new solution and aim for a market product as soon as possible. After the period of initial setup and roadmaps clarification, a dedicated development team was established. The software development process includes infrastructure for the development compliant with the work practices in the company and cyber security measures, a framework for alignment and communication with the technology partner, Contact Software, and alignment with product release practices. It includes the development repositories, architecture alignment, code review, and testing practices, all of which aim to have a ready-for customers' product release.

The very first release of Wave product, which encapsulates the SEUS platform, was aligned with other Cadmatic products and prepared on 12 November 2024. Already be-fore the official release a set of preliminary marketing materials were available for discussions with SEUS partners and potential users to facilitate the exploitation of the product.

Significant interest from the industry indicated that the Cadmatic's targets are aligned with demand, and numerous meetings were held to discuss industry input and needs. As Cadmatic always welcomes such input, it provided several valuable adjustments for the development priorities and also set a solid foundation for later exploitation of the project's results.

Link: www.cadmatic.com

CONTACT

Digital Transformation

CONTACT is a leading vendor of open standard software and a pioneer of open source for product engineering and digital transformation. Our products enable project organization, reliable process implementation, and global collaboration based on virtual product models and their digital twins. Our open technology and the low-code platform. Elements are ideal for integrating IT systems and the Internet of Things to create end-to-end business processes.

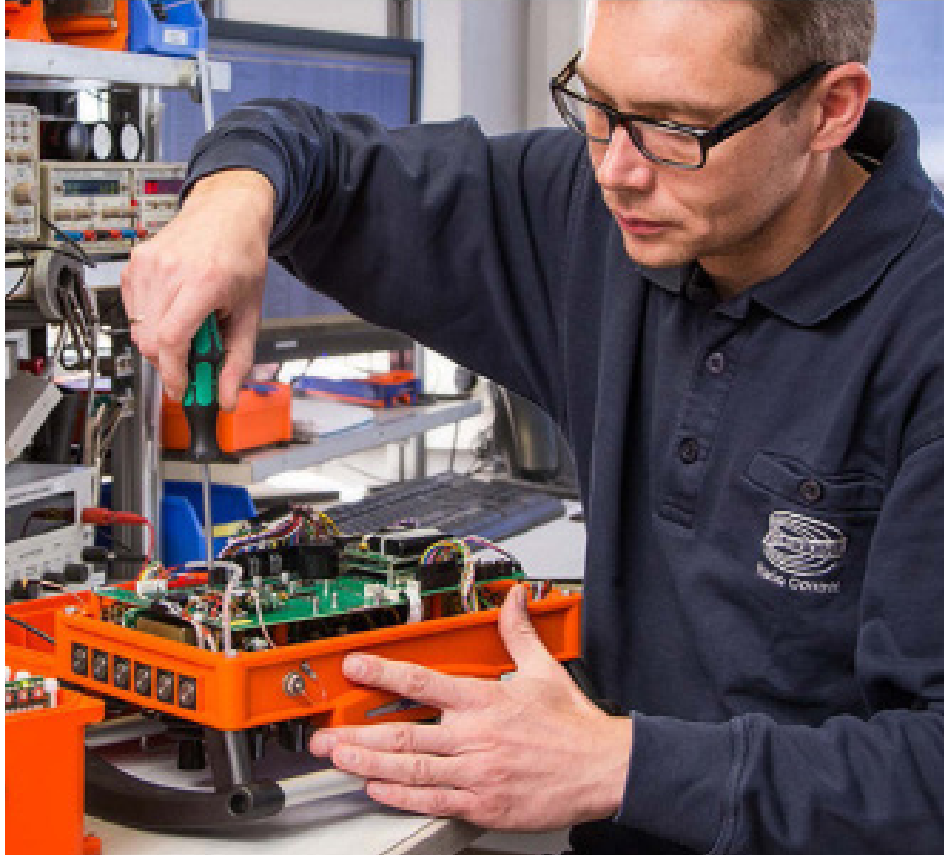
Agile Collaboration

Shipbuilding deals with complex projects and involves numerous trades. Efficient project management is essential to provide suitable support for shipyards, their engineers, and suppliers. CONTACT Project Office combines systematic planning and control of the entire project with agile collaboration within individual teams. It also intelligently merges complex delivery structures of engineering processes with conventional project elements. The data of a new product, which is contributed by many companies, should be always available in its current version, even beyond organizational and system boundaries. Additionally, CONTACT Collaboration Hub simplifies data flow through intelligent data sharing and supports end-to-end processes. It is particularly suitable for collaborating in engineering projects and integrating suppliers.

Mastering The Entire Product Lifecycle

CONTACT's product lifecycle system CIM Database facilitates the entire product lifecycle, from first designs to customer use. It combines product data management through virtual models and digital twins with functionality for collaboration as well as process and project management. This enables companies to streamline their processes, reduce repetitive tasks, enhance their outcomes, and meet regulatory requirements.

However, shipbuilding companies need specialized solutions to perform their challenging tasks efficiently and at lower costs. As an independent unit of the



CONTACT Software Group, CONTACT Research is well suited to meet these unique requirements. We work with creative minds from science and industry to explore and validate sustainable solutions for the engineering and production of tomorrow in a wide range of fields.

Our focus topics are clustered along the strategic triangle of digital sovereignty, including the development of new digitalization strategies for various industries to determine and implement different types and degrees of digital transformation, as well as digital maturity. Our research focuses on improving digital maturity levels by enhancing data availability, process management, employee qualifications, and integration with customers, partners, and suppliers. We also develop and implement process patterns to increase efficiency through standardization and automation across the product lifecycle.

Link: www.contact-software.com

SARC

The Company

SARC BV is a naval architectural software development company founded in 1980. They started with basic software and have since grown to a team of 15 experienced naval architects involved in software engineering and project management. SARC continues to invest in **research and development** to offer state-of-the-art solutions to clients.

Standard Software

SARC offers software called PIAS and LOCOPIAS for ship design and onboard use. The software complies with the latest legislation and classification societies demands. PIAS includes modules for hull design, decks, bulkheads, compartments, and probabilistic damage stability. It is used by over a hundred organizations, while LOCOPIAS has been delivered for more than a thousand vessels.

Project Support

Besides developing new software, SARC also offers project support for design offices, shipyards, ship owners or any other party that lacks time, capacity, knowledge or software. Using our **in-house developed software** as basis for project support, SARC can ensure expert and highly efficient use of software. Over the years, SARC has been involved in over 3500 projects, with tasks such as:

- Calculations for tables of hydrostatic data and tank sounding tables.
- Calculation and optimization of probabilistic damage stability.
- Intact stability booklets.
- Performing inclining tests and light weight surveys.
- Comparative studies on longitudinal strength.
- Determination of engine power requirements, including propeller optimization.
- Preliminary ship design, including preliminary lines plan and all design calculations.
- Hull fairing, and producing shell plate expansions.
- Advise on optimal use of developable shell plates.
- Calculations of stability and motions of heavy transports.
- Ship hull shape measurement.
- Design or computations on non-ship structures, such as a floating swimming pool and a river flood barrier.

Vessel types include tugs, passenger ships, tankers (chemical, gas, crude and product), livestock carriers, heavy lift vessels, heavy cargo vessels, container ships, bulkers, reefers, fishing vessels, sailing vessels, frigates, patrol boats, landing platform docks, pontoons, crane vessels, yachts, submarines, survey vessels, standby vessels, suppliers, ferries, short sea ships and inland waterway vessels.

Software Support

All SARC employees are involved in support, developing software and projects. Therefore, in general questions are answered by experienced users with in-depth knowledge of the software and the applicable **practice and regulations.** SARC highly values this direct contact between end user and developer, as it gives excellent insight in the requirements and opinions of PIAS and LOCOPIAS users.

Link: www.sarc.nl

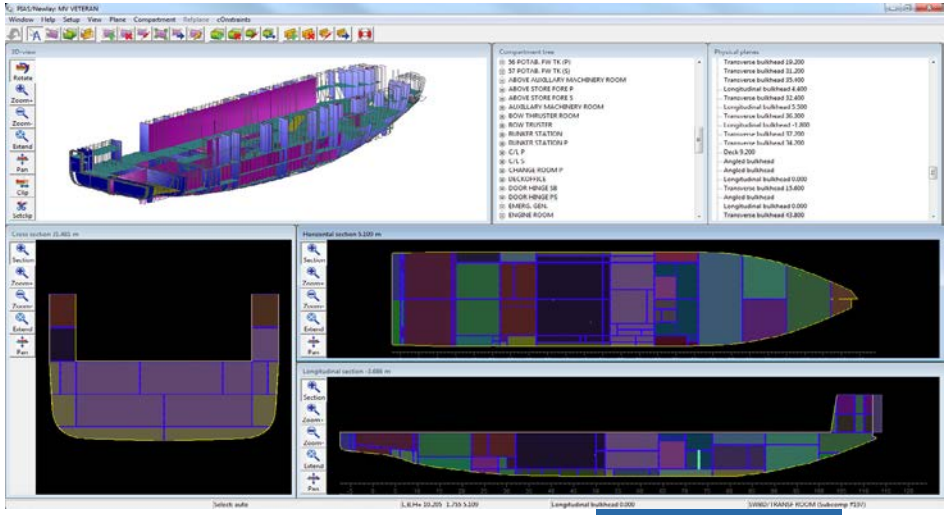


Photo: Ulstein

ULSTEIN

Overview of Ulstein

Ulstein is a third-generation family-owned company and an internationally renowned provider of ship designs, shipbuilding, and system solutions for ships. The company was founded in 1917 and is headquartered in Ulsteinvik, Norway.

Ulstein's vision is to create tomorrow's solutions for sustainable marine operations. For over a century, Ulstein has been able to spot and exploit new opportunities and sustain momentum through changing times in the maritime business. Through hard work and creative enthusiasm, the group keeps renewing and applying its expertise to benefit its customers. Ulstein bases its work on a continuous exchange of knowledge and experience in the maritime cluster between energy companies, contractors, shipowners, designers, suppliers, and shipbuilders.

Ulstein is an international and innovative driving force within marine operations. The group provides cost-effective, safe and reliable products and services to future-oriented players who think holistically and long-term.

Its solutions allow shipowners, operators and contractors to gain long-term competitiveness in their marine operations.

Ulstein's values are Innovate, Engage and Advance. Its employees shall be able, willing and allowed to carry these through.

Innovate

We are bold but disciplined when finding and turning new ideas into reality.

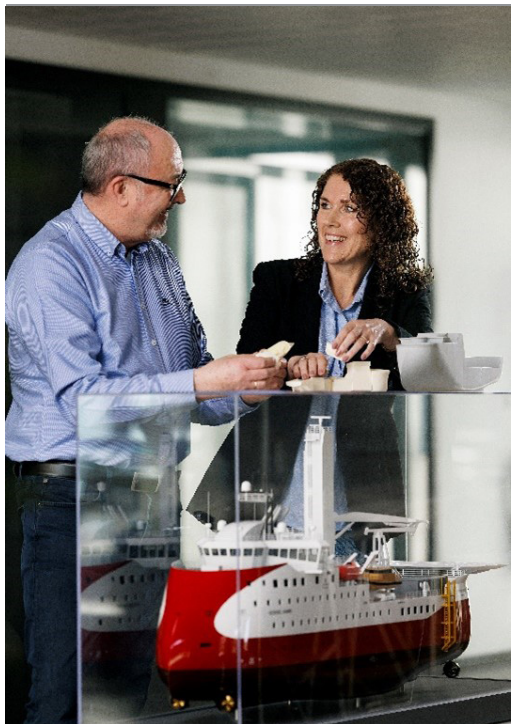
Engage

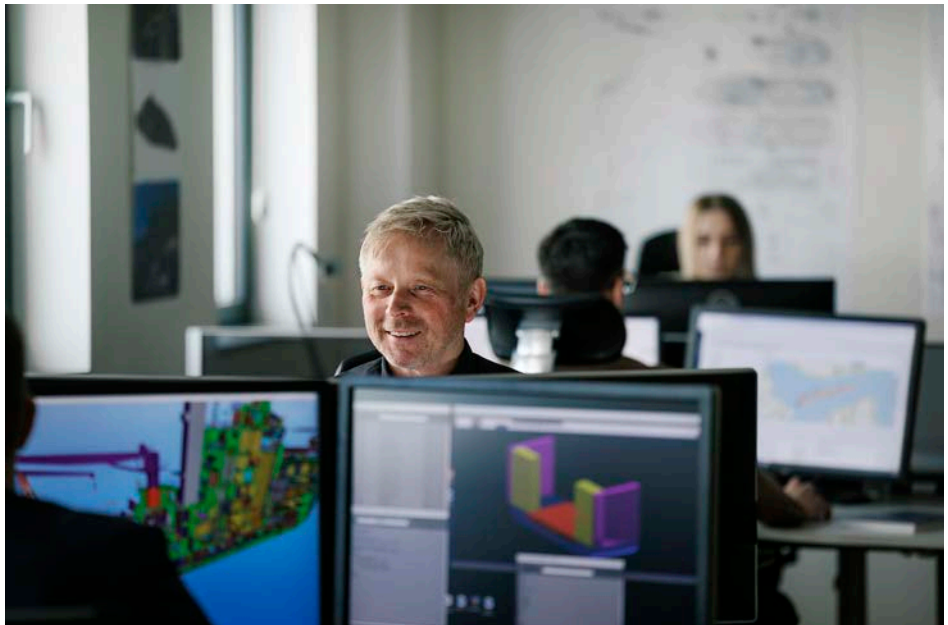
We say yes to committed employees who help us solve the challenges facing Ulstein and the industry.

Advance

We actively seek possibilities for further development and improvement.

Link: www.ulstein.com





Gondan

Photo: Gondan

GONDAN Shipbuilders

100 years of excellence in shipbuilding

Since its founding in 1925, GONDAN Shipbuilders has evolved to become a benchmark in the marine industry. With a century of experience, the company has developed a wide variety of vessels, from offshore vessels and fishing boats to tugboats and passenger ferries. Its specialization in the manufacture of tailor-made boats, adapted to the needs of each client, has allowed it to combine traditional craftsmanship with the most advanced technologies.

GONDAN's commitment to innovation and sustainability is reflected in its approach to energy efficiency and the use of cutting-edge technologies in its production processes. With facilities prepared to handle highly complex projects, the company has positioned itself as an outstanding leader in shipbuilding, standing out for its ability to offer innovative and environmentally friendly solutions.

Customer satisfaction remains a top priority. GONDAN works closely with its customers to ensure that each vessel

Photo: Gondan

is perfectly tailored to their operational requirements. This customer-centric approach has been key in cementing long-term relationships in the maritime sector.

GONDAN continues to consolidate its position as a benchmark in naval technology with the construction of its vessel 506, a state-of-the-art USV (Uncrewed Surface Vessel) designed to operate autonomously in offshore environments, optimizing offshore inspection and maintenance tasks with a notorious reduction of CO^2 emissions. In addition, the company is building its 513 vessel, an OESV (Offshore Energy Support Vessel) designed to perform a wide range of offshore operations, including inspection, repair and maintenance, construction and cable laying, being the largest vessel built in the shipyard's history. In line with its commitment to innovation, GONDAN has reinforced its production capacity with the incorporation of a second 3D welding robot for blocks, which allows increasing the level of automation, optimizing production times and shortening delivery times.

Looking to the future and celebrating its 100th anniversary 1925-2025, GONDAN continues to set milestones in global shipbuilding. The combination of tradition, innovation and excellence in customer service continues to be the key to its success, consolidating its reputation in the maritime industry.

Customer satisfaction is a pivotal aspect of GONDAN Shipbuilders' philosophy. The company engages with clients through **all stages of construction, from design to delivery,** to guarantee that the final product aligns perfectly with their operational needs and preferences. This **client-focused strategy** has been instrumental in establishing long-term relationships within the maritime sector. GONDAN Shipbuilders also places a strong emphasis on research and development, investing in new technologies and methodologies to **enhance the efficiency and environmental performance** of its vessels. This forward-thinking approach not only positions GONDAN as a leader in shipbuilding innovation but also contributes to the broader goal of advancing sustainability in the maritime industry.

Overall, GONDAN Shipbuilders represents a **blend of tradition, innovation, and client focused service,** making it a noteworthy player in the global shipbuilding landscape. Its commitment to quality, sustainability, and customer satisfaction continues to drive its success and influence in maritime construction.

Link: www.gondan.com

Photo: Gondan

NHL Stenden
University of Applied Sciences

About NHL Stenden & MIWB

NHL Stenden University of Applied Sciences is a dynamic and innovative institution renowned for its commitment to excellence in education and research. With campuses in the Netherlands and internationally, NHL Stenden offers a diverse range of programs tailored to meet the demands of today's global society. Committed to fostering creativity, critical thinking, and practical skills, NHL Stenden equips students with the tools they need to succeed in their chosen fields. Whether in hospitality, business, engineering, or arts and sciences, students benefit from hands-on learning experiences and personalized support from dedicated faculty. Embracing cultural diversity and sustainability, NHL Stenden cultivates a vibrant community where students from around the world come together to collaborate, innovate, and thrive. From cutting-edge facilities to industry partnerships, NHL Stenden prepares graduates to make meaningful contributions to their professions and communities.

The Maritime Institute Willem Barentsz (MIWB) on Terschelling, Netherlands, is a beacon of maritime education and research with over a century of esteemed history. Offering programs in maritime management, engineering, and navigation, MIWB prepares students for the dynamic demands of the global maritime industry. Under the guidance of experienced faculty and industry experts, students at MIWB benefit from practical training and cutting-edge facilities. The institute's strategic location on the UNESCO world heritage Wadden Sea provides a unique learning environment rich in maritime culture and activities. Committed to sustainability and innovation, MIWB collaborates closely with industry partners to explore emerging technologies and best practices. Through its emphasis on leadership, teamwork, and professionalism, MIWB equips graduates to excel in their maritime careers and contribute meaningfully to the industry.

Link: www.nhlstenden.com

University of Turku


Photo: UTU

University Overview

The University of Turku (UTU), Finland's second largest multidisciplinary university, is an internationally competitive research-led university. The UTU is recognized for the quality of research, teaching, and excellent support services. UTU offers study and research opportunities in eight faculties: Humanities, Technology, Science, Medicine, Law, Social Sciences, Education, and Turku School of Economics; and in four independent units. In the international QS ranking, the UTU is among the top 400 universities and is ranked the fifth best university in Finland (QS Ranking 2025).

