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SEUS SMART EUROPEAN SHIPBUILDING 2023 REPORT

SARC MARITIME SOFTWARE AND SERVICES
GONDĀN SHIPBUILDERS
CADMATIC
ULSTEIN
CONTACT Software
NHL STENDEN university of applied sciences
UNIVERSITY OF TURKU
NTNU

Partners


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SARC
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GONDAN
SHIPBUILDERS
CADMATIC

SEUS
Smart European Shipbuilding

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Contents

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

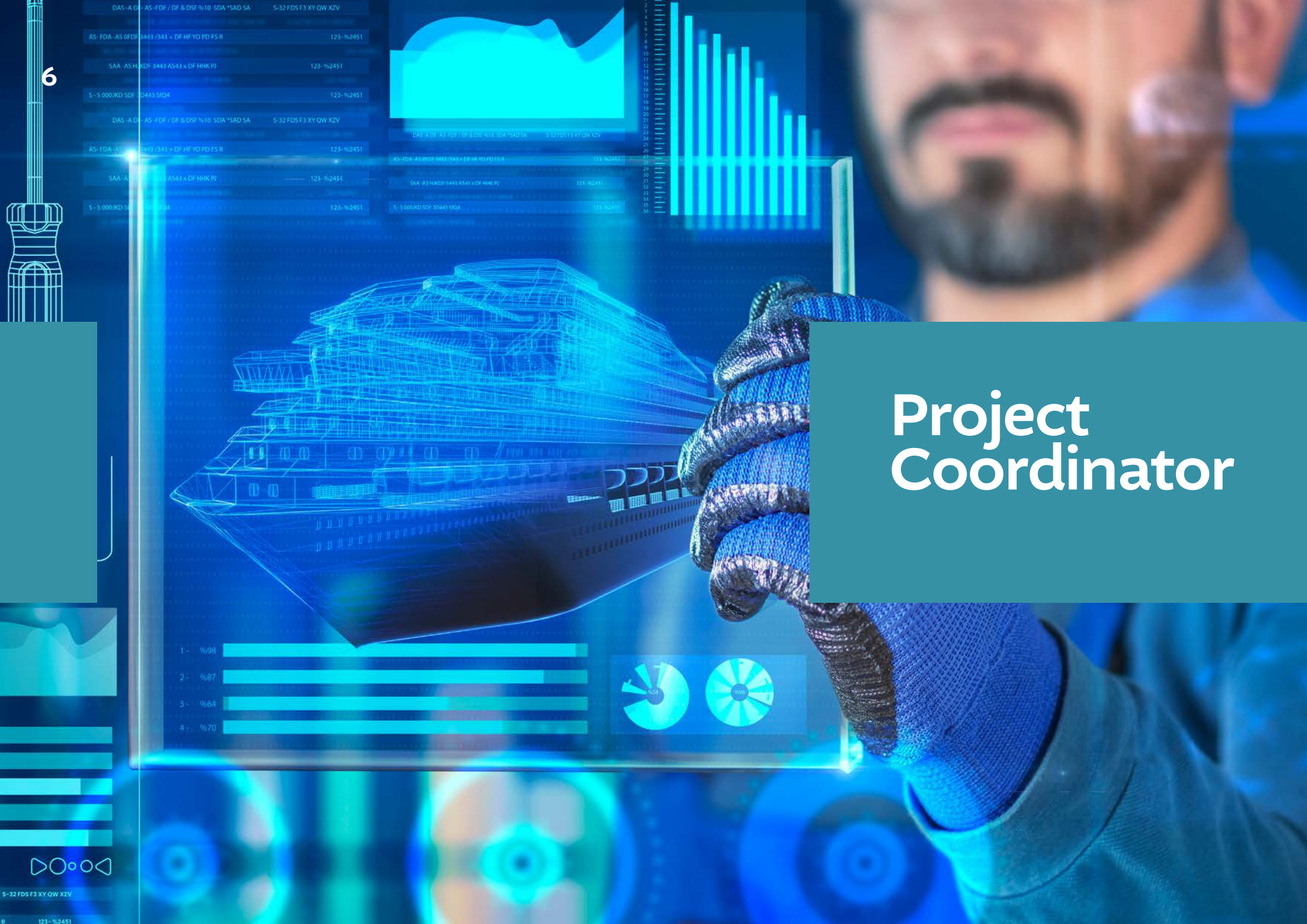
Computational Tools & Data Integration


Photo: Gondan

Data Driven Ship Design & Shipbuilding


Photo: Gondan

Knowledge Management



Project Coordinator

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: Tony Hall

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.

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 first year of the project (2023), 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

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.

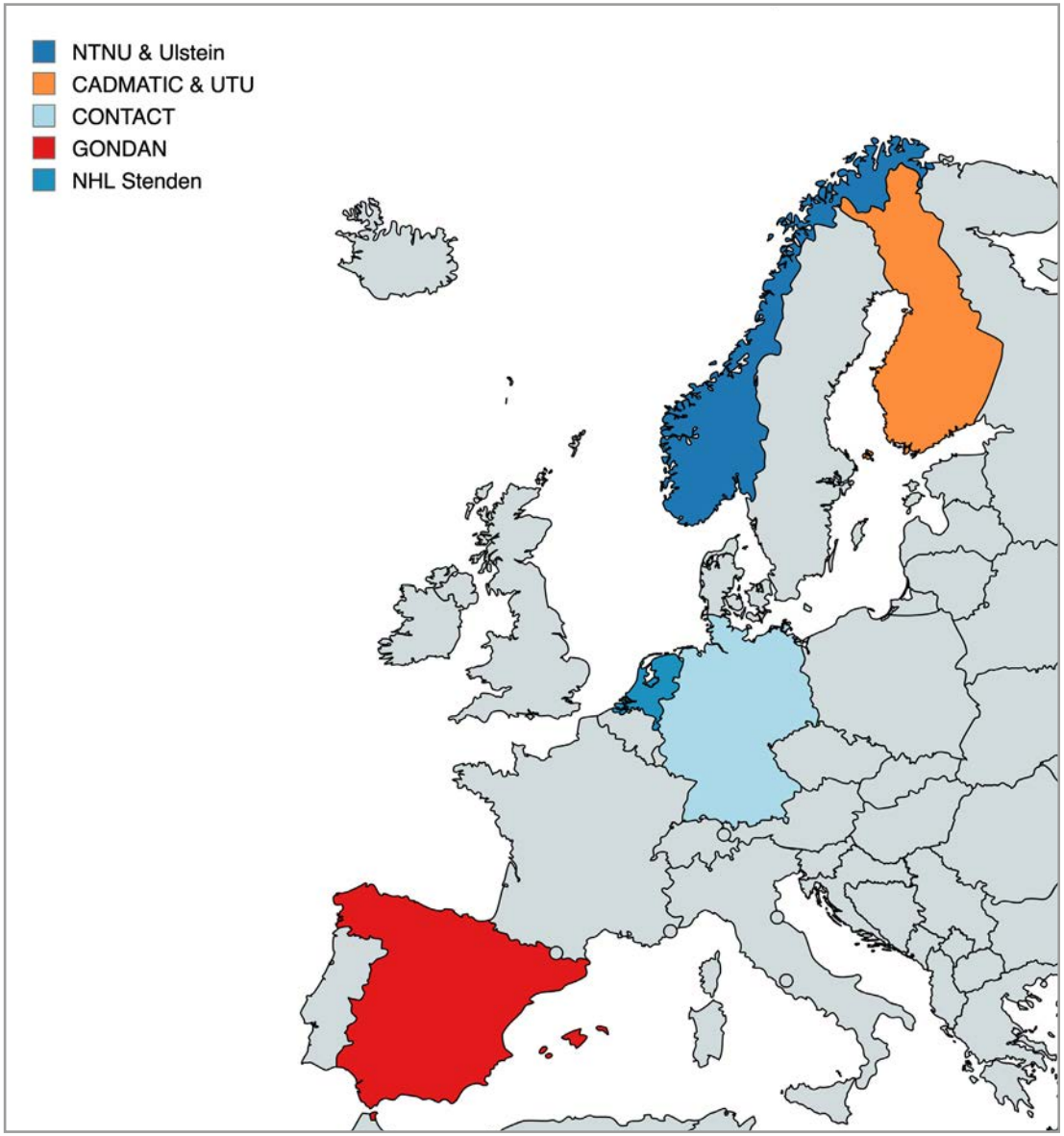
New business and research areas are undergoing strong growth and development. The future maritime activities will integrate people in a way that can digital technology transform how we design, build, and operate ships.