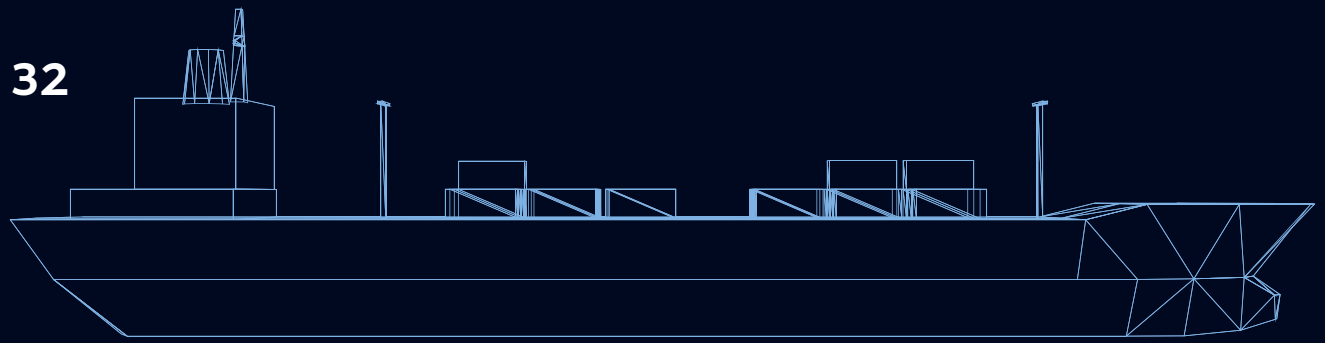
Today, the UTU has about 22,000 students and about 3,500 staff members (14.7% international, 58.6% female). External funding covers 42% of the total funding of 310 million euros. The UTU is active in international cooperation. It is a member of the Coimbra Group, a network of prestigious universities in Europe, and the EC2U European Campus of City-Universities alliance. Over 2,500 international students from over 100 countries study annually in the University of Turku.

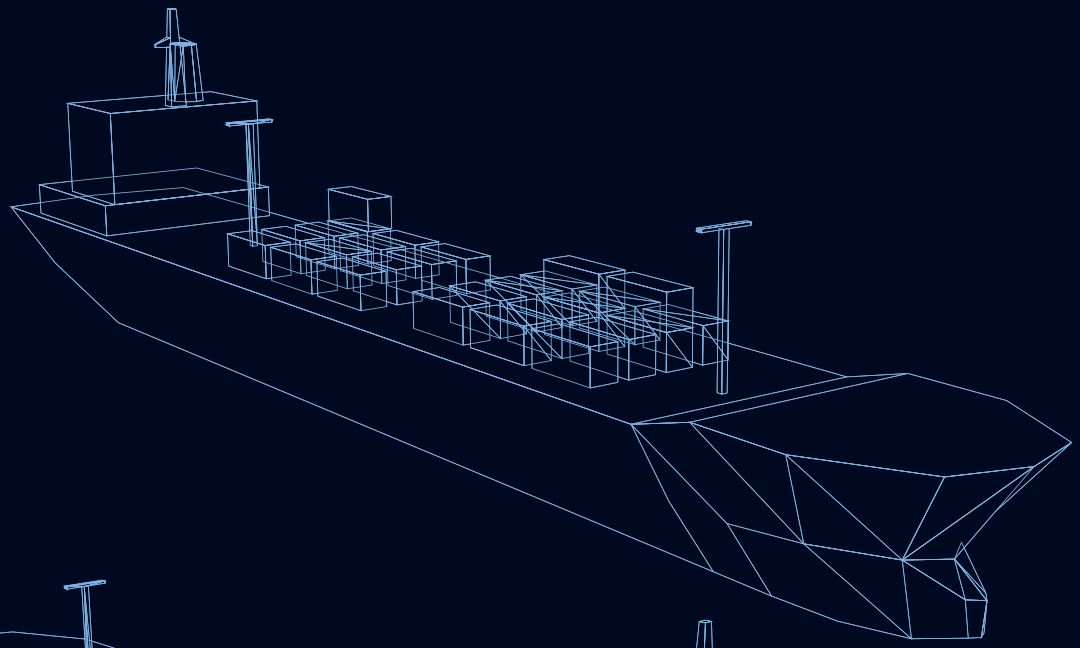
In June 2013, the European Commission awarded the University of Turku the right to use the HR Excellence in Research logo, and this right was continued 2024 onwards. The logo is a token of the University's commitment to continuous development of the position and working conditions of researchers along the guidelines set forth in the European Charter for Researchers.

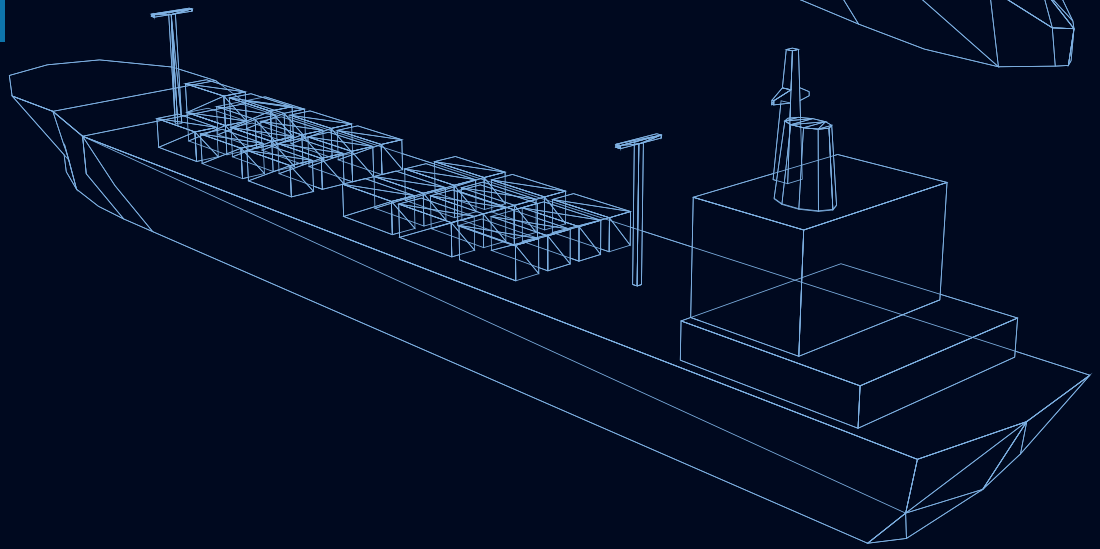
The UTU is an internationally competitive university whose operations are based on high-quality, multidisciplinary research. The UTU promotes education and free science and provides higher education that is based on research. SEUS project belongs to the Maritime and seafaring thematic research area, which is one of the multi-disciplinary strategic profile areas of the UTU till the end of 2024.

The Faculty of Technology that is involved in SEUS project was established 2021, and it is now one of the largest faculties of the UTU. The faculty consists of three departments: Computing, Biotechnology, and Mechanical and Materials Engineering. Emphasis is placed on using the knowledge produced in the field as a basis for solving the complex problems in society. The faculty is an active partner of the businesses in the region of South-Western Finland and internationally.

Link: www.utu.fi







WP1:
Best Practice for Smart Shipbuilding


Photo: Tony Hall

Work Package Overview

Work Package 1 (WP1) of the SEUS project focuses on researching, evaluating, and compiling best practices related to innovative Product Lifecycle Management (PLM) approaches in European shipbuilding. This research aims to establish a comprehensive foundation for the development of a digital Single Source of Truth (SSoT) solution, directly supporting SEUS partners in their software development initiatives. Specifically, it elucidates software and open platform requirements for Work Package 2 (WP2) and WP3 and provides material for knowledge dissemination related to WP5.

Current and Best Practices in European Ship Design and Shipbuilding

European yards face unique challenges, including:

- Multi-organizational complexity with extensive offshoring
- High degree of customization requiring sophisticated systems integration
- Fragmented lifecycle management across multiple stakeholders
- Limited shipyard capacity requiring precise facility planning
- Increasing regulatory demands, particularly environmental regulations

Additionally, regulatory shifts, sustainability goals, global competition, and digitalization trends further influence the industry. To cover these challenges, trends, and information, the research was focused on the following main themes:

- EU Place in Shipbuilding Market – Current trends in European and global ship design and shipbuilding industries,
- The Ship Design and Shipbuilding Process – Current practices and logical stages in ship upstream lifecycle,
- Multi-domain Taxonomy – Key features in ship design and shipbuilding that affect the information systems that are used in design firms and yards,
- The Ship Design and Shipbuilding Toolbox – The state of digital tools used in the industry,
- Distinctions in Ship Design and Shipbuilding – Unique perspectives and challenges on the application of lifecycle management tools in ship design and shipbuilding,
- Single Source of Truth (SSoT) Concept or Attempt – Current and latest attempts to develop an SSoT Solution thus far.

Single Source of Truth Solution

The SEUS project identifies the need for a Single Source of Truth (SSoT) approach to address these challenges. While Product Lifecycle Management (PLM) tools offer potential solutions, there are concerns regarding:

- Additional work required to incorporate existing data
- Lack of ship-specific terminology and methodologies
- Limited integration with third-party

tools
- High costs for acquisition, installation, and training

The desired SSoT solution must integrate information across domains while providing flexibility for different stakeholders and workflows. It should enable data reuse, support 3D model utilization across value-chain phases, maintain accessible data throughout the design process, and intelligently integrate with existing ship design tools.
By addressing these challenges, the SEUS project aims to significantly improve efficiency across the vessel lifecycle, reducing lead times and enhancing European shipbuilding competitiveness in the global market. All these findings and results are summarized in Best Practices in the Shipbuilding. Additional results were published in diverse conferences, such as IMDC and OMAE papers for 2024.

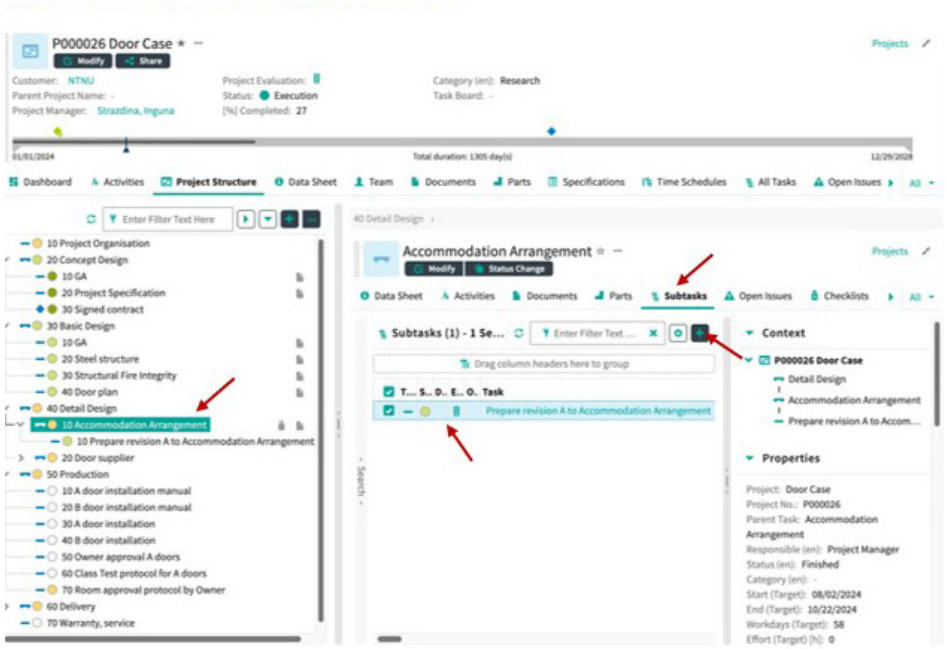
Survey Findings and Results

To get a comprehensive view of the current position of the shipyards and design firms' perspectives regarding PLM and Industry 5.0 applications, the survey was developed to be applicable for personnel, engineers, and managers involved in various levels of the ship design process.

The SEUS project conducted internal and external surveys to assess data management needs in shipbuilding. The external approach used a thirteen-question online questionnaire addressing data quality management and Single Source of Truth (SSoT) solution feasibility. The survey was collaboratively designed to be impartial, semi-structured, and broadly applicable to all shipbuilding stakeholders.

Internal research involved surveys and workshops with partners Ulstein and Gondan, including site visits to Ulstein in October 2023 and April 2024. Additional research on software functionality was conducted with CONTACT, CADMATIC, and Sarc to contextualize findings.

Results indicated strong industry demand for improved data management, particularly in data quality, digital tool compatibility, and SSoT development. These improvements are deemed essential for advancing EU shipbuilding's digital transformation. The SEUS project will use these insights to guide development of an intelligent platform leveraging Industry 5.0 technologies to enhance efficiency and collaboration.



Inguna Strazdina

Industrial Scenarios

Several industrial scenarios were developed based on real-life shipbuilding cases to support testing and evaluation of the SEUS Platform. A researcher from NTNU, using her industry experience, created these scenarios to reflect practical challenges and workflows faced by shipyards and design companies. The scenarios were used to validate the platform's functionalities, assess progress, and identify opportunities for improvement. Results from the evaluations were discussed with development partners to provide input for future software updates.

The scenarios offered a practical foundation for feedback loops and continuous development.

Furthermore, they have been reused across additional work packages, serving as illustrative material for training activities and knowledge sharing. By using realistic examples, the industrial scenarios helped align platform development with real industry needs and educational goals within the project.

WP2:
Platform Development

Ludmila Seppälä

Overall Project

Overall, at Cadmatic, about 50 people are involved or partially involved in the project ac-tivities. Besides people who develop software functionality, we involve other personnel to ensure that newly developed parts are ready for customers to use, and our technical support people can handle any tasks related to implementation or the use of the prod-ucts. This large number of people involved also provides a targeted effort for the project to boost software development capabilities by involving younger generations of IT spe-cialists and providing them with needed industry exploitation backgrounds. This way, software development skills trained and developers' abilities to understand the needs of users and the shipbuilding industry overall.

Infrastructure with a cloud instance established before allowed a central use of the soft-ware for all project participants, and separate local instances for the shipyard's exploita-tion were established. Later on, the selected use cases will be executed for each of the participating shipyards.

Rising interest from the industry was mainly facilitated by direct discussions with potential users, and more general marketing campaigns are planned for later stages of the project for dissemination and exploitation.

CAD+PLM Development

2.1. Roadmap Definition

The development roadmap was refined based on received input from partners and po-tential users. It included already completed tasks and prioritization for the rest of the pro-ject. As software de-velopment is a continuous improvement process, the roadmap fol-lows the agile principles of software development. It is updated and refined regularly, at least twice a year, by the Product Owner, and smaller sprints of development include subtasks, tasks, and issues for developers to tackle.

2.2. Data Model Discussion and Alignment

Cadmatic and Contract Software specia-lists thoroughly discussed the data model, and a version that supports intended use cases was developed. The discussions will continue to include the PIAS data model and develop a generic version that other industry developers can use.

2.3. Integration with DMU

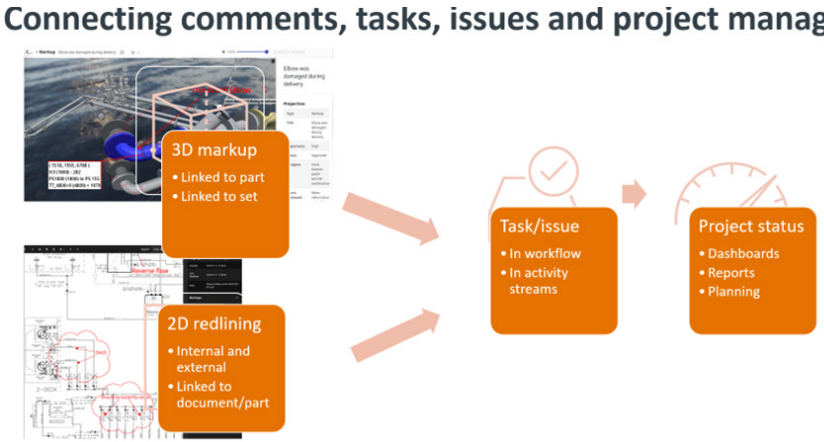
An early prototype of the Digital Mockup Unit was developed further and included more use cases, such as he use of 3D mo-dels for commenting and 2D documents for redlining. Such functionality allows for effective collaboration in shipbuilding projects and takes the traceability of pro-ject progress to a new level.

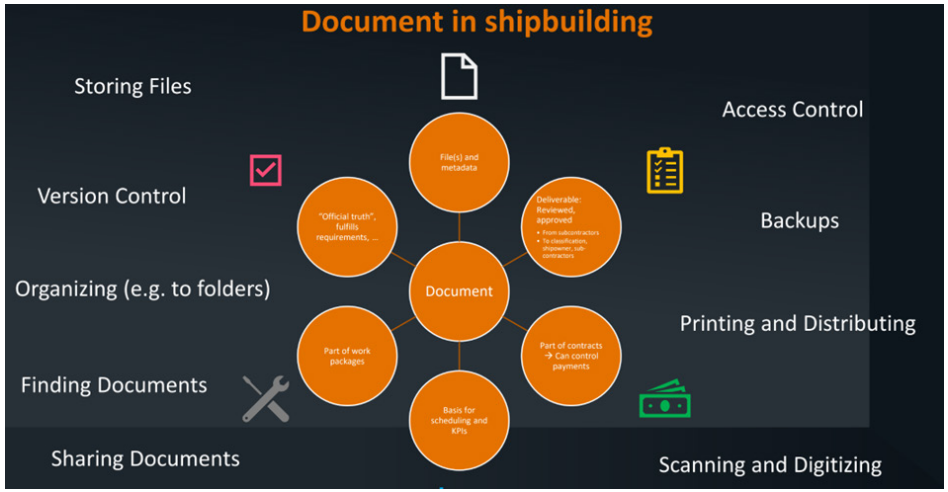
2.4. Early Stages of Design Model Integration

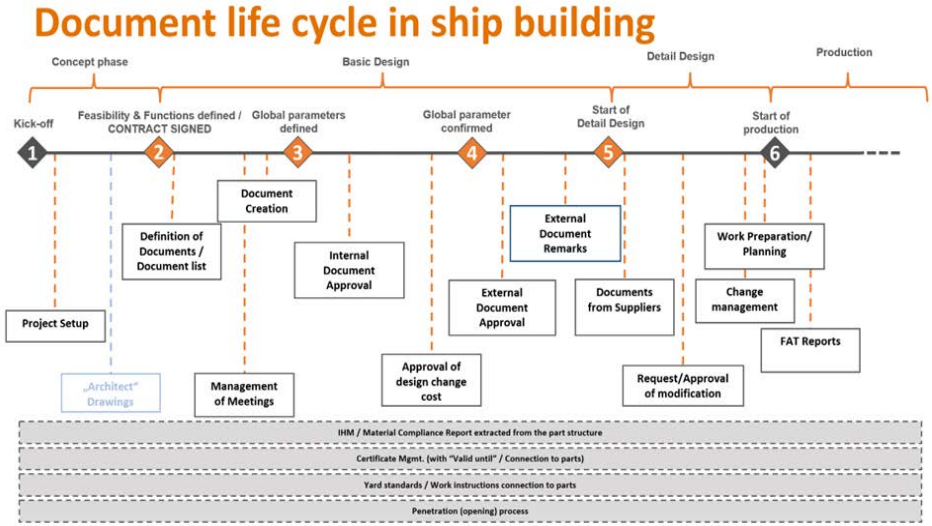
Early-stage design model integration is a cornerstone of the SEUS project and a vital element in achieving efficient Product Lifecycle Management (PLM) in shipbuilding. By aligning teams and digital resources from the earliest concept work, stakeholders can collaboratively refine ideas, detect design issues long before production, and maintain seamless data flow across disciplines. This proactive integration–emphasized in the SEUS initiative–lowers the risk of expensive redesigns, reduces both engineering and assembly times, and ultimately accelerates delivery of higher-quality vessels. By capitalizing on the other Work Packages results', the shipbuilding process becomes more transparent, interconnected, and responsive to industry needs throughout the entire product lifecycle.

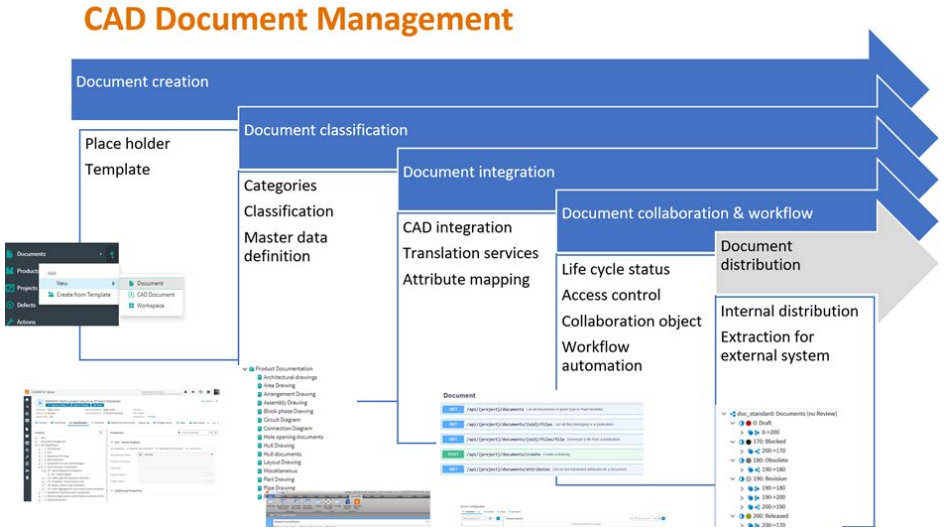
The early design part of the process is covered by PIAS software from SARC, and as part of the project, an investigation was done to find a suitable way to link the data models. Typically, the early design stage focuses on the functional and naval architecture needs of the design, while later detailed and production design stages are focused on geometry, lay-outs, materials etc. Hence, this area is the most challenging from the data organization and integration perspectives. Discussions resulted in the paper intended for publication at the IMDC conference in June 2024 and in the first steps of data alignment.

Specifically, there are four topics at the early design stages that are further elaborated:









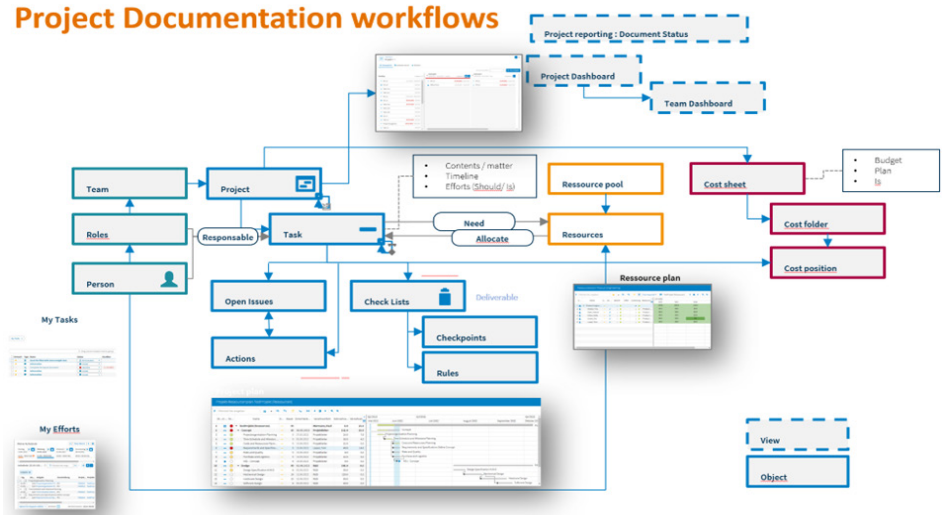
1. Quick configuration of internal layout (spaces and compartments). Within the PIAS software, 'chuncks' (boxed portion of the subdivision of a ship) will be selectable that will allow the user to quickly generate a complete subdivision within a given hull. Requirements can also be created for volumes, areas, or distances. Currently, a constraint management function is already available in PIAS' Layout module.
2. Propulsion and machinery. Empirical formulas go a long way for resistance and propulsion, which have always found a place in PIAS' resistance and propulsion modules. However, as demand is becoming increasingly complex, think of combinations with wind propulsion and alternative fuels, SARC is now developing a module which integrates (a variety of combinations of) resistance, propellors, wind propulsion, combustion engines, fuel cells, gear boxes, electric motors etcetera. All connected, working as one system, either in the stationary condition or for series of conditions.
3. Running OpenFoam CFD from PIAS. Currently, at SARC research is currently conducted to execute calculations with OpenFoam CFD, driven by PIAS.
4. Global hull shape modifications. The Fairway module for hull form design is very suitable for early ship design because there are no topological restrictions, regularity requirements or indirect surface manipulation. Also, tools for evaluating and improving smoothness (fairing) are available. A new tool which will be added is spatial deformation. This will allow deforming the fabric of space in which the model is defined, hence supporting shape variations in larger areas, fully under user control, as depicted in the picture.

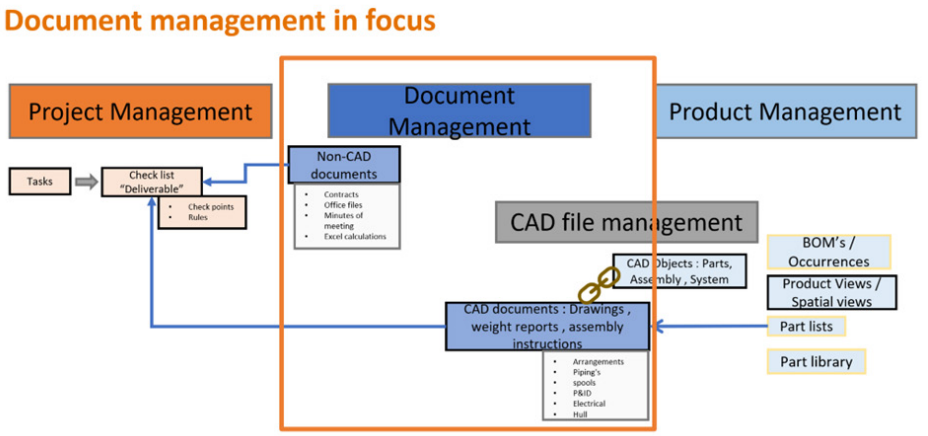
2.5. Integration of DMS and CAD documents

Within the framework of the SEUS project, integrating Document Management Systems (DMS) with CAD deliverables is critical for streamlining collaboration and maintaining consistent design data across all phases of shipbuilding. By linking CAD documents directly to a robust DMS, the SEUS consortium aims to eliminate gaps in digital information flows, enable precise version control, and ensure that up-to-date engineering resources are readily available to all stakeholders. This harmonized approach supports the project's broader goals of accelerating design and assembly times by facilitating traceability and knowledge sharing throughout the vessel's entire lifecycle.

The most often mentioned need for the PLM system is document management functionality. Therefore, it was selected as the first goal of the integration. The functionality of existing document management from the PLM solution (CONTACT Software) must meet how documents are created and managed inside CAD applications.

Existing CAD functionality provides a bi-directional link between the 3D model and 2D drawings, as well as revision





controls and documentation templates to ensure the unified appearance of the documents in shipbuilding projects. The working prototype provided document integration between the two approaches and complemented existing CAD functionality with PLM-type controls – such as the document's status in the project management process (in design, released, or approved). A detailed flow of data was considered, and at the next step, user feedback will be incorporated to ensure the UX of the integrated solution.

2.6. Creating a cloud environment with a platform prototype for the collaboration of partners and demonstration of use cases

This task was a central development focus for the first release, as every project and every shipyard needed to manage documents related to each project, and a significant number of people from different departments were involved in such activities.

Besides the functionality, the process of working with documents over the project's lifecycle. The research on the shipbuilding's typical process and information collected through interviews with Cadmatic and customer experts resulted in a defined process that includes flexibility to accom-modate different types of organizations and practices

2.7. Change and workflow management system

Change management workflows already exist within the Contact Software platform, and customizations were needed to align them with the defined document management pro-cesses. Later on the same mechanism can be used for parts change management.

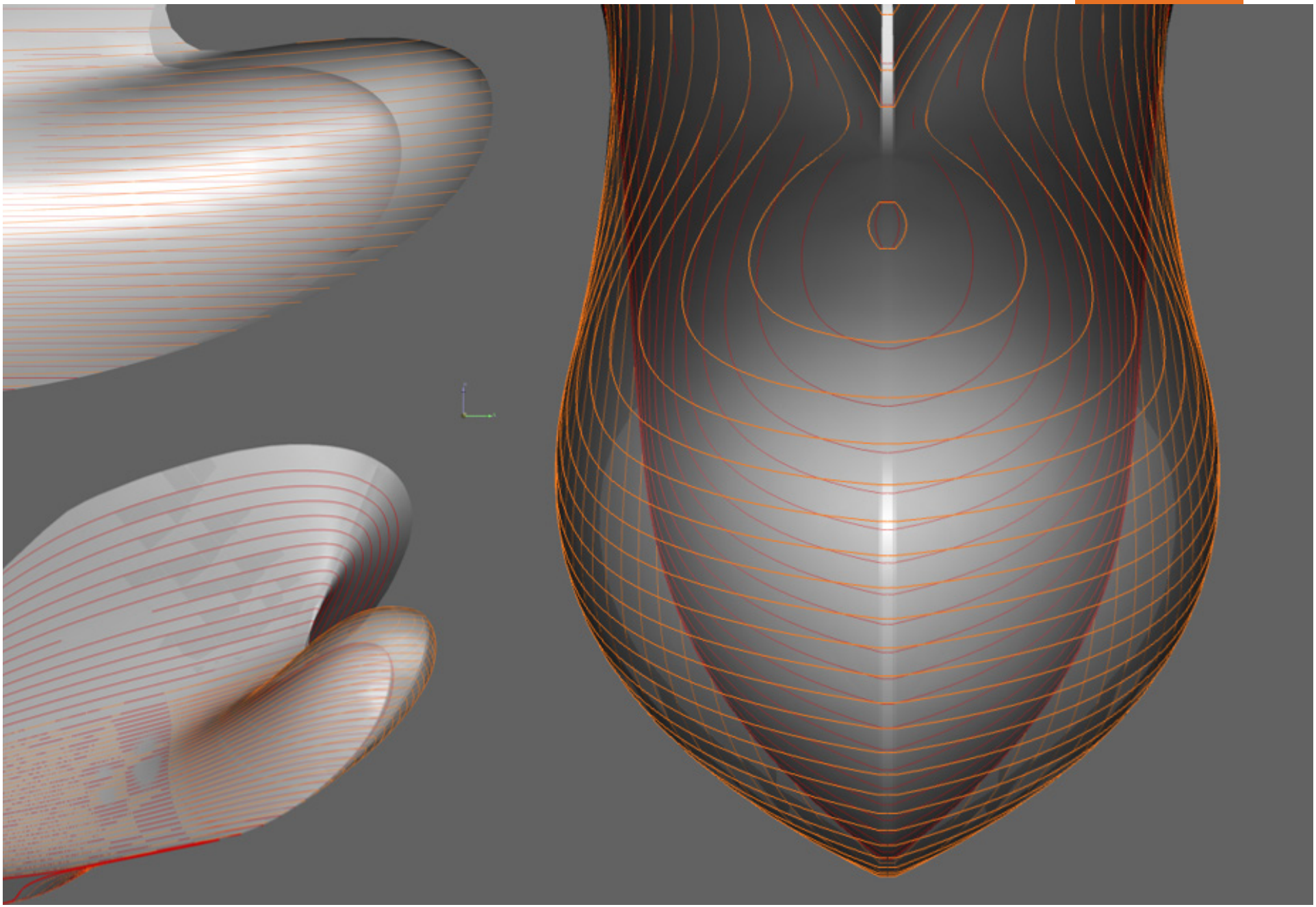
2.8. Project management tools

Project management tasks in shipbuilding are often based on the contract and document delivery structure and, therefore, are directly linked with document management. The needed integration provided the possibility for the users to connect needed tasks and deliverables with documents, and this way, to have visibility to project structure and pro-gress.

3. Introduction of the solution on the market

After the initial discussions and product introduction to Cadmatic's customer base, the in-terest in the market grew significantly in the global shipbuilding market. The scope of the PLM solution is substantially more expansive than the SEUS project, and the first target group for potential exploitation of project results is existing Cadmatic users, and they can benefit the most from the integrated solution.

Future plans include the development of a new business model for commercial exploita-tion and the development of commercial marketing materials for go-to-market strategy.



WP3:
Open Platform Development

Elisabeth Brandenburg

Open Platform Development

This work package ensures the platform's compatibility with major proprietary systems (used in commercial shipbuilding, incorporates possibilities to use of ship operation data via standardized protocols, and supports I5.0 principles. It includes cyber security development tasks and targets to develop the interoperability of the SEUS platform and the existing IT shipbuilding landscape to facilitate the rollout tasks and develop new unified data exchange standards for shipbuilding. To fulfil this goal the proposal offers 7 tasks. The tasks can be summarized into the following subgoals:

- Interoperability: combining CAD authoring tools from CADMATIC and SARC with CONTACT Elements PDM solutions for ship design, connecting MES and ERP with PDM for shipbuilding and provide IoT mechanism with PDM system for ship operation.
- Artificial Intelligence Integration: Giving AI mechanisms access to the platform means, for example, allowing NLP models to process all stored product data to find and analyse the data in relation to a specific user request.
- Cyber Security: Based on best-practice cyber security governance a security management model will be developed and implemented for the platform.

Interoperability

In the second SEUS year, the following interoperability topics were prioritised: the architecture of the SEUS platform with collaborating databases and their external access points, the description of these connectivity options for other authoring software and ERP integration for specific use cases.

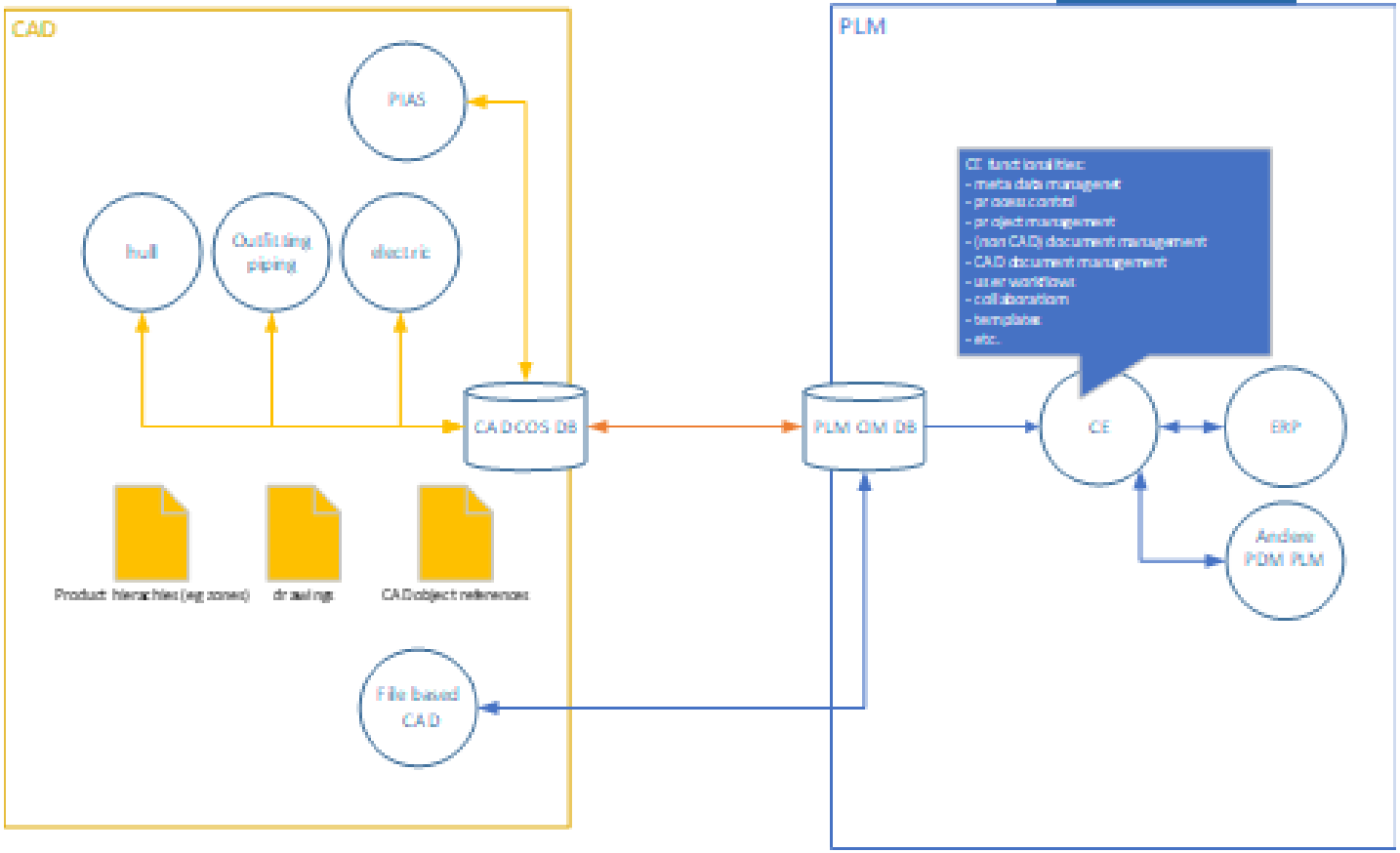
Architecture and Communication

We differentiate between two main areas of interoperability on the SEUS platform. Firstly, the individual links between the PLM extension for the CADMATIC design tools (the core of the SEUS platform, called WAVE) and secondly, the options for exchanging data with other third-party providers.