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.no/ihb

Photo: Geir Mogen/NTNU

Photo: Geir Mogen/ NTNU

CADMATIC

SEUS Project at Cadmatic - Pioneering Marine Innovation

Cadmatic, a forerunner in 3D design and information management software, is dedicated to revolutionizing the ship design and shipbuilding industry. With a vision to empower engineers for a brighter future, Cadmatic's mission enhances the efficiency and simplicity of designing, engineering, building, and operating maritime vessels.

At the heart of the marine industry, Cadmatic's influence spans over 1,000 customers in 56 countries, underscored by its robust global presence and in-depth shipbuilding expertise. Our solutions, characterized by agility and technological prowess, cover extensive ground from 3D hull and structure design to electrical, automation, and digital information management, ensuring unparalleled collaboration and data visualization.

The SEUS project represents a cornerstone of Cadmatic's commitment to innovation, embodying our pursuit of integrated digital solutions that streamline the entire shipbuilding process. This initiative, a collaboration among industry leaders, academia, and research institutions, seeks to significantly reduce engineering and construction times through advanced CAE, CAD, CAM, and PDM software integration, setting a new standard for efficiency and digital fluency in European shipyards.

Cadmatic's engagement in SEUS mirrors our forward-thinking approach to shipbuilding, emphasizing data-driven methodologies that promise substantial Return of Investment (ROI) and sustainable practices. As we continue to lead with our digital twin solutions and customer-centric software, our participation in SEUS is a testament to our dedication to advancing the marine sector, fostering a community of innovation, and contributing to a future where ship design and construction are profoundly transformed.

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.

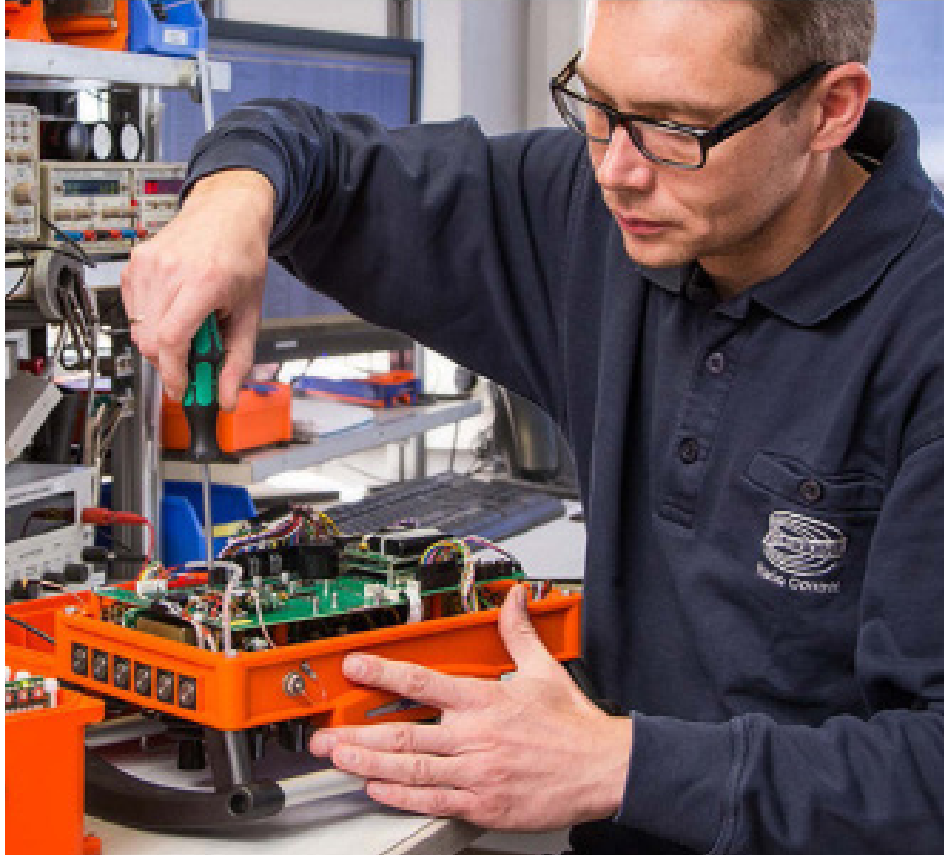
Agile Collaboration

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 12 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