These communication points for exchanging information with other software are described below:

1. **REST API** requests used for the WAVE connection between COS and CIM:

REST (REpresentational State Transfer) is a communication approach for distributed software architectures that we have been using for years: for the interaction between client and server and for the integration of other IT systems. REST describes the structure of programming interfaces that control access to and use of data via http requests. The REST APIs are therefore used, among other things, to connect third-party systems. Application companies and partners are generally dependent on the expertise of software manufacturers in such scenarios if they want to link in-house and third-party solutions with their IT systems. This is because although the syntax of a REST API is defined, the semantics are not. It requires the necessary knowledge of the data model and the business logic of the respective software in order to implement the interface.



On the left CADMATIC design tools with its COS database. On the right, PLM with its CIM database. The core of the SEUS platform WAVE has direct synchronisation between COS and CIM via REST API. Access and write-back to and from information from third parties, for example other CAD tools, is done via CIM via Workspaces, or ERP systems via CIM via Catalyst

We provide comprehensive documentation on our REST interface based on the OpenAPI specification for customers and partners. It offers a standardised graphical interface that helps to intuitively understand the possibilities of our REST services and to use them quickly and without in-depth knowledge of our technology.

The interface description contains the REST resources for CAD documents, articles, projects, etc. and the corresponding access methods GET, POST, PUT and DELETE. It is created automatically on the basis of the CONTACT Elements data model. The documentation includes the most important product and project-related objects as well as administration and configuration settings, such as classification, materials and article names.

2. Synchronization from local folder via **WORKSPACES Desktop** for communication with other file-based CAD programmes: A file, as known from an operating system, is a universal data container. It stores data from various applications. For example, a file can contain an iPhone application, an image

or a text. A file is usually addressed via its path (name) in the file system. In addition to its content and name, it has additional attributes. These include the size, the time of the last change, the time of the last access, the time of creation and information on write or read permissions.

The Workspaces Desktop usually displays files in its views, whereby certain files that are displayed in Windows Explorer are filtered out of the view. For example, a backup copy of the last save of an MS Word document and temporary files are not displayed. This makes the file system view clearer compared to Windows Explorer.
Workspaces Desktop also offers a simplified abstract view of files. For example, in the CAD system Creo Parametric, the different versions of a file are given a counter as an extension, e.g. "Part1.prt.1", "Part1.prt.2" and following. However, these endings are only required for the CAD system. In Workspaces Desktop, both versions of the file are then simply displayed as "Part1.prt". Workspaces Desktop is the tool for managing workspaces. Tasks of Workspaces Desktop include:
- Visualization of the objects contained in a workspace and their relationship (here, only the objects relevant to the user are displayed where possible; backup files, etc. are filtered out of the display)
- Managing versions of the objects contained (it is possible to save versions of the objects contained in the workspace that can be restored at a later time)

3. **Individual Solutions**: In our SEUS case with CADMATC and PIAS, it's an opportunity, that PIAS has direct access to CADMATIC database COS and no accessibility to CIM database. This more an individual solution for the SEUS Platform in this customer and member related instance. Even if the SEUS platform offers standardised connectivity options, individual customer solutions (customisation) may be the better solution later on in productive use.

Catalyst 2.0

The Rest Api therefore offers the service of requesting information. For this, the third-party software must know what exactly and then they can retrieve the information from the PLM database via the request. In the case of WAVE, the CADMATIC database also has an API retrieval mechanism. This allows information to be synchronised between CIM and COS. This process assumes that both systems know each other exactly and this results in a high configuration effort to convert this knowledge into queries of the entire information objects. It is therefore

Overview of the query methods for the "Document" object

a passive process that is set up and triggered manually. In contrast, Catalyst offers an intermediate level that defines objects with semantic meanings that are always recurring in the data exchange.

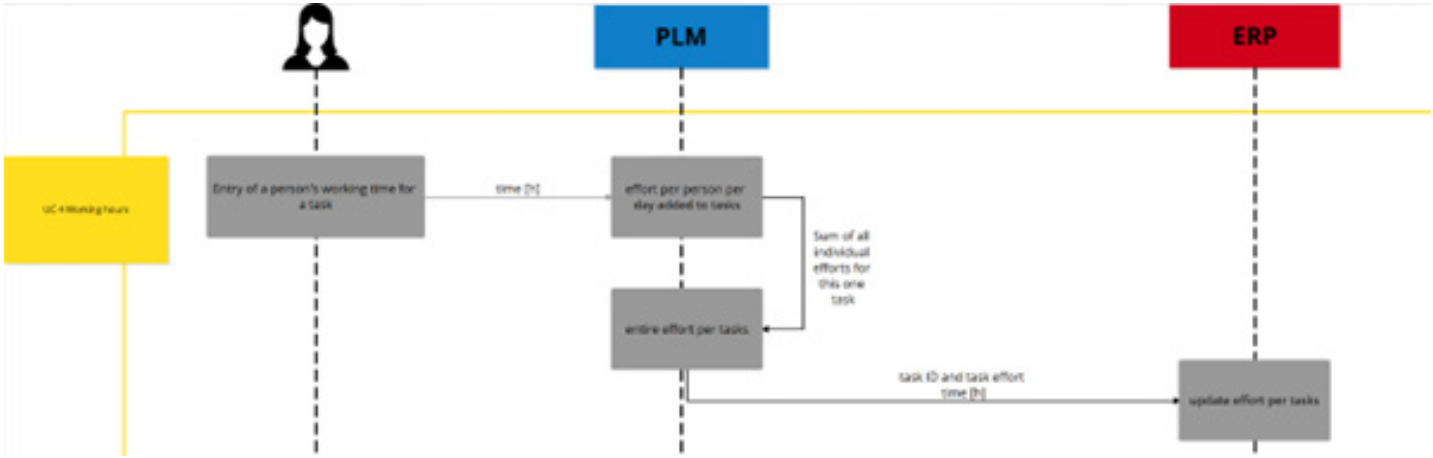
In the Catalyst 2.0 implementation, requirements analyses, and concept developments were carried out in particular in order to be able to implement a so-called ERP-related PLM. This approach is particularly necessary in the supplier-intensive shipbuilding industry. To create the basis for this, the following fundamental technical challenges were solved.
- A key development point last year was the design of an ontology modelling system that provides stable and reliably defined models, e.g. for different industries, while also allowing customer-specific extensibility. For example, 3rd party providers should be able to offer tools that are compatible with our Catalyst2 system for their use cases, while at the same time being able to cope with optional additional data being packed into the communication. To this end, we use a system of hierarchical namespaces in which, for example, corporate namespaces are based on namespaces of industry-specific service providers as extensions, which in turn extend standard namespaces. In addition to the formal definition of dependencies, this allows to take advantage of process-specific

standard procedures in combination with the artefacts defined as outcome of each process step. At the same time, it is possible to integrate additional more specialized data into the artefacts beyond this standard. These additions can be processed by specialised tools but at the same time can be omitted by the standard tools without any problems.

- Another point was technical efficiency considerations. The system should be able to distribute high-frequency, small-scale events quickly, while at the same time efficiently sending heavyweight messages with a considerable volume at the transitions between the process steps.
- Finally, the focus was on security aspects. This includes the question of which participants are allowed to inject messages into the system, as well as which participants or tools may see or receive certain messages. For example, development steps of classified projects should only be allowed to be processed within a core company, while the development data of standard products must also be available in the respective responsible global plants.

ERP Use Case Implementation

In order to implement a targeted solution for the consortium partner's ERP integration, so that the functionalities and usage patterns of the SEUS platform could be tested and evaluated, an ERP connection was created on the tried-and-tested and technically mature Catalyst1 technology. The focus was on the rapid introduction of PLM-ERP connectivity, especially as the functionalities and views for the end user did not differ.



The first implemented use case involves the transfer of tasks and their booked workloads. The aim was to transfer the tasks from the PLM project planning module to the ERP. The time entries made by employees then had to be transferred back into PLM for each task. This use case was completed.

Cyber Security

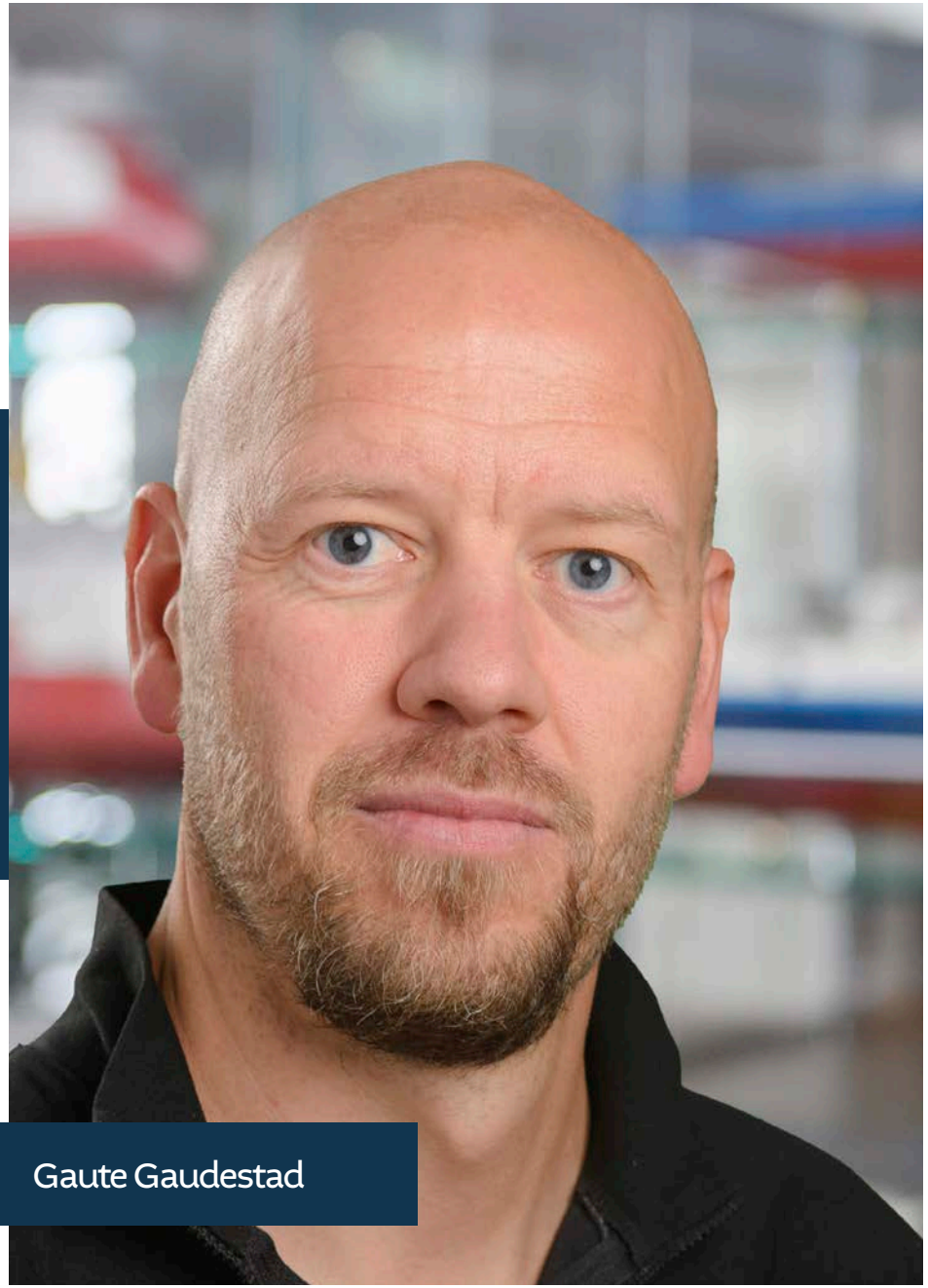
In 2024, the cyber security workshops were conducted for all the SEUS partners. We visited each and every partner and invited people within the organisation that could benefit from the workshop to attend and participate.

The workshops proceeded as follows, after a brief introduction of the cyber security team, we led a discussion of cyber threats to the maritime world. Then we showed real life cyber threats specifically targeting to the field of work of the partner. We then introduced participants to the NIST cyber security framework, and in case the company does their own software development, also secure development. After lunch, the session continued with a focus on the cyberattack surface of the partner and an intro into the field of cyber threat modelling. We also zoomed in on some particular threats posed by AI.

Visiting the partners gave us some insight in their processes and particular challenges. After conducting all workshops, we saw numerous similarities between the different partners. The feedback and recommendation one-pager reports were handed out after each workshop. Some common recommendations included creating and communicating cyber security policies, identify the organisations attack surface, perform threat modelling and perform penetration tests. During the SEUS project meeting in Turku, we also presented about these workshops and the

Cyber Security Workshop in NTNU (Norway)

WP4:
Implementation at Shipyards



Gaute Gaudestad

Work Package Overview

Shipbuilding projects can be divided into different stages. A normal practice is to divide shipbuilding projects into four stages, named concept & basic design (pre-contract), detail engineering, production, and operation (after delivery) – Figure 10. The operational stage might be included outside of the shipbuilding project. However, shipyards do perform activities at this stage, such as guarantee management, handling of spare parts, or other aftermarket services such as repair, maintenance, retrofit, or conversion works.

The activities involved in the user case are indirectly connected to this lifecycle since Ulstein shipyard is involved in the four stages, while Gondan focuses primarily on the stages between the shipbuilding contract and vessel delivery.

The project will involve four user cases, which will be used for testing of software functionality and for identification of productivity improvements. The four user cases are described below:

-User case I: Concept design development carried out completely in Cadmatic Wave, including documentation, collaboration with external parties, and management of document revisions

- User case II: Establish a newbuilding project including data connections to ERP system, document management, and collaboration with external suppliers

- User case III: Integration PIAS and Cadmatic Hull

- User case IV: Purchase process including management of offers, technical review of documentation, and storage of technical documents. Managing the influx of technical documentation from various suppliers, which often arrive in different formats and classifications.

Deliverables

During 2024 the project has had two deliverables related to work package 4. The first deliverable (D4.1) related to the selection of user cases and was finalized in June 2024. This deliverable lists the user cases and connects them to the partners involved on them. The second deliverable (D4.2) goes deeper in the establishment

of the user cases, and defines the list of by company, department and role. This deliverable was finalized in December 2024.

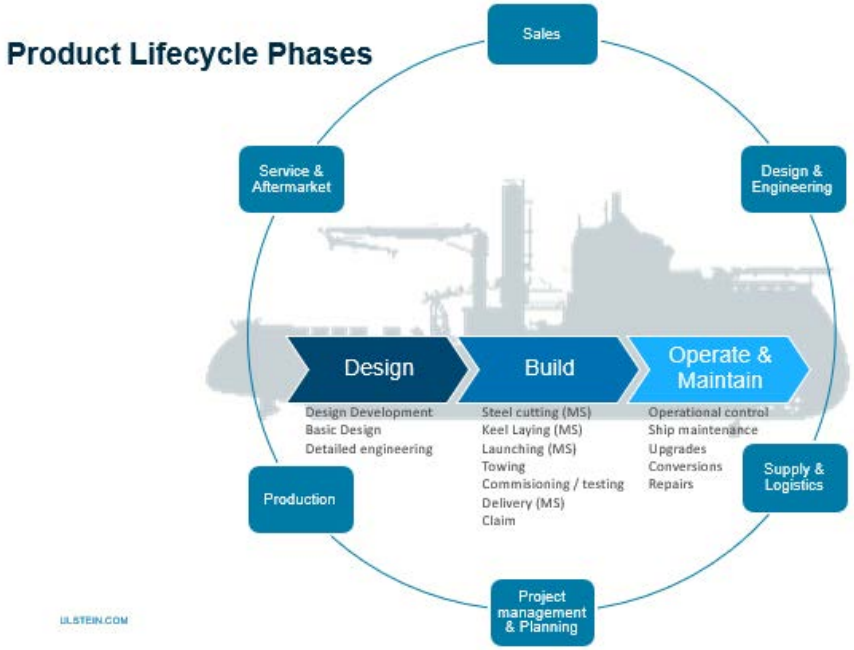
Ongoing work on user cases

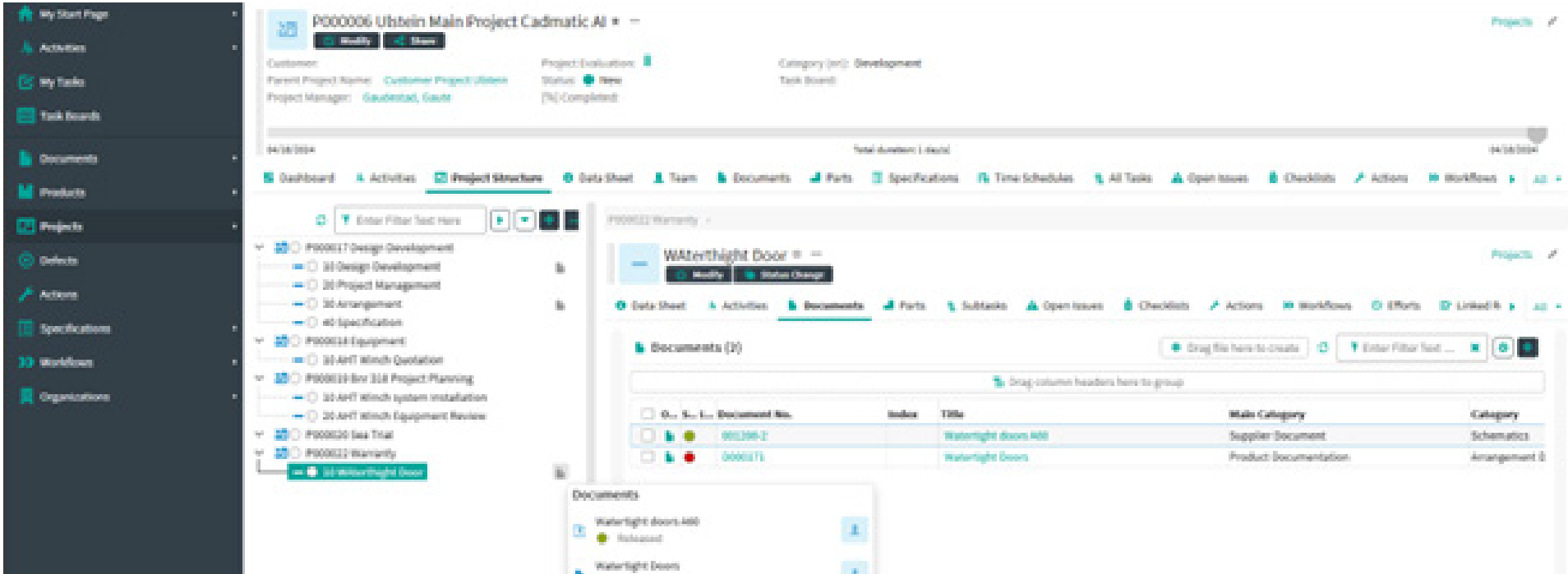
User case I, Concept design development, started the first week of November 2024. This user case involves Ulstein Group as ship designer and Cadmatic and Contact Software as software suppliers. Ulstein's concept design team is primarily involved in this user case.

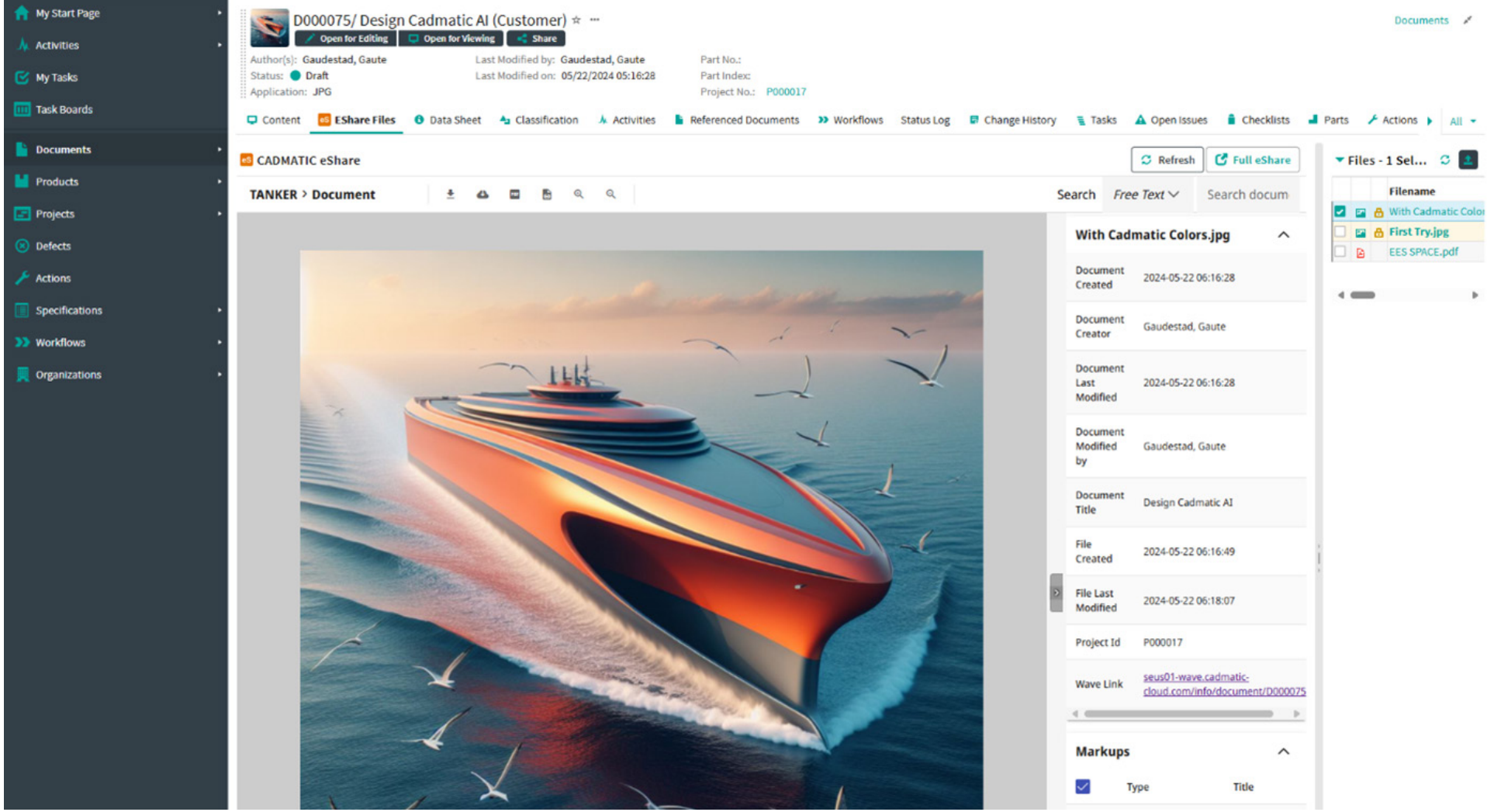
We have imported all the historically delivered vessel designs (products in the PLM language) with their associated metadata (length, beam, draft, nos. people, stability characteristics, classification notations, etc.

We have started registering as products and projects all the new concept design activities ongoing at Ulstein Design & Solutions AS and so far by the end of the year we have registered and started developing 18 products in the system. As part of the process, we are testing the functionality that is described in the user case.

We have also implemented the project management functionality using tasks and associating them with the relevant







resources. We have defined a template for design development, so each task has pre-defined document objects that are linked to the product breakdown structure (PBS). We are using status handling to track ongoing activity on tasks and documents.

Task 4.5: Full scale application involving design company and one shipyard

So far, implementation and testing has been done with the individual stakeholders. Either the ship design firm, or the shipyards. In this task, two stakeholders – ship design and shipyard – will collaborate in one case study. This will enable to explore communications and cooperation outside the own organizations, and evaluate potential limitations (or further strengths) of the methodology and software developed.

Task 4.6: Evaluation & Feedback

The last task will rely on the analysis of all the case material developed and collected on Task 4.2 to 4.5. The data, information and knowledge generated and collected will be analysed and compared to equivalent projects lacking PLM structures. Reports will be developed and learning communicated.

WP5:
Knowledge Management and Skills Development

Miia Martinsuo

Work Package Overview

Work package 5 addresses the objective of the SEUS project on human centricity, that is, to enhance the human-centric competitiveness of shipbuilding and reflect diverse values of stakeholders. This WP addresses overall shipbuilding planning and management with human-centric representation and management of shipbuilding activities. In shipbuilding, interaction and collaboration between various stakeholders is necessary, including the shipyard, ship owners, operators, supply chain partners, and service providers as well as users and passengers. The expectations of these stakeholders may differ from each other, which calls for suitable mechanisms for balancing different value priorities and elegant knowledge management systems. WP5 addresses the knowledge and requirements of shipbuilding actors and their skills development including training. WP5 also includes an AI-based document intelligence development component as well as interfacing with the platform development in WP3.

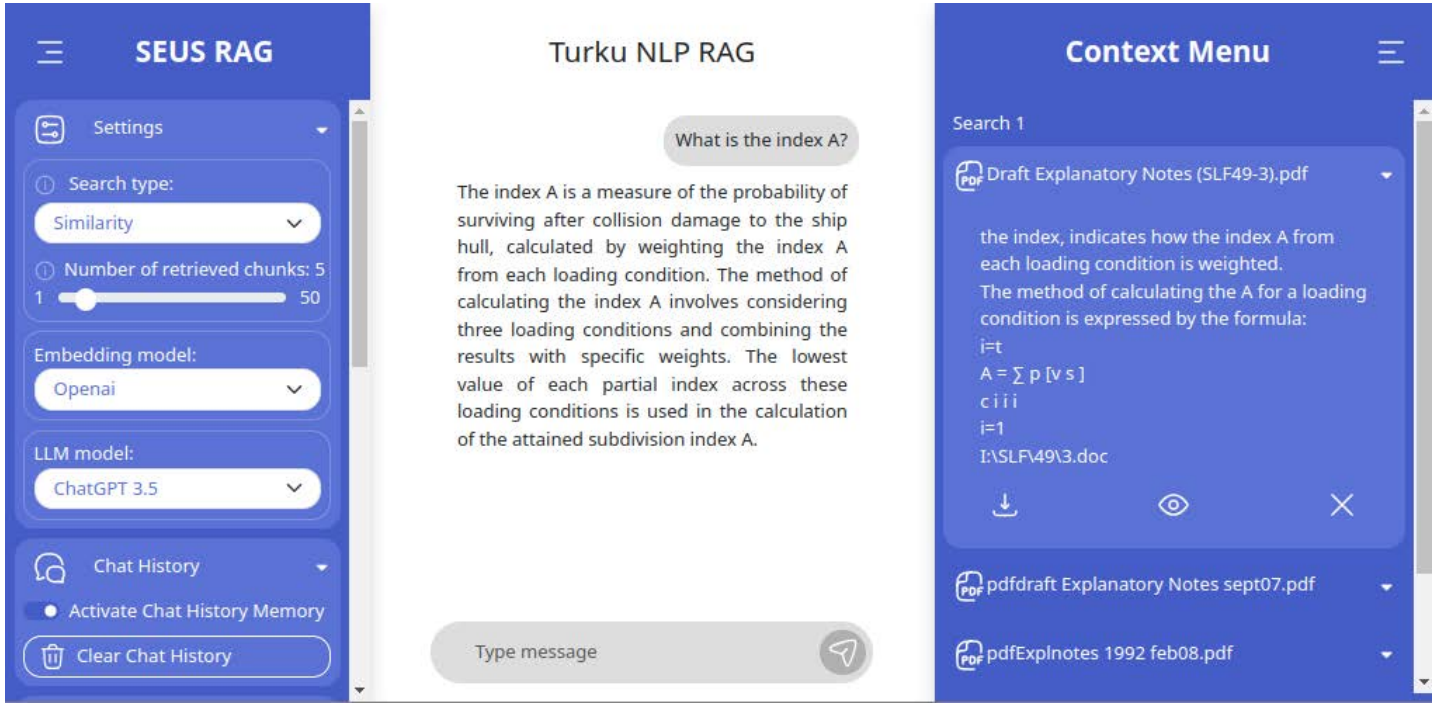
The core researchers of WP5 are from the Department of Mechanical and Materials Engineering and the Department of Computing of the University of Turku (UTU). Professor Miia Martinsuo and Doctoral Researcher Junsong He are working on human-centric shipbuilding activity mapping, Professor Jussi Kantola and Doctoral Researcher Pengcheng Ni develop the knowledge management system, Professor Filip Ginter and Project Researcher Maryam Teimouri are working on AI-based document intelligence using natural language processing, and Postdoctoral Researcher Dr. Zeynep Tacgin and Professor Miia Martinsuo develop the learning technology solution for training digitalization understanding in shipyards and shipbuilding understanding for software professionals. During the year 2024, WP5 has produced some results that build a solid foundation for further advances in human-centric smart shipbuilding. The first version of a knowledge management system architecture has been developed and reported, now ready for validation and further development. An initial version of an AI-based search engine has been released and shared in the SEUS community to enable further development. Concerning the shipbuilding activity mapping, two overarching activity-related values were selected as a focal point of research: efficiency value and service value. Different stakeholders' views of value priorities have been revealed, and various value balancing mechanisms have been identified. The expectations

and requirements toward the learning technology solution intended for educating digitalization in shipbuilding have been identified, to enable developing the solution concept next year. The next sections introduce WP5 key tasks and achievements in 2024. Specific research tasks of WP5 are like to following;

Task 5.1: Knowledge management system:

In task 5.1 (conducted by UTU), the analytical part of the Knowledge Management System (KMS) has been completed. A comprehensive KMS architecture blueprint has been drawn. The stakeholders of the KMS were defined based on interviews with selected participating companies. Some workshops were organized as physical meetings, and some workshops took place in online meetings, to define expectations toward the KMS. Based on the stakeholders' needs and expectations, functional requirements for the KMS were specified. Also, some constraints for certain functional requirements were included. Special attention was paid to the independence of the functional requirements, which is a prerequisite for a modular and updatable system design. After several rounds of sketching, the architecture of the KMS v 1.0 was created.

One logical finding was that the KMS architecture has the same base elements regardless of the business of the stakeholder. These elements match well with the known theories of knowledge management and knowledge creation. When the base architecture is decomposed towards different businesses of the stakeholders, the KMS will take different conceptualization and realization. As a consequence of the development in the year, the KMS architecture is ready for the next development steps, that is, validation and innovative concept development. The key results are published by Ni and Kantola (2024) and Ni (2024). More publications that describe the KMS architecture of a complex system are under preparation.



Task 5.2: Requirement and shipbuilding knowledge capture, preservation, management, and development using AI:

In task 5.2 (conducted by UTU), AI-driven solutions are being explored to handle shipbuilding knowledge efficiently. Using Retrieval-Augmented Generation (RAG), the system enables seamless access to technical documents, design specifications, and regulatory requirements. AI enhances knowledge retention by structuring complex shipbuilding data, automating document classification, and ensuring real-time updates for evolving industry standards. Additionally, natural language processing (NLP) models facilitate intuitive search capabilities, allowing engineers and stakeholders to retrieve critical information effortlessly.

Task 5.3: Shipbuilding Activity Map to manage shipbuilding activities from a contract, design

to production, test, and delivery as well as aftermarket services:

Task 5.3 (conducted by UTU) aims to deliver a shipbuilding activity map, which helps project managers gain an overview of the whole project and dive into specific activity areas. The investigation concentrates on such activities that can benefit from digitalization and, thereby, will add value in the shipbuilding process. Activities represent the core value-creating elements during a project's lifecycle. Each activity is characterized by its involved stakeholders, allocated resources, expected outcomes, the digitalization tools and data platforms employed, and its connections to preceding and succeeding activities (Kim et al., 2024). Value is a critical element of these activities, and different stakeholders have different expectations concerning the value created in each activity and phase.

Our research has explored value expectations both from the perspective of shipyards that implement new digital tools and software firms that supply digital solutions for shipyards. Qualitative case studies are being conducted, to build understanding from both perspectives. For example, business development and sales managers prioritize flexibility, customization, and co-creation–aspects closely tied to service value. In contrast, technical office and purchasing managers emphasize standardization and predefined processes, reflecting a focus on efficiency value.

The focus in the first analysis phases has been on efficiency value and service value that are both created during shipbuilding activities and need to be balanced during the project, to serve different stakeholder expectations. For example, balancing mechanisms may involve internal strategies such as standardizing, modularizing, configuring, reusing, and scaling products and services, along with external strategies like co-creating, negotiating, adapting, bargaining, and segmenting communications with customers. To ensure usability and general applicability, various shipbuilding contexts and shipyard characteristics will be considered through a series of workshops and user testing in shipyards.

Task 5.4: Business model development for implementation and use of the platform:

Development of business model strategy and go-to-market tactics, including evaluation of added value, market size, type of product-service ratio and marketing action planning, will be conducted. This task will begin in the year 2025 and will be primarily conducted at CADMATIC.

Task 5.5: Learning technology-based training of highly skilled workforce with new shipbuilding and computational technology:

Tasks 5.5 (conducted by UTU) focuses on designing and developing a digital learning solution to motivate users of the SEUS platform and Task 5.6 is about training software professionals to the complex world of shipbuilding. The primary goal is to support the integration of data-driven systems into shipbuilding workflows, improving efficiency and process optimization. Given the complexity of shipbuilding and the involvement of multiple stakeholders, the learning solution must be tailored to meet the specific needs of different user groups. The digital learning solution aims to increase user motivation, foster collaboration, and provide an effective transition to data-driven methodologies (Tacgin & Martinsuo, 2025a). As an outcome, we pursue a structured and adaptable learning experience that enhances productivity, optimizes processes, and supports digital transformation in shipbuilding.

A design-based research approach is employed to ensure an iterative development process that refines the learning solution based on user feedback. This ensures alignment with industry needs while addressing practical challenges in adopting the learning solution. The research started with a comprehensive educational needs analysis, identifying the primary users of data-driven tools, their expectations, learning patterns, and current challenges (Tacgin & Martinsuo, 2025b). Surveys, interviews, and a detailed assessment of existing workflows provide insights that shape the content and instructional strategies. Validation by subject-matter experts ensures terminological accuracy.

Learning materials and activities are designed for every stakeholder group after the needs analysis, taking into account their distinct roles and responsibilities. The learning modules incorporate interactive elements, simulations, and real-world scenarios to enhance engagement and practical application. Once the content is tested and approved, development focuses on integrating instructional methods, including technical demonstrations, self-paced modules, and scenario-based learning, to ensure seamless adoption of data-driven tools in daily workflows.

WP6:
Dissemination and Communication

Welmoed Van Der Velde

Work Package Overview

The purpose of this work package is to let the world know about SEUS. It is to assure the project's visibility and spread pertinent information on its goals, activities and results to the relevant stakeholders and scientific communities.

This includes:

- Distributing knowledge about SEUS to the wider maritime world.
- Disseminating knowledge that is or can be made publicly available to academics and software developers.
- Distributing user knowledge about SEUS to present and future designers, engineers and their managers.
- Identifying and managing the Intellectual Property Rights as developed in SEUS.
- Training the next generation of ship designers and shipbuilders in the use of digital technologies in the industry.

The deliverables of this work package are:

1. SEUS repository of basic commercially useable communication material;
2. Customer-oriented commercial material from software suppliers CADMATIC, Contact and SARC;
3. SEUS website;
4. Set of IP management and exploitation rules and agreements;
5. Training material.

Work package 6 is lead by NHL Stenden in close cooperation with partners CADMATIC and NTNU that lead specific tasks identified in this work package. These tasks are:

1. Communication of results

The purpose of this task is to compile commercially useful material that can be used as basis for the SEUS partners in their commercial communications. The same material will be used for (non-scientific) contributions in professional magazines.

A dedicated SEUS repository of basic commercially useable communication material supports SEUS partners in their communication activities. The SEUS Dissemination and Communication Plan and Visual was updated in 2024. In 2024, communication activities on SEUS were performed during international events such as ISOPE 2024 in Greece, SIM 2024 in Portugal, the TRA conference in Ireland, a seminar in Norway, an event at DNV in Finland and during presentations at NHL Stenden and SARC in the Netherlands. SEUS gained continued attention through SEUS partners' company websites and social media (LinkedIn and blogs)

2. Reach through customers, partners and prospects networks (lead: CADMATIC)

Software companies CADMATIC, Contact and SARC will use the material as developed by NTNU in their existing channels to reach their customers and prospects.