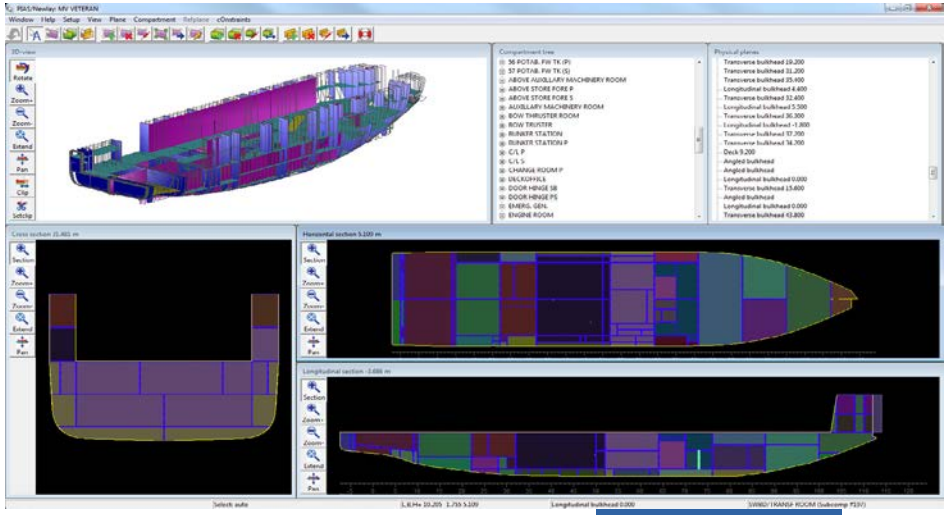


Photo: Ulstein

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. Ulstein's vision is to create tomorrow's solutions for sustainable marine operations. The company was founded in 1917, and is headquartered in Ulsteinvik, Norway.

For over a century, we have been able to spot and exploit new opportunities and sustain momentum through changing times in the maritime business. Through hard work and creative enthusiasm, we will keep renewing ourselves and applying our expertise to benefit our customers. We base our 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. We provide cost-effective, safe and reliable products and services to future-oriented players who think holistically and long-term.

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

Ulstein's values are Innovate, Engage and Advance. It is our people and our partner that represent these values. Our 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.

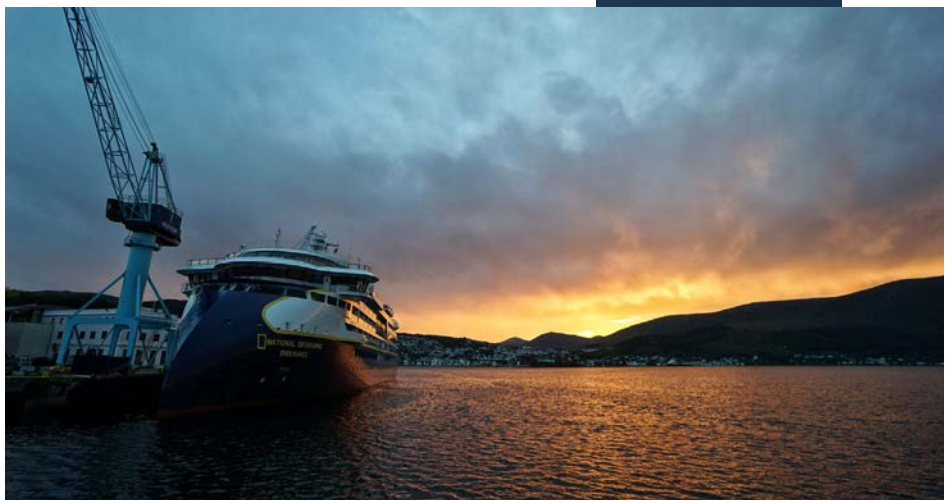
Engage

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

Where Tradition Meets Innovation on the High Seas

GONDAN Shipbuilders, established in Spain, has grown into a significant entity in the shipbuilding industry, focusing on the construction of a diverse array of vessels including offshore ships, fishing boats, tugs, and passenger vessels. The company is recognized for its capability to produce custom-made vessels that adhere to specific client requirements, reflecting a blend of traditional craftsmanship and modern technology.

The core of GONDAN's operations lies in its commitment to utilizing **advanced technology** and **innovative practices** within its shipbuilding processes. This approach ensures the production of vessels that are both efficient and environmentally conscious, aligning with contemporary demands for sustainability in maritime operations. The company's facilities are equipped to handle projects of various complexities, enabling GONDAN to maintain a competitive edge in the industry.

Link: www.gondan.com

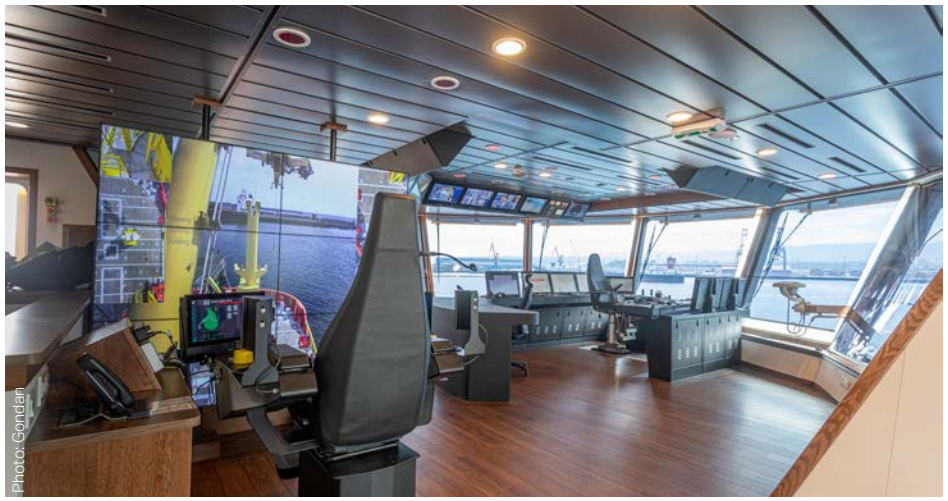


Photo: Gondan

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.

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

University Overview

The University of Turku (UTU), Finland's second largest multidisciplinary university, is an internationally **competitive research-led university** whose operation is based on high-level research. The UTU is recognized for the quality of research, teaching, and excellent support services. As one of the leading universities in Finland, UTU offers **study and research opportunities** in eight faculties: Humanities, Technology, Science, Medicine, Law, Social Sciences, Education, and Turku School of Economics; and in five independent units. In the international QS ranking, the UTU is among the top 300 universities and is ranked third best university in Finland (QS Ranking 2020).

The UTU, whose roots reach as far as the Royal Academy of Turku in the 1650s, was established in 1920. Back then, the University was formed by the Faculty of Humanities and the Faculty of Mathematics and Natural Sciences. New faculty, the Faculty of Medicine, was established in 1943 to serve a nation in war. In 1960s and 1970s, three more faculties were established: the Faculty of Law in 1960, the Faculty of Social Sciences (departed from the Faculty of Humanities) in 1967, and the Faculty of Education in 1974. The private University of Turku was nationalized in 1974. The Turku School of Economics and the University of Turku decided to merge to a new university starting from 2010.