3. Promotion

The public website which has been created for the SEUS Project by NTNU in year 1, has been updated in 2024. This website will be maintained during the project's lifetime and will include summaries of deliverables and achieved results, as well as practical results on a specimen vessel.

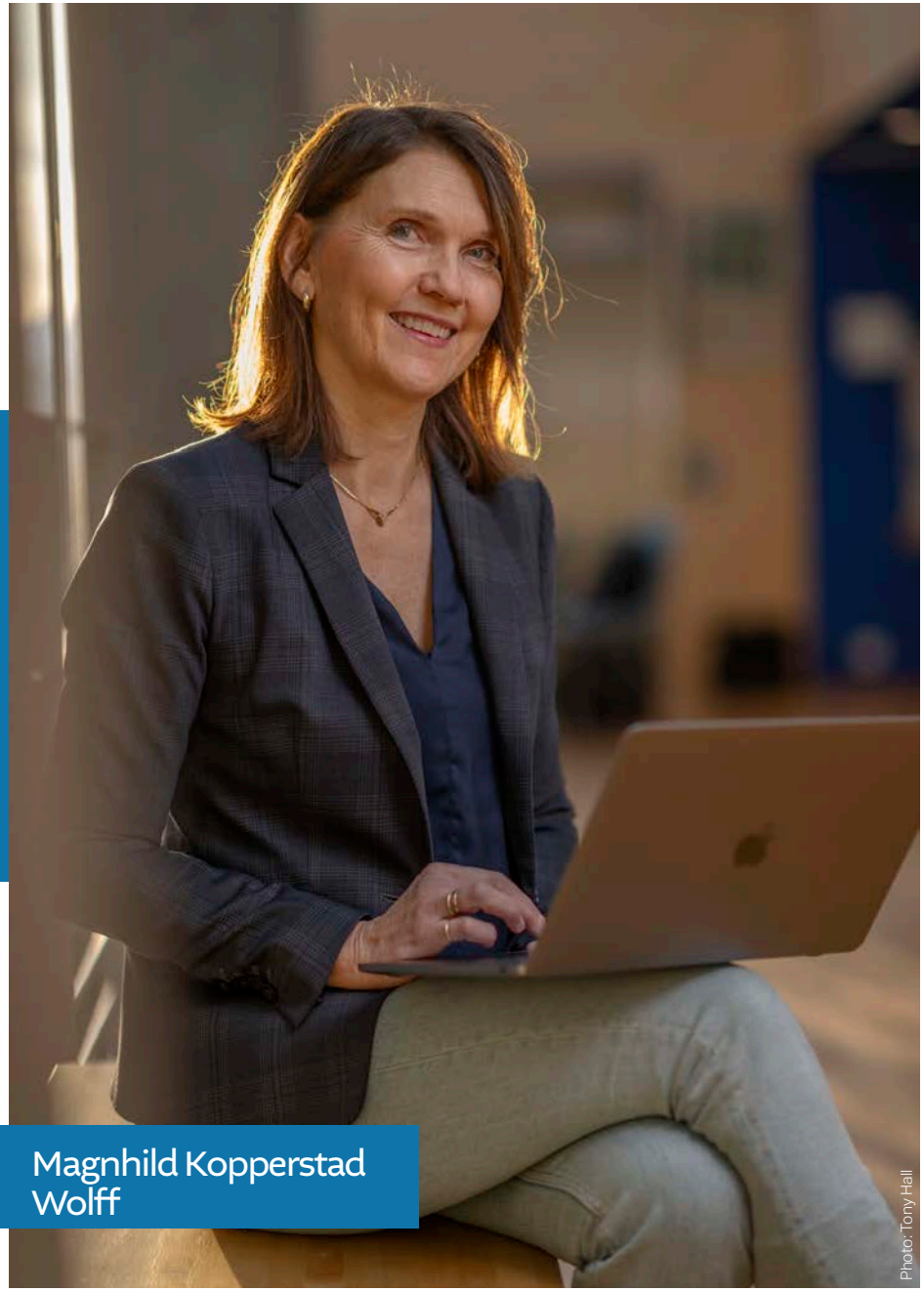
4. Protection of Intellectual Property Rights

In year 2 a report was delivered summarizing the principles for IP management during the SEUS project and setting up the guiding principles for exploiting the project results. The IP practices are based on corresponding parts of the Consortium and Grant Agreements and on results of a survey for participants in the project held in year 1. The agreed practices aim to set a foundation for the business model for project outcomes exploitation later.

5. Connecting project outcomes to education

Teaching and training material on the background and usage of the SEUS software are being developed by NHL Stenden and project partners to connect project outcomes to university and vocational teaching.

WP7: Project Management



Magnhild Kopperstad Wolff

Photo: Tony Hall

Work Package Overview

During the first year of the project we established administrative routines for the project to ensure good progress, meet reporting and delivery deadlines, and achieve the project's goals. Furthermore, routines were established to ensure good communication among partners. All routines were developed throughout the first year based on project needs and feedback from partners. During the second year of the project, 2024, we have continued to follow the same routines. Although many necessary procedures are now established, we still aim to maintain a dynamic approach to our routines to ensure the best possible follow-up and facilitation to meet the goals of SEUS throughout the project period.

The purpose of WP7 can be summarized as:

- Ensuring smooth cooperation among consortium partners
- Leading the consortium towards fulfilling the planned goals of SEUS project
- Efficient financial, technical, and legal management
- Establish efficient coordination and communication between partners and the EC project officer

Communication Among Partners

A meeting structure has been established with meetings held on Teams approximately every 6 weeks, with each partner required to have at least one representative present. These meetings are used to convey necessary information from the Management Team to the partners, gather status reports from each work package, present research-related topics, and address any questions or other matters that may arise. Additionally, two physical workshops are scheduled per year, except in 2024, when only one workshop was held in Turku (Finland) in May. These gatherings are important meeting places for strengthening the consortium's ties. Additionally, there are meetings with more focused technical content initiated by the partners themselves and guided by the needs connected to research within each work package. A TEAMS chat including all internal participants was also created as an active channel to communicate, as well as mailing lists.

All communication with the Project Officer at the European Commission goes through the Project Management Team.

Document Exchange

A data repository for the partners has been established using SharePoint capabilities, with access via the SEUS website and with

required personal login. This is managed by NTNU, which provides hosting and management of the repository to all partners, including assigning access to the area for new project participants. All formal documents are stored here and made available to all partners. Here you can also find a list with an overview of all the participants in the project.

Financial Reporting

Internal financial reporting is scheduled every 6 months. This allows us to follow up on whether the activity in the work packages is as expected and to have a dialogue with the partners if corrections are needed. Payments to the partners are made according to the payment schedule following the submission of the internal report. A template to be used for reporting is sent out to the partners, and participants have approximately two weeks to submit their reports. In addition, periodic financial reporting to the EU is due in M18, 36, and 48. This is done directly in the EU portal by each partner.

Technical Reporting

Routines for reporting Deliverables have been established and communicated to the partners, see Figure 1.

An Excel-based Roadmap has also been established and archived in SharePoint, where each work package leader is expected to continuously update the status of their work package using colour-coded markers (green, yellow, red) and comments containing necessary information.
So far in the project, we have had the following deliveries in WP7:
D7.1 – Management and Quality Plan – delivered in June 2023
D7.2 – Risk Management Plan - delivered in June 2023
D7.3 – Initial Data Management Plan - delivered in June 2023
D7.4 – First update to the DMP - delivered in June 2024

Internal administrative procedures may be subject to change depending on needs that may arise throughout the project period.

Deliverable No	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date	New Due Date (if delay)	Delivery Date (actual)	Status	Comments
D1.1	Results and analysis of the best practices research	WP1	NTNU	R	PU	30 June 2024		30 June 2024	SUBMITTED	
D1.2	Result and analysis of the survey	WP1	NTNU	R	SEN	30 June 2024		30 June 2024	SUBMITTED	
D1.3	Strategic roadmap for development	WP1	CADMATIC OY	R	SEN	31 December 2023		21 December 2023	SUBMITTED	
D4.1	Use cases selected	WP4	Ulstein	R	SEN	30 June 2024		30 June 2024	SUBMITTED	
D6.1	Repository of basic commercially useable communication material	WP6	NTNU	R	PU	31 December 2023		21 December 2023	SUBMITTED	
D6.3	Website	WP6	NTNU	DEC	PU	31 December 2023		21 December 2023	SUBMITTED	
D6.4	Set of IP management and exploitation rules and agreements	WP6	CADMATIC OY	R	SEN	30 June 2024		30 June 2024	SUBMITTED	
D6.6	Plan for the Exploitation, Dissemination and communication of results	WP6	NTNU	R	PU	30 June 2023		29 June 2023	SUBMITTED	
D7.1	Management and Quality Plan	WP7	NTNU	R	SEN	30 June 2023		29 June 2023	SUBMITTED	
D7.2	Risk Management Plan	WP7	NTNU	R	PU	30 June 2023		29 June 2023	SUBMITTED	
D7.3	Initial Data management plan	WP7	NTNU	DMP	PU	30 June 2023		29 June 2023	SUBMITTED	

SEUS TECHNICAL REPORT (PART B)

PROJECT	
Project number:	101096224
Project name:	Smart European Shipbuilding
Project acronym:	SEUS

REPORTING PERIOD	
Please note that you must report on the entire reporting period.	
RP number:	*1*
Duration:	from 01/01/2023 (M1) to 30/06/2024 (M18)

SEUS
Smart European Shipbuilding

NTNU CADMATIC CONTACT ULSTEIN CONDÁN SARC

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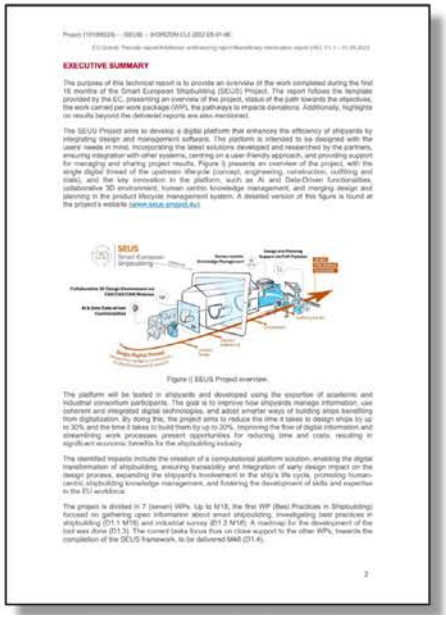
1. EXPLANATION OF THE WORK CARRIED OUT AND OVERVIEW OF THE PROGRESS

1.1 Objectives



EXECUTIVE SUMMARY

2. EXPLOITATION PRIMARILY IN NON-ASSOCIATED THIRD COUNTRIES (IF APPLICABLE)

4. OPEN SCIENCE

Diego De León
PHD Candidate

Academic Researchers

Data Driven Design - Ship Engineering Application

Project Description

A combination of two factors defines the current evolution of Ship Design. First, the challenges brought by the necessity of tackling the climate impact of shipping with the change in regulations and uncertainty about the solutions to come; and second, the availability of new computational methods based on machine learning and the boom in accessibility of computational power. This leads to a scenario where an opportunity to bridge the gap between the maritime industry's need for a more agile Ship Design process, and the current limitations in software tools and methodologies.

With a goal of contributing to the creation of applicative tools that consider the specific needs and workflow of Ship Design, adapting them to the maritime industry and aiding its transition to newer computational methods, the question itself becomes: How to implement modern computational technologies to enhance the ship design process, in a way that matches the necessities of the maritime industry.

Yet, to ensure applicability and feasibility, a start with the limitations of the available technology and the priorities of the industry is being evaluated as the first step in the creation of such prototypes.

Supervisor Team

1. Herbert J. Koelman, NHL Stenden & SARC BV
2. Henrique M. Gaspar, NTNU
3. Jose Jorge Garcia Agis, Ulstein International AS
4. Javier García Llaneza, Gondan Shipbuilders

Photo: Tony Hall

Gökce Yılmaz
PHD Candidate

Industry 5.0 in Shipbuilding: Improving Collaboration and Management with Digital Tools

About

Gokce is a PhD candidate who previously participated in the SEUS Project as a technical manager, supporting various work packages, primarily WP7. She earned her bachelor's degree in architecture from Yeditepe University, Turkiye, and master's degree in sustainable architecture from Politecnico di Milano, Italy. After her contributions to supporting project management at SEUS, she began her PhD in Industry 5.0 in Shipbuilding, concentrating on enhancing project management.

Project Description

Her current PhD thesis explores existing solutions and challenges in shipbuilding project delivery models. It examines ways to enhance the adoption and use of digital tools for improved project management within organizational frameworks under the goals of Industry 5.0 defined by the EU framework.

Research Questions

1. What challenges do shipbuilding firms face with digital tools that impact project success?
2. How does Industry 5.0 influence the role of digital tools in supporting people and teamwork in shipbuilding projects?
3. How can shipbuilding firms improve the use of digital tools to strengthen project management?

Industrial & Academic Goals

Analyzing how digital tools influence teamwork dynamics and improve collaboration across different teams through shipbuilding case studies

- Developing guidelines to overcome common adoption barriers of digital tools and their practical
- integration into shipbuilding workflows
- Meeting industry needs that aim to convert research findings into practical, scalable solutions

Supervisor Team

1. Henrique M. Gaspar, NTNU
2. Miia Martinsuo, University of Turku
3. Maria Jose Legaz Almansa, Polytechnic University of Cartagena
4. Jose Jorge Garcia Agis, Ulstein International AS

Janica Altea Bronson
PHD Candidate

Data Integration Solutions for the Maritime Industry

About

Janica is a current PhD Candidate for Maritime Computational Tools at NTNU. She completed a Master's in Naval Architecture at the University of British Columbia and a Bachelor of Mechanical Engineering (Mechatronics Specialization) at the University of Calgary in Canada. Before NTNU, she worked in industry at Robert Allan Ltd and Vard Marine Inc., with a focus on ship concept design and the use of programmatic tools to improve decision-making, automate reference data handling, and design simulations. Her prior research involvements include machine learning for fuel consumption with BC Ferries, Queen of Oak Bay.

Project Description

Her current research Ph.D. thesis is focused on assessing the impact value of linking information silos and cross-domain data in ship early design and determining how this can be quantified in terms of time savings. Her current hypothesis is that the use of node-based and open data models can enhance the interoperability and interactions amongst the parameters used in different systems.

Research Questions

- What are the industry's main challenges regarding computational tools or digital infrastructure to manage ship data?
- What are the different ways that one can attain semantic and syntactic interoperability today?
- What data model could address the industry's unique challenges?
- How does this solution increase the overall efficiency and digital competitiveness of a ship design firm and yard?

SEUS, Innovation, and Industrial Goals

For the SEUS project, she is currently providing ancillary support for ongoing deliverables where additional academic and or literature input is needed. Collaboration with class societies, ship design firms, and shipyards is something she hopes to foster to provide software partners with a current and accurate understanding of the needs and information flows in present day ship design and shipbuilding.

Supervisor Team

1. Henrique M. Gaspar, NTNU
2. Icaro Fonseca, NTNU
3. Jose Jorge Garcia Agis, Ulstein International AS

Jungsong He
PHD Candidate

Stakeholder Management for Value Creation in Project-Based Firms

About

Junsong is a doctoral researcher at the University of Turku (UTU). He completed a double master's degree at Tongji University in China and Politecnico di Milano in Italy, majoring in Product-Service System Design. Before UTU, he worked at Accenture and an AI startup.

Project Description

His research focuses on value creation and services from industrial, business, and management perspectives, using specific sectors as the research context. He also supports the development of Work Package 5.3, "Shipbuilding Activity Mapping," which supports and enhances the shipbuilding workflow.

Industrial Goals

The SAS will help project managers, engineers, and stakeholders gain a clear overview of the project, track activities, and optimize resources. By integrating data tools and considering values such as efficiency and service, it enhances decision-making, improves collaboration, and drives productivity–ensuring adaptability across different shipbuilding contexts.

Research Questions

Within the SEUS project, this overarching focus is examined through three key research questions:

- RQ1 (value-creation): How can managers balance service value and efficiency value in customized solutions?
- RQ2 (lifecycle activities): How do data platforms enable smart services through specific lifecycle activities in delivering a complex system?
- RQ3 (stakeholders): How do managers enable the implementation of smart services for business benefits in delivering a complex system?
- In practice, these research questions will guide the implementation of the SAS.

Innovation

Introducing an innovative SAM tool to enhance practical project management in shipbuilding.

Supervisor Team

1. Miia Martinsuo, University of Turku
2. Jussi Kantola, University of Turku

Pengcheng Ni
PHD Candidate

Knowledge Management System in a Complex Environment

About

Pengcheng Ni is a doctoral researcher at the University of Turku (UTU), department of Mechanical and Materials Engineering. He is working in the smart system lab in the University of Turku. His research interests are axiomatic design, system architecture and knowledge management. He is doing research on knowledge management systems in complex projects and knowledge-intensive organizations by using axiomatic design methods and system architecture theory.

Project Description

Knowledge Management System (KMS) is a vital yet abstract concept in industrial activities. It is an interdisciplinary research field that combines technology and management research to tackle complex problems in projects. KMS enhances the core competitiveness of projects and contributes to each stage of the project. WP5 in SEUS focuses on the lifecycle of shipbuilding and involves all stakeholders, including shipyard workers, ship owners, operators, and shipbuilders. The final KMS will be the milestone of smart European shipbuilding management.

Industrial Goals

Use KMS to ensure the maximum efficiency of managing the knowledge asset, finally contribute to the core competitiveness of projects and organizations.

Research Questions

1. How does axiomatic design contribute to the knowledge management system?
2. What is the concept of system architecture of a knowledge management system?
3. What is the architecture of the knowledge management system in SEUS?

Innovation

One of the innovative points of developing the KMS in smart European shipbuilding is the first time the axiomatic design in the knowledge management system in SEUS has been applied. WP5 in SEUS focuses on systematically constructing the knowledge management system.