Today, the UTU has 20,323 students and 3,515 staff members (10.1% international, 59.2% female). External funding covers 39.5% of the total funding of 263.6 million euros. The UTU is active in international cooperation. It is a member of the Coimbra Group, a network of prestigious universities in Europe. Almost 2,300 international students from over 100 countries study annually in the University of Turku.

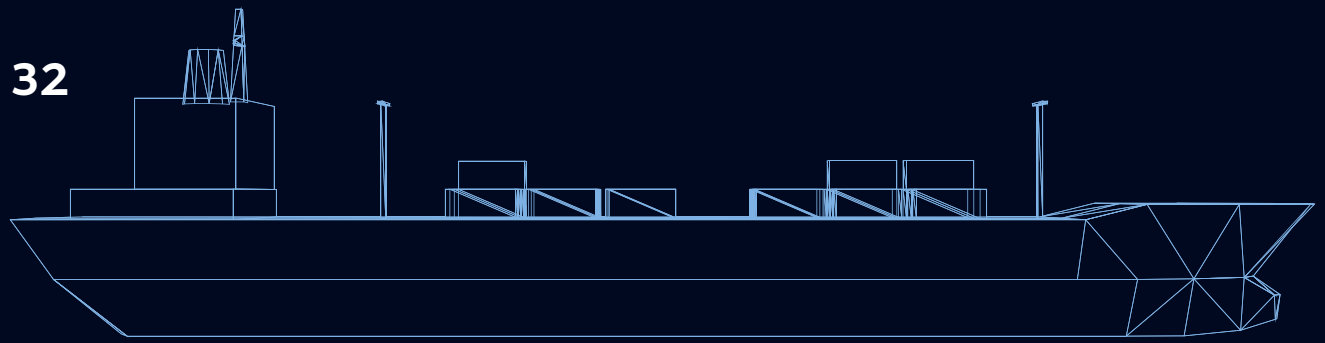
In June 2013, the European Commission awarded the University of Turku the right to use the HR Excellence in Research logo. The logo is a token of the University's commitment to **continuous development** of the position and working conditions of researchers along the guidelines set forth in the European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

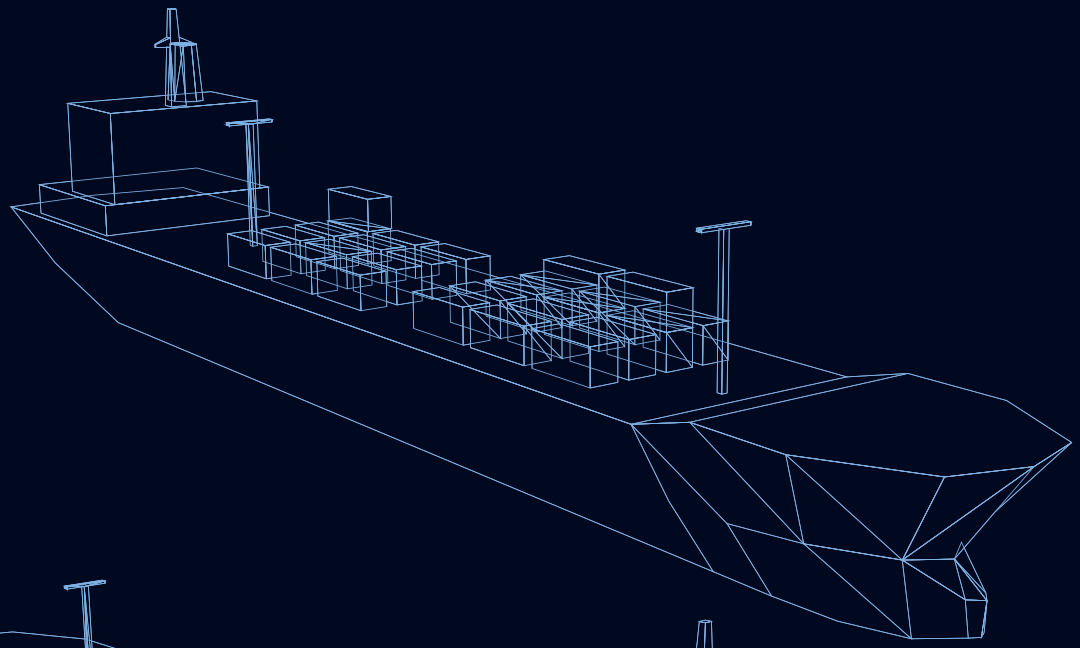
The UTU is an internationally competitive university whose operations are based on high-quality, multidisciplinary research. The UTU promotes education and free science and provides higher education that is based on research.

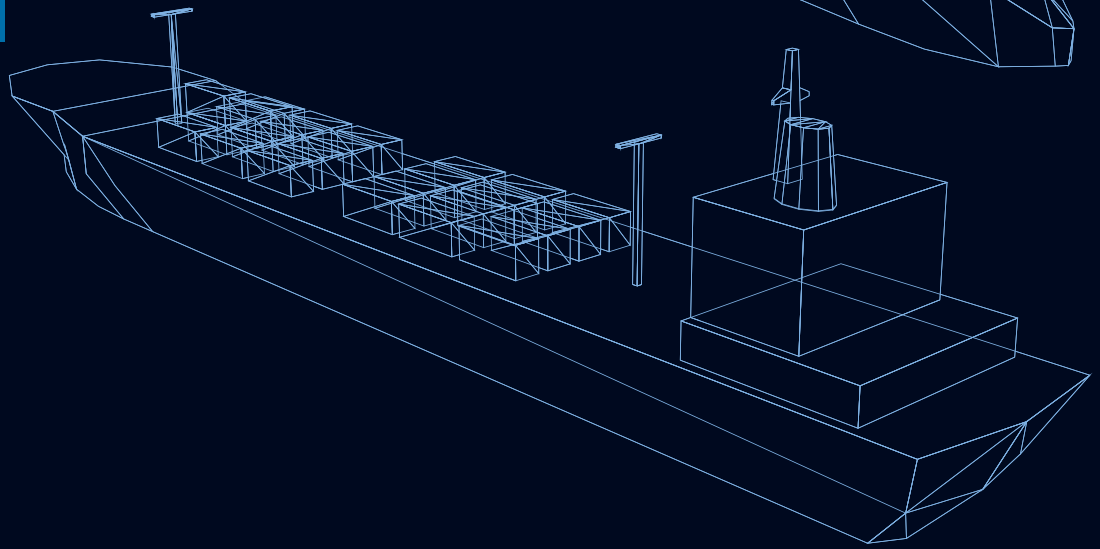
The UTU recognizes areas of strength in research in its strategy for 2021–2030. The strategic profiles implement and advance **multidisciplinary research** and education between faculties. The profiles strengthen internal collaboration and create platforms for networks, business collaboration, innovations and strategic partnerships. The work conducted within the profiles advances sustainable development, decision-making based on researched information, application of expertise, and other societal impacts of research. The research is profiled through the thematic collaborations in Biodiversity and sustainability; Future technologies and digital society; Cultural memory and social change; Children, young people and learning; Health, diagnostics and drug development; and Sea and Maritime Studies.

The research in UTU in biosciences and medicine is at the international top of the field, which creates a strong basis for the further development of the thematic collaborations. In the other disciplines that are part of the thematic collaborations, the research in UTU is significant and of high-quality on a national level. The University has a leading role especially in **future research**. Sea and maritime studies strengthens the regional expertise cluster in the Southwest coast of Finland.

Link: www.utu.fi







WP1:
Best Practice for Smart Shipbuilding

Photo: Tony Hall

Work Package Overview

This work package involves researching, evaluating, and compiling activities related to adopting an innovative PLM approach in shipbuilding. It aims to assist SEUS partners in their software development and implementation efforts by gathering academic and industry insights on what European shipbuilders can expect from a digital single source of truth (SSoT) solution. Specifically, it elucidates software and open platform requirements for Work Package 2 (WP2) and WP3 and provide material for knowledge dissemination related to WP5. As such, the following tasks were identified for this work package:

- **Data Collection of current and best practices** – Collect and analyze available data for current PLM practices in shipbuilding in European and global contexts.
- **Evaluation of bottlenecks and points-of-improvement (POI) for solution development and adoption** – Synthesize the collected data to understand opportunities for improvement and potential risks or bottlenecks related to the development and implementation of the PLM solution.
- **Framework Compilation** - Continuously evaluate and assess the data and relevant elements for SEUS PLM solution and framework adoption.

Data Collection of Current and Best Practices

Due to high multi-organization and design customization, the ship design and shipbuilding process is both technically and operationally complex. Differences in business priorities also increase the variety of ship design and shipbuilding strategies and exacerbate the challenge of mapping design and production activities. Given the breadth of this information and the proprietary nature of data related to these processes, it is challenging to capture a complete and comprehensive view of these activities from conceptualization to ship delivery.

The industry is undergoing rapid regulatory changes and is increasingly concerned with sustainability, facing heightened competition, digitalization, global connectivity, and risk aversion due to events like the COVID-19 pandemic. Therefore, it is necessary to provide a more current understanding of shipbuilding, as well as, a more accurate representation of shipyards' and firms' expectations for a PLM solution. To cover this information, the research was narrowed to the following main themes:

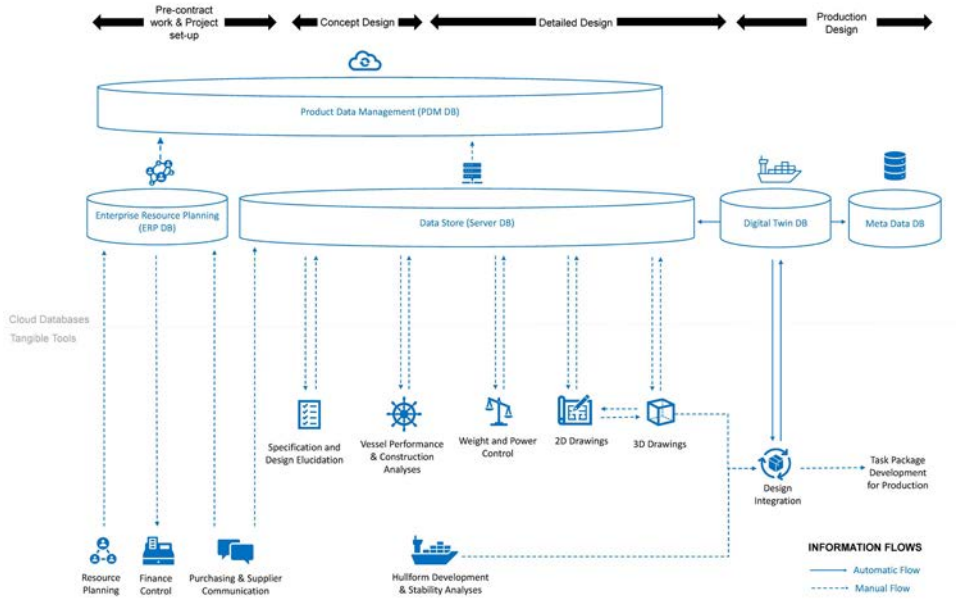
- **EU Place in Shipbuilding Market** – Current trends in European and global ship design and shipbuilding industries,
- **The Ship Design and Shipbuilding Process** – Current practices and logical stages in ship upstream lifecycle,
- **Multi-domain Taxonomy** – Paradigms in how ship data is presented in ship design and shipbuilding,
- **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.