Supervisor

1. Jussi Kantola, University of Turku

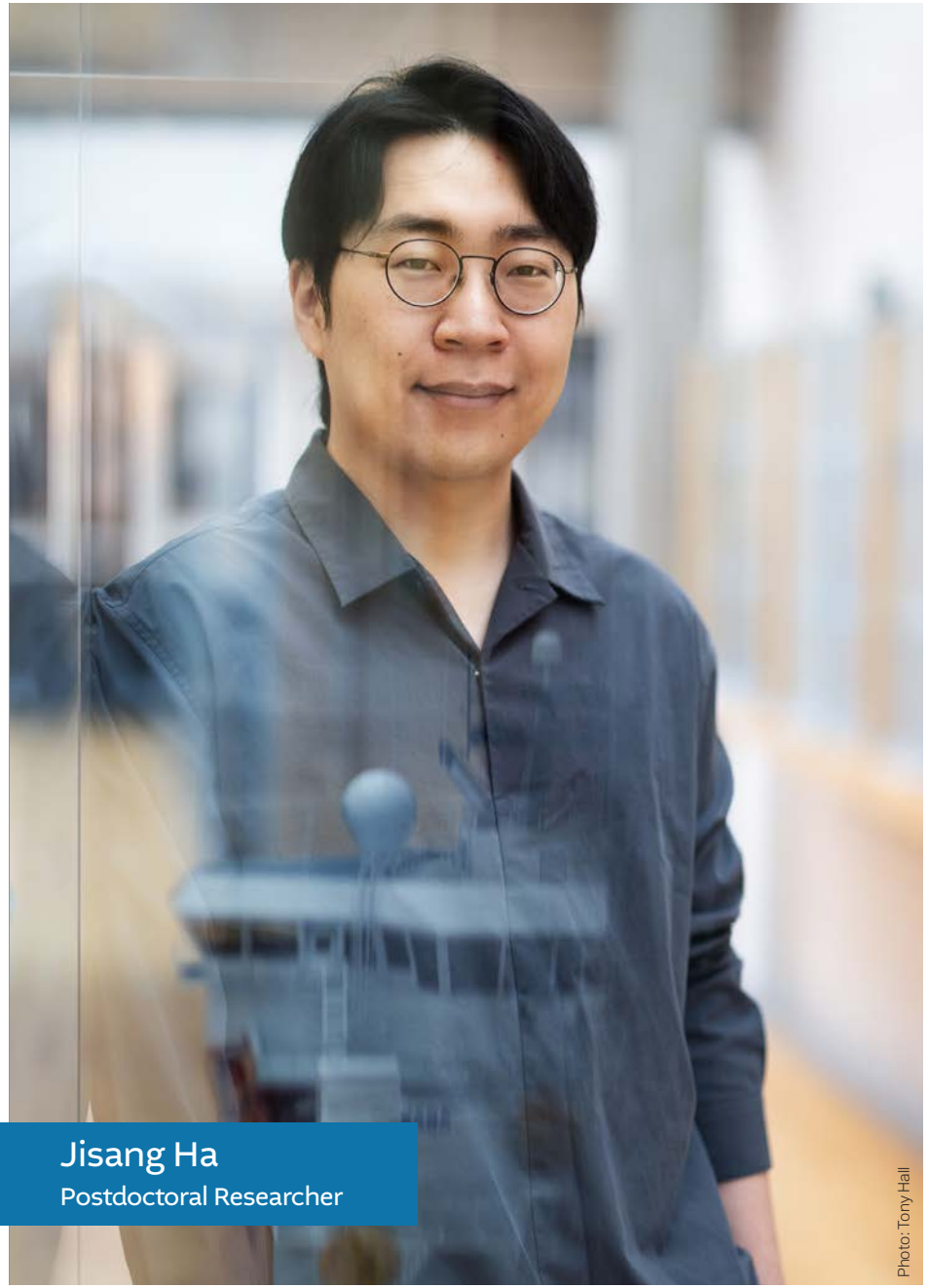


Photo: Tony Hall

Jisang Ha
Postdoctoral Researcher

Improving Ship Design with Digitalization and Integrated Data Model

About

Jisang is a Postdoctoral Researcher for SEUS at NTNU. He completed a bachelor's and PhD (Naval Architecture and Ocean Engineering) at Seoul National University in Korea. Before NTNU, He mainly conducted research on ship arrangement design, equipment and piping design. He also worked on image-based ship detection and collision avoidance using deep learning techniques.

Project Description

His current research involves exploring the potential applications of Single Source of Truth (SSoT) and data integration solutions within the SEUS project framework. This research extend to performing design elements such as compartments, equipment, and piping during design phases with integrated data model from 2D drawings to 3D models.

Research Questions

- What technologies are required to perform both ship design and production with one integrated data model?
- Can deep learning technology contribute to ship design using an integrated data model?
- How can shipyards take advantage of digitized ship design?
- Can SEUS solutions improve the fragmented models between detailed and early-stage design?

SEUS, Innovation, and Industrial Goals

For the SEUS project, he is working on the development of Work Package 1 (WP1) and supporting other deliverables where additional academic and or literature input is needed. He would like to contribute to the SEUS project by applying SEUS solutions from industrial partners to research cases or by improving solutions.

Maryam Teimouri
Project Researcher

AI-Integrated Solutions for Smart Knowledge Management

About

Maryam is currently working as a Project Researcher at Turku NLP, University of Turku (UTU), Department of Computing. Her work focuses on AI-driven solutions for smart knowledge management. She holds a Master's degree in Data Analytics from the same university and department. Previously, she has conducted research on the role of Mixed Reality in education and analyzed interactions involving Large Language Models (LLMs) and AI. Her research interests span natural language processing, human-AI interaction, and intelligent systems.

Project Description

Maryam is currently exploring the use of Retrieval-Augmented Generation (RAG) technology to develop a flexible and intelligent knowledge management system. The goal is to create a system that is easily updatable while maintaining an interactive and natural communication style, similar to human language.

Industrial goals

The goal is to develop a web-based search engine with configurable settings, including the ability to switch between different language models. This flexibility enables the integration of multilingual models, allowing users to access documents in multiple languages. By supporting diverse language sets, the system aims to enhance accessibility and usability for a global audience.

Research Questions

1. Model Selection: Which language models are best suited for retrieving the most relevant documents while ensuring that all aspects of the user's prompt are considered?
2. Attention Control: How can we effectively control the aspects that models focus on during retrieval and response generation?
3. Specialized Retrieval: How can the system efficiently retrieve specific types of documents, such as tables, images, and formulas?

Supervisor

1. Filip Ginter, University of Turku

Zeynep Tacgin Simsek
Postdoctoral Researcher

Learning technology-based training

About

Zeynep Tacgin has worked in the field of education technologies for more than ten years. She is a Postdoctoral Researcher at the University of Turku, an Adjunct Associate researcher at Charles Sturt University and an Associate Professor at Marmara University. She graduated from the Computer Education and Instruction Technologies program at Marmara University in 2012. She received a PhD degree in Computer Education and Instruction Technologies program in 2017. Her fields of interest are education, human-computer interaction, wearable technologies, innovative learning environments, technology integration into education, education management and policies, distance education, augmented reality, virtual reality, simulations, instructional design, and material development.

Project Description

Her current postdoctoral research focuses on designing and developing an orientation tool aimed at motivating individuals in the shipbuilding industry to adopt data-driven shipbuilding tools in their daily work routines.

Research Questions

- What are the most suitable learning models and instructional techniques for training programs aimed at integrating data-driven shipbuilding tools into daily work practices?
- What should be the scope and content of such training programs to effectively support the adoption of data-driven tools in the shipbuilding industry?
- How do learners evaluate the usability of the developed digital learning solution?
- How do learners assess the effectiveness of the developed digital learning solution in supporting their work practices?

Innovation

For the SEUS project, Zeynep is working on Work Package 5 in tasks 5.5 and 5.6 which focus on designing solutions for training shipbuilding and software professionals based on learning technologies. The development of this learning material involves not only an in-depth review of relevant literature but also close collaboration with various project partners to analyze their specific needs for adopting data-driven shipbuilding

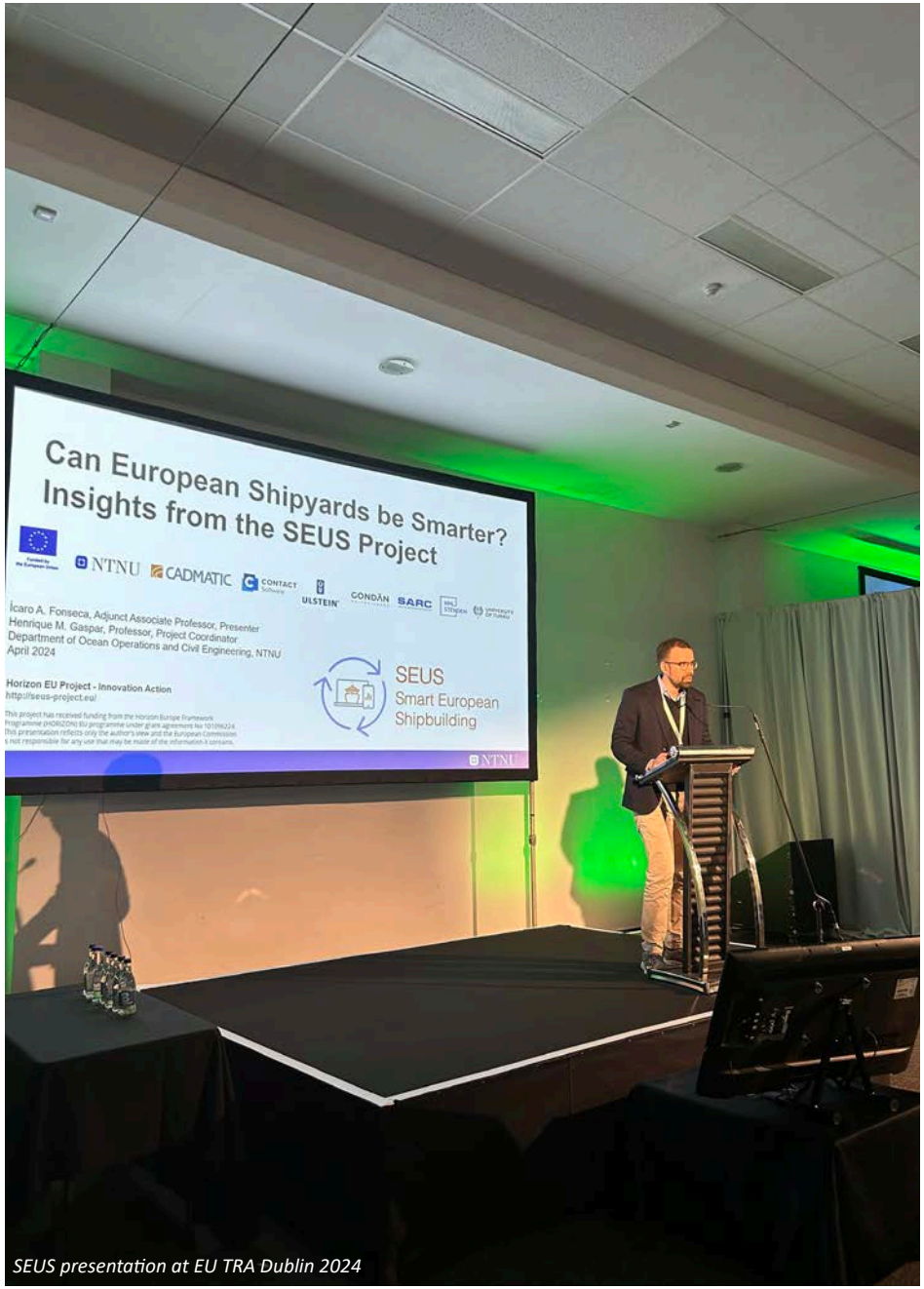
Target Group

Collaboration between KRISO (Korea) and NTNU (Norway)

Target Audience

The dissemination of project results will be directed towards specific target groups, aiming to engage with them and enable the utilization of the project's outcomes. Additionally, this project involves a comprehensive analysis of customer segments, which will help identify their needs and preferred modes of communication. The target audience is based on the extensive experience of consortium members in the maritime industry, as well as their current understanding of the potential impact and value gains for various customer groups, shipbuilding, shipping, logistics, manufacturing, and IT industries. In summary, the target audience can be defined as follows:

- EU shipyards
- Ship design and naval architecture firms
- Shipowners and operators
- Shipbuilding subcontractor
- Wider shipbuilding industry: classification societies, technology providers
- Engineers, designers, naval architects, and others involved in the shipbuilding industry
- EU workforce in computational tools development and implementation fields
- Universities and research organizations globally
- Students in shipbuilding, mechanical engineering, manufacturing, and IT



SEUS presentation at EU TRA Dublin 2024

Communication & Dissemination

SCIENTIFIC ARTICLES (2024)

Koelman, H. J., Veelo, B. N., Seppälä, L., & Filius, Closing the gap between early and detailed ship design models, International Marine Design Conference.
SARC

Legaz, M. J., & Gaspar, H. M., Computer Vision For Reverse Engineering In The Design, Simulation And Operation Of Maritime Systems, ECMS.
NTNU

Bronson, J. A., FONSECA, Ícaro A., Gaspar, H. M., & Luz, F. H. P., Data models in ship design and construction – insights from 4D BIM, International Marine Design Conference.
NTNU

Agis, J. J. G., & Brett, P. O., Digital Shipbuilding – Needs, challenges, and opportunities, International Marine Design Conference.
Ulstein, NTNU

Giovanni A. Amaral; Kazuo Nishimoto; Edgard B. Malta; Henrique M. Gaspar; Mehrnoosh Nickpasand; Rodolfo T. Gonçalves, Considering the Design for Operability, International Ocean and Polar Engineering Conference.
NTNU

Bronson, J. A., Luz, F. H. P., Fonseca, Ícaro A., & Gaspar, H. M., Graph Databases for Multi-Domain Taxonomies in Maritime Systems, ECMS.
NTNU

Seppälä, L., Industry 5.0: Transforming ship design through human-centered approach, International Marine Design Conference.
CADMATIC

Koelman, H. J., Piping layout integrated in ship design and stability evaluation, International Marine Design Conference.
SARC

Koilo, V., Decarbonization in the maritime industry: Factors to create an efficient transition strategy, Environmental Economics.
NTNU

Koilo, V., Value chain approach towards decarbonisation in the maritime industry: factors to create an efficient transition strategy, Conference on Sustainable Initiatives in Maritime Sector - SIM` 24.
NTNU

Kim, Y. S., He, J., & Seppälä, L., A service blueprint approach in shipbuilding activity mapping, 15th International Marine Design Conference, Amsterdam, Netherlands.
UTU

Ni, P., Can knowledge management be appropriate for shipbuilding? Based on typology and the seven C's model. Journal of Knowledge Management Practice, 24(4). https://doi.org/10.62477/jkmp.v24i4.461.
UTU

Ni, P., & Kantola, J., Taxonomy of knowledge management systems in a complex environment. 15th International Conference on Applied Human Factors and Ergonomics (AHFE 2024). https://doi.org/10.54941/ahfe1004933.
UTU

SEMINARS (2024)

Janica Altea Bronson
DNV(Det Norske Veritas) Workshop
Aalto, Finland, 24.01.2024
NTNU

Icaro A. Fonseca
Conference in Transport Research Arena
Dublin, Ireland, 17.04.2024
NTNU

Stephen McCombie
Workshop about Cyber-Security
Ålesund, Norway, 23.04.2024
NHL Stenden

Stephen McCombie
Workshop about Cyber-Security
Ulsteinvik, Norway, 22.04.2024
NHL Stenden

Stephen McCombie
Workshop about Cyber-Security
University of Turku, Finland, 14.05.2024
NHL Stenden

Stephen McCombie
Workshop about Cyber-Security
CADMATIC, Finland, 16.05.2024
NHL Stenden

Gaute Gaudestad
Seminar Marco Polo
NMK, Ålesund, 12.06.2024
Ulstein

Diego De León
Knowledge Making Day - ResearchTalk: A path to the next era of naval architecture, data-driven design
Leeuwarden, Netherlands, 29.02.2024
NHL Stenden

Diego De León
Presentation and discussion of Data Driven Early Ship Design
Bussum, Netherlands, 15.02.2024
NHL Stenden

Giovanni A. Amara
Conference at ISOPE 2024
Rhodes, Greece, 16.06.2024
NTNU

Herbert Koelman
Anchorites presentation
Amsterdam, Netherlands, 22.08.2024
SARC

Henrique Gaspar, Janica Altea Bronson
OCX AGM
Ancona, Italy, 31.10.24
NTNU

Diego De León
Internal Update meeting for the NHL Stenden Maritime Research Group
Leeuwarden, Netherlands, 17.12.24
NHL Stenden

Diego De León
NHL Stenden Research Stand at Bedrijvenmarkt
Leeuwarden, Netherlands, 31.05.2024
NHL Stenden

SEUS at 15th International Maritime Design Conference (IMDC) 2024 (Netherlands)

SEUS Workshops

SEUS Workshop in Turku

The SEUS EU Project held its third workshop in Finland from May 22 to 23, 2024. During the workshop, partners discussed shipbuilding digital tools, business exploitation, cybersecurity, and research activities.

On the first day, the workshop opened with a project summary by NTNU with planning, upcoming tasks, information sharing, and WP highlights of the project. Key sessions included technical presentations on Product Lifecycle Management (PLM) challenges (CONTACT), target use cases, and a document management demo via Wave (Cadmatic). Additionaly, production planning, early-stage design integration (SARC), a live PLM solution demo (ULSTEIN), and implementation insights from shipyard (Ulstein and Gondan) are shared and discussed in sessions.