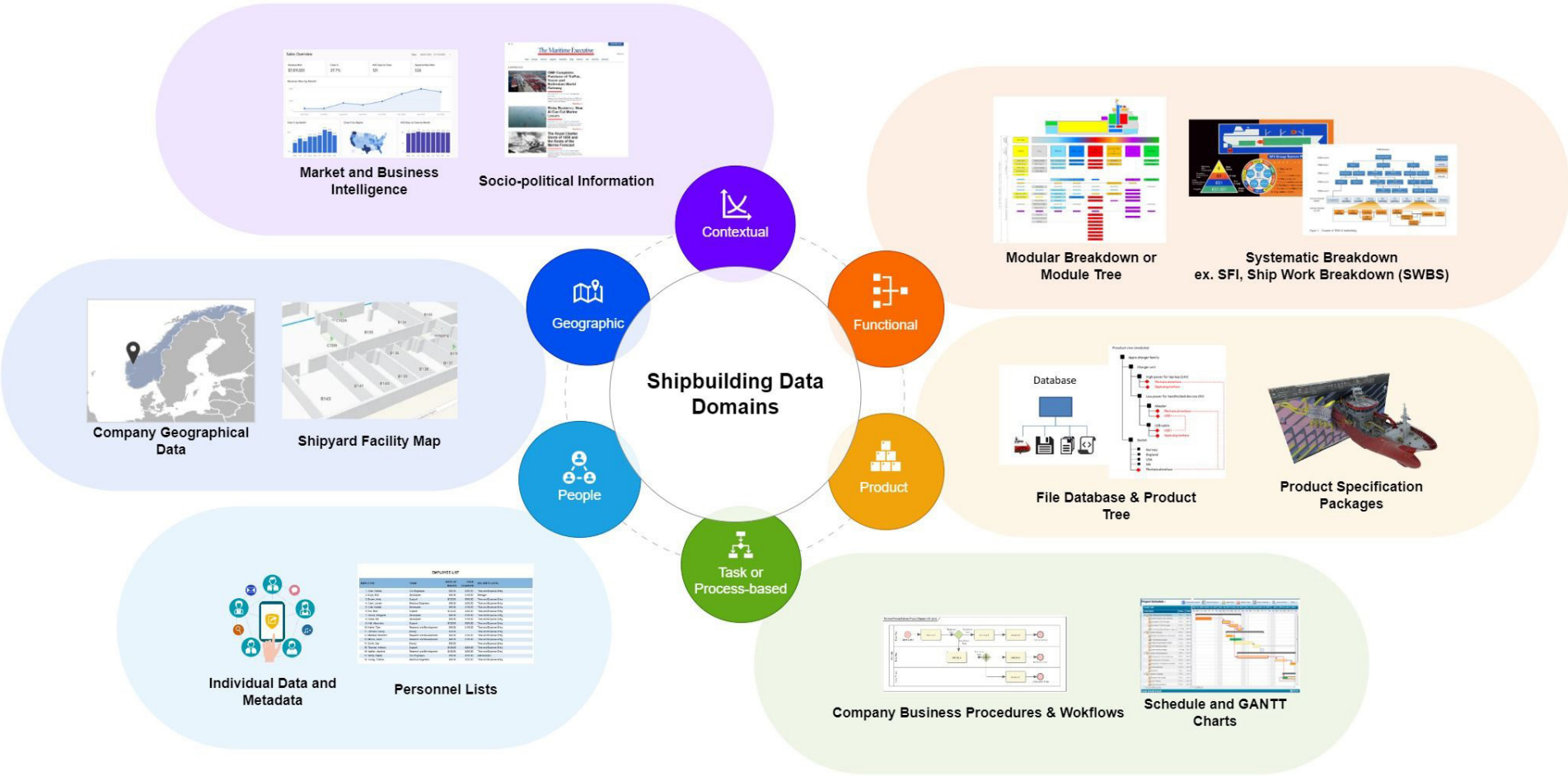
A combination of literature review and qualitative research was employed to acquire the data and is planned to be conducted before the WP1 deliverable in June 2024. The approach covers:

1. Desk research – Compilation of data and findings related to summaries, user stories, articles, white paper synopses, and research papers related to current and projected solutions related to PLM in ship design and shipbuilding
2. Interviews – Close discussions with industry partners, GONDAN and Ulstein, to supplement the desk research findings with current practices in the industry today. These interviews are conducted with various personnel involved with different stages of the ship design and construction process.
3. Online Survey – Online survey to determine the understanding of companies and expectations regarding a PLM and SSoT solution. The methods for survey data accumulation are provided in closer detail in the following section. 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. With the diversity of survey respondents from GONDAN and Ulstein, results can also help determine the use cases for PLM in both shipyards and understand the degree of customization such a solution will require.





The survey has three main sections, including (a) the role and main activities of the person concerning the lifecycle phase of the vessel, (b) the different challenges they encounter related to data management, and (c) their impressions of critical elements in an SSoT solution. The aim of this survey is to identify the areas in information management that need improvement in ship design and construction. The marketing materials for this survey have been disseminated through various channels, including SEUS's LinkedIn page and partner platforms such as Cadmatic LinkedIn. While the survey evaluation is still underway, results and findings will be compared with literature and benchmarked with international standards for data management practices. The number of individuals who are reached through email and social media channels are the key performance indicators (KPIs) for outreach efforts.

Framework Compilation

To synthesize the data collected from the survey, interviews, and literature review, an evaluation of state-of-the-art and previous SSoT solutions or platforms is ongoing. This evaluation can help to determine best practices, achievements, bottlenecks, and possible improvements that can support the Roadmap for Implementation (D1.3) which is being developed by Cadmatic. This compilation will be continually updated with data and information gathered from the SEUS platform implementation for broader industry adoption.

WP2:
Platform Development

Ludmila Seppälä

Overall Project

1. Initiation and Planning

At the start of the project, management tasks needed to be done to prepare plans and roadmaps, identify the responsibilities, and set goals. In Cadmatic development, a separate team was established, and several people were hired. The development of the CAD + PLM platform included infrastructure preparation tasks, learning of technology used in the CONTACT Elements platform, and preparing numerous prototypes and architectural decisions. Along with project management tasks, development tasks outlined below, and getting to know the technology used in the PLM platform, the first business-related models were established and discussed.

The main phases of the project were identified, and more detailed plans were prepared throughout the workshops and discussions focused on the role of computational tools in shipbuilding and how they can be further developed to support the industry's growth.

CAD+PLM Development

2.1. Roadmap Definition

The development roadmap for the duration of the project was developed for D2.1. The roadmap outlines integration levels and steps for developing the CAD +PLM platform from the software development perspective. As the work has already started, the first use cases were discussed, and later, more input will be incorporated and the roadmap adjusted.

2.2. Data Model Discussion and Alignment

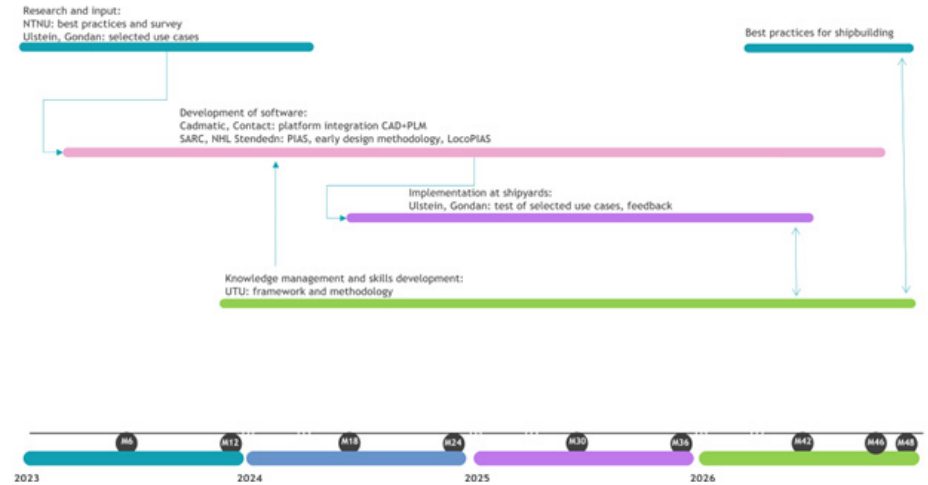
The data model lies at the center of integration flows, as all systems are database-based and use proprietary technologies. Connecting how data is structured has challenges as each partner needs to learn and understand other software solutions and align with the industrial needs.

2.3. Integration with DMU

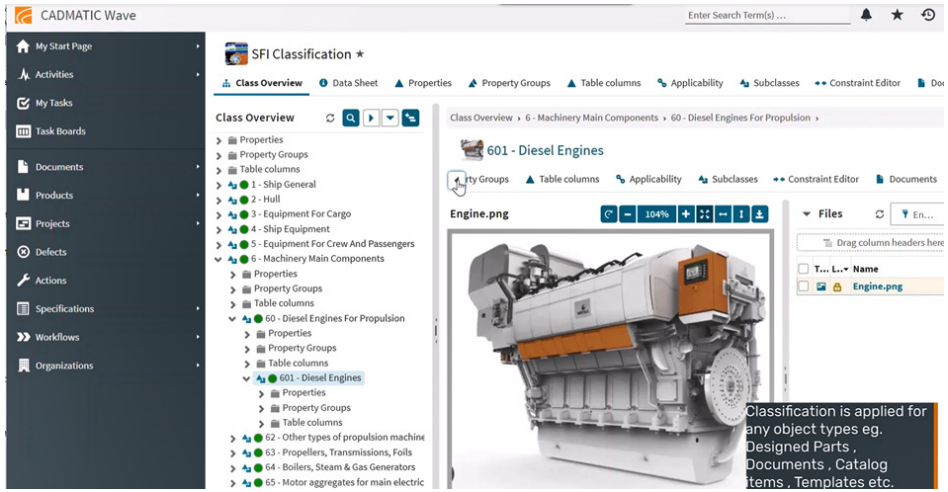
As part of early prototyping, the DMU was embedded in the data management interface to demonstrate the approach's viability. It takes the existing solution - Cadmatic's eShare as a natural interface with the 3D view and links it with data in the PLM system. The workflows and UX of the solution are being evaluated and adjusted according to the needs.

2.4. Early Stages of Design Model Integration

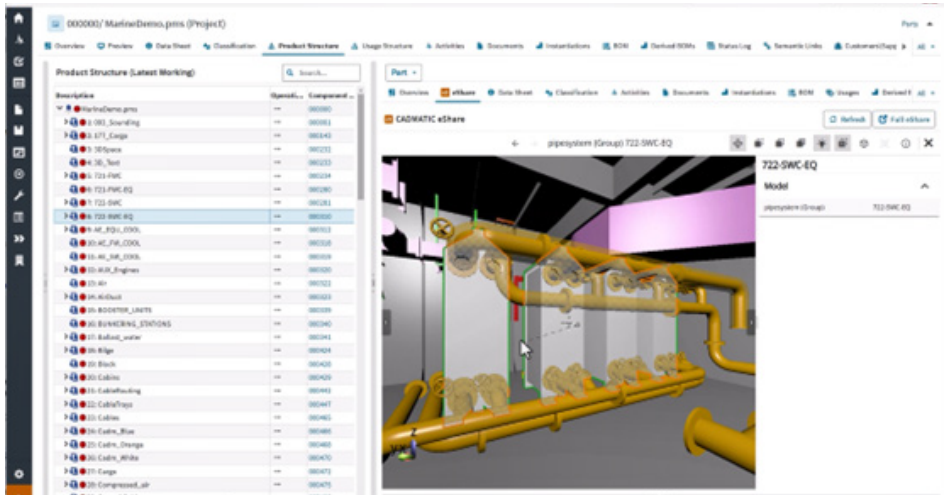
The early design part of the process is covered by PIAS software from SARC, and as part of the project, an investigation was done to find a suitable way to link the data models. Typically, the early design stage focuses on the functional and naval architecture needs of the design, while later detailed 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.



Roadmap Definition



Data model discussion and alignment



Data model discussion and alignment

Introduction of the solution on the market

2.5. Integration of DMS and CAD documents

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

Within the project setup, an experiment was done with setting up the cloud environment hosting all applications. The intention was to have a development environment where all applications are available for trial and integrated versions of applications are gradually installed from the software development. After several trials, the solution based on Azure and Citrix desktops was chosen and will be used on the further stages of the project.

3. Introduction of the solution on the market

As part of the early exploitation, the total solution was presented at the Cadmatic Users' Meeting 2023 in Hamburg. It aroused significant interest from the industry and created several discussions of the need for shipbuilding to implement a PLM type approach and its benefits.

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 (AI) Integration:** Giving AI mechanisms access to the platform means, for example, allowing Natural Language Processing (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.

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Interoperability PLM

This topic is led by CONTACT Software. The initial aim is to use Catalyst 2.0 technology to ensure a standard for interoperability with other systems. The CONTACT Catalyst EAI Gateway provides the integration of CONTACT Elements applications with ERP and other EAI systems in the company and thus forms the basis for a comprehensive orchestration of IT systems and processes using modern communication technologies such as web services. The CONTACT Catalyst EAI Gateway is an integration service primarily used for coupling CONTACT Elements with ERP systems. The integration of PDM/PLM and ERP systems can be broken down into the synchronization of data and the control of processes.

The data synchronization is frequently used to transfer design data like part master records, design drawings and BOMs that are to be passed on to Production after reaching certain maturity levels. Simple examples of the integration of cross-system processes are the ordering of purchased items triggered by a status change or process planning (PP) for production planning triggered by a BOM update. For these two tasks, CONTACT Catalyst EAI Gateway uses generic XML and JSON formats as well as standard protocols such as HTTP. Through flexible configuration and the provision of extension frameworks, transformation into specific data formats and the use of web services is possible. On the other hand, file-based data exchange with ASCII or CSV formats or the use of SQL adapters can also be realized. Furthermore, CONTACT Catalyst EAI Gateway can be used as a tool for the one-time or regular export or import of data from/to CONTACT Elements.

The Catalyst 2.0 vision for the SEUS project includes the following points:

- to orchestrate aggregated processes across systems,
- to model knowledge of the semantics of data involved in these processes and be able to map it to the respective concrete data models,
- maintain the provisioning of data for execution of corresponding process steps across systems or have knowledge of its location (links),
- the ability to retrieve data sets from the respective linked systems or to distribute them to the systems involved,
- integrate existing data silos and systems/functions under a common interface provided by Elements.

The idea here is that once an ontology has been defined, messages are distributed over a bus to all the systems involved. Each system has software that can generate messages and interpret incoming messages in the context of its own data mapping.