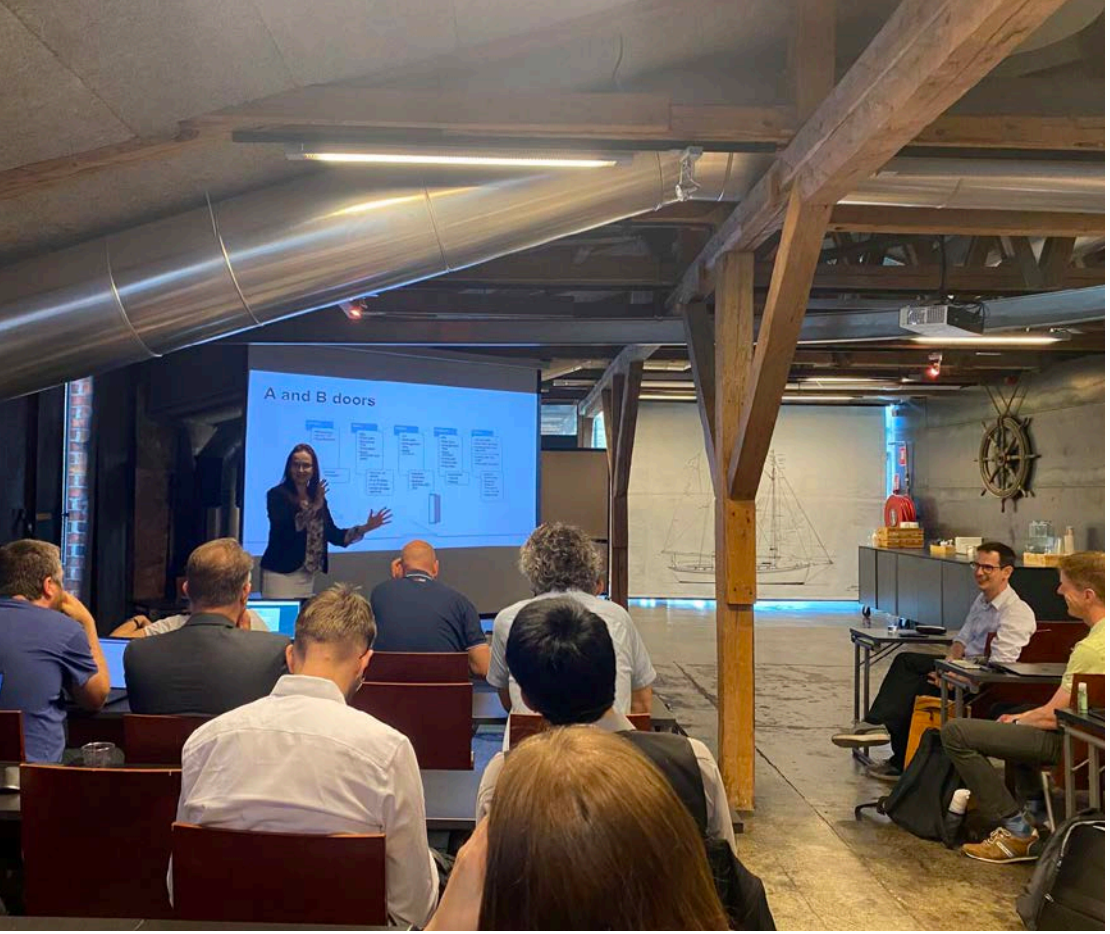
On the second day, the workshop focused on PhD updates and demos from CADMATIC. PhDs from NTNU, UTU, and NHL Stenden discussed multi-domain taxonomies in ship design, activity mapping and knowledge management systems. A IP management session and cybersecurity session led by NHL. The day wrapped up with a summary of action points and a visit to Cadmatic HQ for a VR/AR demo.

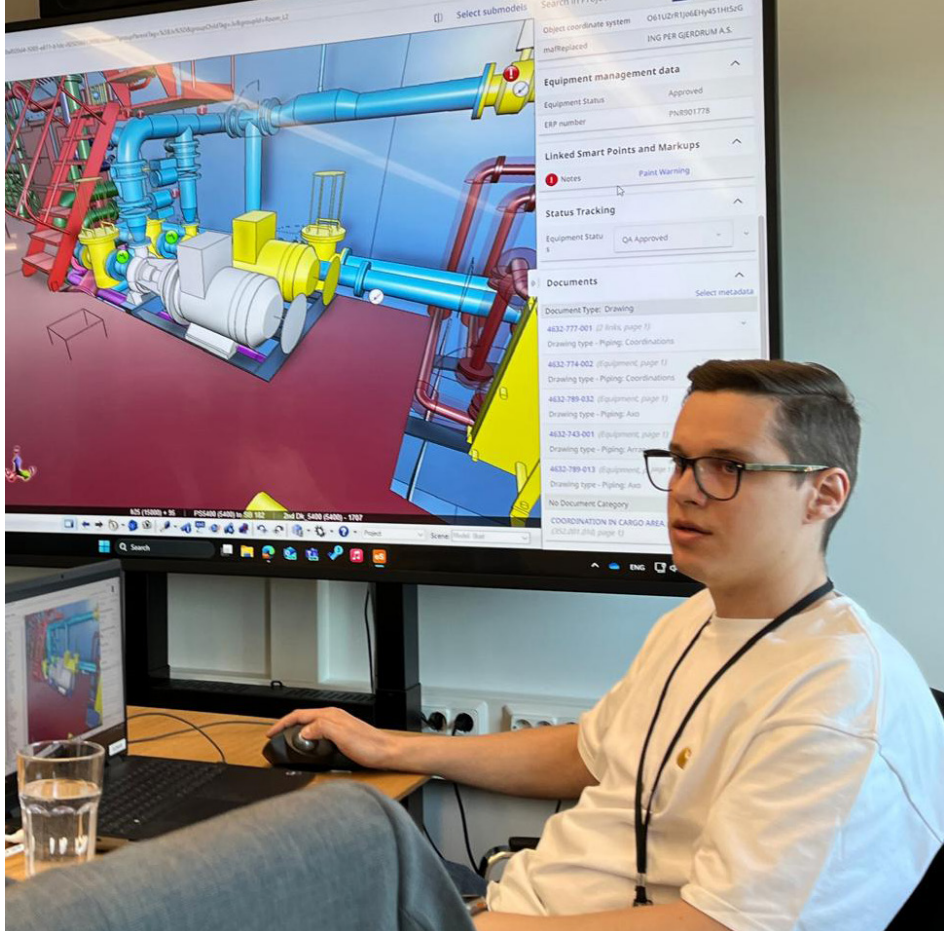
Cyber Security Workshops

In 2024, the cyber security workshops were conducted for all the SEUS partners. We visited each and every partner and invited people within the organisation that could benefit from the workshop to attend and participate.

The workshops proceeded as follows, after a brief introduction of the cyber security team, we led a discussion of cyber threats to the maritime world. Then we showed real life cyber threats specifically targeting to the field of work of the partner. We then introduced participants to the NIST cyber security framework, and in case the company does their own software development, also secure development. After lunch, the session continued with a focus on the cyberattack surface of the partner and an intro into the field of cyber threat modelling. We also zoomed in on some particular threats posed by AI.

Visiting the partners gave us some insight in their processes and particular challenges. After conducting all workshops, we saw numerous similarities between the different partners. The feedback and recommendation one-pager reports were handed out after each workshop. Some common recommendations included creating and communicating cyber security policies, identify the organisations attack surface, perform threat modelling and perform penetration tests. During the SEUS project meeting in Turku, we also presented about these workshops and the common findings.





Presentation Highlights

Personnel

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Gökce Yilmaz
NTNU \ PhD Candidate

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NTNU \ PhD Candidate

Jisang Ha
NTNU \ Postdoctoral Researcher

Icaro Fonseca
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Flora Joelle Mbuebue Larsen
NTNU \ Finance Advisor

Robert Leszczynski
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Fernando Luz
NTNU \ Researcher

Inguna Strazdina
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Viktoriia Koilo
NTNU \ Researcher

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Mikko Yllikäinen
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CONTACT \ Industry

Javier G. Llaneza
GONDAN \ Industry

Alvaro Platero Alonso
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Horizon Europe

Project Information

SEUS

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Climate, Energy and Mobility

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EU contribution
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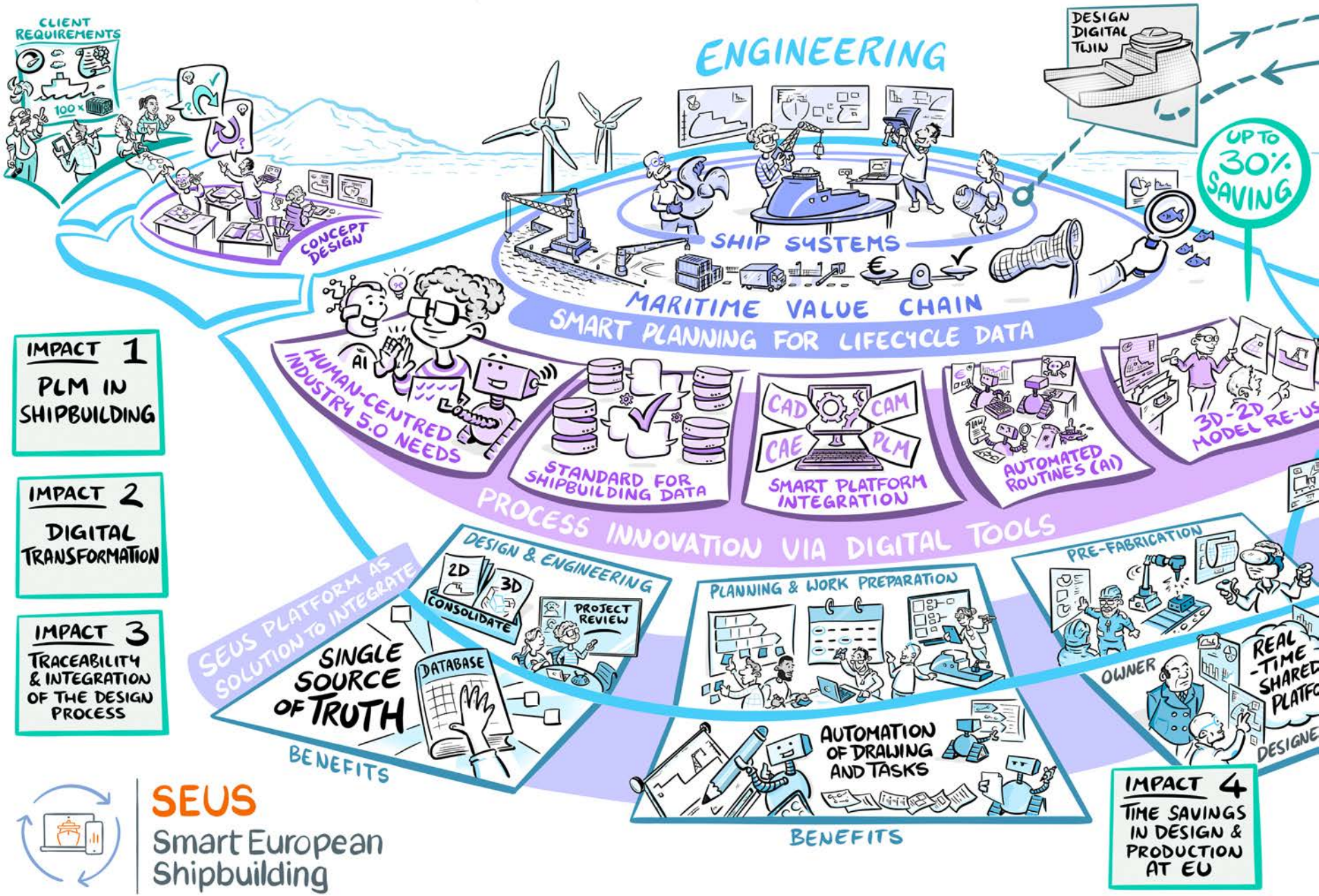
Investment in EU policy priorities

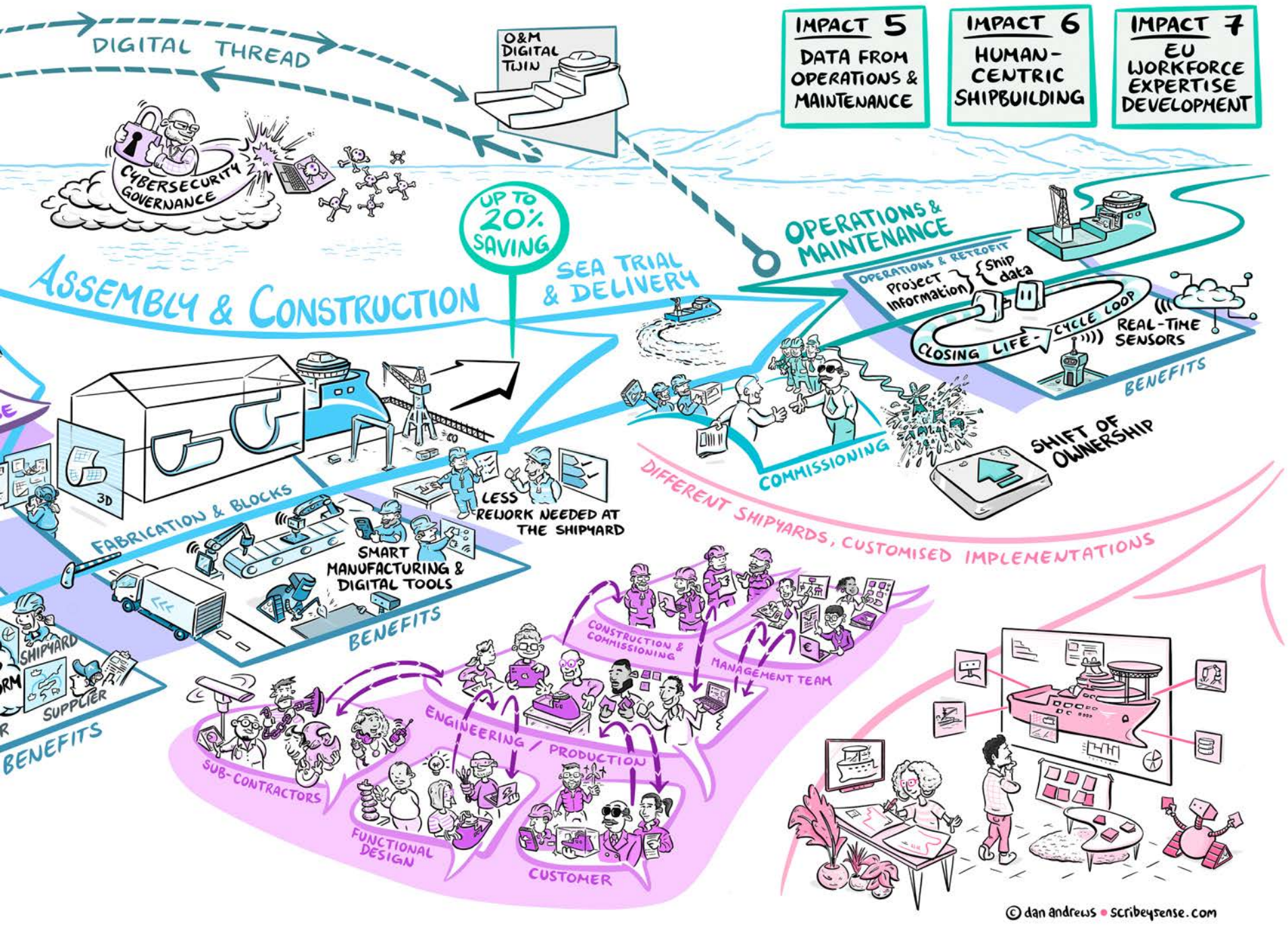
Digital agenda	○	Clean air	◐
Artificial Intelligence	○	Climate action	◐
Biodiversity	○		

Coordinated by
NORGES TEKNISK-NATURVITENSKAPELIGE UNIVERSITET NTNU
Norway

DOI: 10.3030/101096224

NORGES TEKNISK-NATURVITENSKAPELIGE UNIVERSITET NTNU		Net EU contribution € 2 070 875,00
CONTACT SOFTWARE GROUP GMBH	Germany	Net EU contribution € 835 275,00
STICHTING NHL STENDEN HOGESCHOOL	Netherlands	Net EU contribution € 528 285,00
TURUN YLIOPISTO	Finland	Net EU contribution € 663 290,00
CADMATIC OY	Finland	Net EU contribution € 1 184 357,25
THIRD-PARTY CADMATIC EAC OY	Finland	Net EU contribution € 78 693,65
THIRD-PARTY CADMATIC BV	Netherlands	Net EU contribution € 332 274,10
ULSTEIN GROUP ASA	Norway	Net EU contribution € 624 755,00
SCHEEPSBOUWKUNDIG ADVIES- EN REKENCENTRUM SARC BV	Netherlands	Net EU contribution € 388 709,00
ASTILLEROS GONDAN SA	Spain	Net EU contribution € 66 062,50
THIRD-PARTY SOCIEDAD DE INVERSIONES GONDAN S.L.	Spain	Net EU contribution € 52 062,50
GONDAN INGENIERIA SL	Spain	Net EU contribution € 167 562,50


CLIENT REQUIREMENTS
100 x
CONCEPT DESIGN
ENGINEERING
DESIGN DIGITAL TWIN
UP TO 30% SAVING
SHIP SYSTEMS
MARITIME VALUE CHAIN
SMART PLANNING FOR LIFECYCLE DATA
AI
HUMAN-CENTRED INDUSTRY 5.0 NEEDS
STANDARD FOR SHIPBUILDING DATA
CAD
CAM
CAE
PLM
SMART PLATFORM INTEGRATION
AUTOMATED ROUTINES (AI)
3D-2D MODEL RE-US
PROCESS INNOVATION VIA DIGITAL TOOLS
IMPACT 1
PLM IN SHIPBUILDING
IMPACT 2
DIGITAL TRANSFORMATION
IMPACT 3
TRACEABILITY & INTEGRATION OF THE DESIGN PROCESS
SEUS PLATFORM AS SOLUTION TO INTEGRATE
DESIGN & ENGINEERING
2D
3D
CONSOLIDATE
PROJECT REVIEW
SINGLE SOURCE OF TRUTH
DATABASE
BENEFITS
PLANNING & WORK PREPARATION
AUTOMATION OF DRAWING AND TASKS
BENEFITS
PRE-FABRICATION
OWNER
REAL -TIME SHARED PLATFO
DESIGNE
IMPACT 4
TIME SAVINGS IN DESIGN & PRODUCTION AT EU
SEUS
Smart European Shipbuilding


IMPACT 5
DATA FROM OPERATIONS & MAINTENANCE
IMPACT 6
HUMAN-CENTRIC SHIPBUILDING
IMPACT 7
EU WORKFORCE EXPERTISE DEVELOPMENT
DIGITAL THREAD
O&M DIGITAL TWIN
CYBERSECURITY GOVERNANCE
UP TO 20% SAVING
ASSEMBLY & CONSTRUCTION
SEA TRIAL & DELIVERY
OPERATIONS & MAINTENANCE
OPERATIONS & RETROFIT
Project Information
Ship data
CLOSING LIFE-CYCLE LOOP
REAL-TIME SENSORS
BENEFITS
COMMISSIONING
SHIFT OF OWNERSHIP
3D
FABRICATION & BLOCKS
LESS REWORK NEEDED AT THE SHIPYARD
SMART MANUFACTURING & DIGITAL TOOLS
BENEFITS
DIFFERENT SHIPYARDS, CUSTOMISED IMPLEMENTATIONS
SHIPYARD
SUPPLIER
BENEFITS
CONSTRUCTION & COMMISSIONING
MANAGEMENT TEAM
ENGINEERING / PRODUCTION
SUB-CONTRACTORS
FUNCTIONAL DESIGN
CUSTOMER
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Funded by
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Photo: Ulstein