Interoperability for CAD

This topic is led by CADMATIC. Interoperability is a key concept frequently mentioned in discussions concerning data exchange and CAD data formats within shipbuilding. While the idea of a singular, all-encompassing solution for shipbuilding needs remains an aspirational goal, it is unlikely to be achieved due to the inherent complexity of shipbuilding, which involves specialized naval architecture, calculations, 3D design, and engineers' preferences, among others. The fundamental distinction between interoperability and compatibility lies in the utilization of data. While compatibility concerns the static aspect of data formats – whether they can be interchanged, imported, exported, or replaced – interoperability goes further by considering the dynamic nature of data use. It examines how data flows can integrate various formats and influence the overall process.

As part of the SEUS platform solution development, the following interfaces are developed: Napa Design interoperability and Cadfix PPS. NAPA Design is a solution for concept and basic design tasks, especially in stages before the classification approval. Many industrial cases demand the interface, and its development strengthens the position of the SEUS platform against competition. Additional functionality developed as part of SEUS interoperability tasks included support for 64bit hull shape imports and updated the interface to new functionality of Napa Design.

The CADfix PPS, automatic model simplification wizard, enables engineers to achieve rapid and automatic simplification of fully detailed CAD models, removing small parts, unwanted features, and internal components and transforming complex structures into basic shapes. This breakthrough technology, integrated into CADMATIC 3D Outfitting, optimizes performance and streamlines the design process. The newly introduced add-on product facilitates the import of complex 3D CAD equipment models from external Mechanical CAD (MCAD) systems into CADMATIC 3D Outfitting. During the import process, engineers can simplify equipment items before integrating into the layout model. This efficiency improvement translates into faster work, quicker loading times, and expedited drawing creation, enabling customers to work on projects more efficiently and precisely.

Interfaces for MES/ILS and production data

This topic is led by CADMATIC. For production engineering, a fully equipped set of work preparation tools is embedded in the CADMATIC Hull Detailed Design module to ensure that the production department receives all the required information, such as part geometries, weld and bevel details, part lists, weights and CoG, profile lists, profile nesting, profile sketches etc. In addition, it contains various build strategy features offering a wide range of possibilities to generate 2D and 3D work breakdown information and sketches. The production information tools streamline the information flow between engineering, planning, work preparation, and workshops. This speeds up the process of work preparation significantly and shortens the throughput of a ships' assembly stages.

Traceability of welding data

Weld data is created and managed between hull construction parts and structures, and outfitting components, for example, pipe penetrations, foundations, and supports. Welding information and paths can be created automatically in the 3D model according to customizable project rules and settings. Welds are included in the block structures and assemblies' work breakdown, allowing the user to adjust the building sequence to support automated production processes. Using these tools, drawings can be created easily, and weld data can be exported in Excel format for automatic welding processes and traceability of welds for quality assurance inspections. Welds can be presented while 3D browsing and inspection data can be added to the 3D viewer eBrowser and eGo, or to the project visualization portal in eShare. This allows welds to be checked on site and the current status of the welds to be tracked during the whole project.

Data for outfitting production

All kinds of drawings can be generated as an output for production from Outfitting Detailed Design, including piping isometric and spool drawings, HVAC and air duct spools, foundation drawings, piping support location drawings, piping support automatic sketches, and development drawings for pipe branches. The drawings can be completed in the CADMATIC drafting module fully dimensioned, annotated and then exported, for example, to DWG or PDF formats. Complete information can be provided for prefabrication as soon as the unit is modelled in 3D. Changes can be traced with revision control and the progress of the installation with real-time status information through an information sharing portal.

Many interfaces for production data from Cadmatic design solutions are on TRL 9 and are in active use in the industry. Additional interfaces are developed for particular machinery, such as post processors or based on the demand from the industry. Several studies were done for interfaces such as PEMA welding automation robotics as part of the SEUS platform development. Maintaining such interfaces requires continuous effort and ensures the platform's competitiveness.

WP4:
Implementation at Shipyards

Jose Jorge Garcia Agis

Work Package Overview

Work Package 4 aims to implement intermediate and final versions of the platform at the shipyards and design firm, test it in selected use cases and information flows, gain insights into its fit with shipyard processes, and provide feedback on the development. The full-scale implementation of project results addresses three major areas: identification and measurement of gains from PLM implementation, testing of communication, and cooperation with other project stakeholders.

This WP serves as a liaison between the scientific research and the industrial application. The main focus of the working paper is the implementation and testing of the methodologies and resulting software developed as part of the project, and earlier defined in WP1. The character of this WP is, therefore, of high relevance to probe the applicability of the work being developed and measure gains.

Task 4.1: Follow up Best Practices and Software development

Follow up the practical aspects in WP1 and WP2, with management of expectations and risk mitigation before the implementation.

Task 4.2: Implementation and testing at the design company

The design company is the first stakeholder (of the ones participating in this project) involved in a shipbuilding project. Its role is to bring the ideas and needs of a shipping company into a vessel design, describing a fully operational ship. A ship design firm has multiple departments – hydrodynamics, stability, structures, weight, naval architecture, systems, machinery. This task will involve the selection of a case study for piloting of the new PLM software and the upgraded design process. Training of design team members will be performed as part of the pilot project and along the project timeline. A full-scale conceptual ship design process will be carried out as test case for the project.

Task 4.3 and Task 4.4 : Implementation and testing at the shipyards

The shipyard takes the next stage of a shipbuilding project. Bringing the drawings and specification of the vessel into reality. Design work is brought into production details and those into structures, cables and equipment that is put together to realize a vessel. These two tasks will follow a similar structure than Task 4.2, although involving a different stakeholder. In this phase, the connection between the engineering department and production will be critical. Therefore, a lot of emphasis must be put into the coordination and communication between internal stakeholders.

The Whole Process

Areas of Activity

DESIGN & SOLUTIONS

SHIPBUILDING

SERVICE & AFTERMARKET

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

Yong Se Kim

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 including shipyard workers, ship owners, operators, and users/passengers. This WP addresses overall shipbuilding planning and management with human-centric representation and management of shipbuilding activities and interaction and collaboration of various ship building actors including ship owners, operators, and service providers as well as users and passengers. WP 5 includes an AI-based document intelligence development component, which contributes toward the overall knowledge management objective, as well as interfacing with the platform development in WP3. WP5 also addresses the knowledge and requirements of shipbuilding actors and their skills development including training.

The core researchers of WP5 are composed of those in the Turku Design Studio of the Department of Mechanical and Materials Engineering and AI researchers from the Department of Computing of the University of Turku (UTU). Professor Yong Se Kim and Project Researcher Junsong He are working on human-centric shipbuilding activity mapping, Professor Jussi Kantola and Project Researcher Pengcheng Ni address knowledge management issue, Professor Filip Ginter is working on AI-based document intelligence using natural language processing.

People-centered approach will be emphasized throughout the activity modeling, knowledge management, and training. This human-centered approach would be generically applicable whether activities are about ship production or about customer involvement. Furthermore, interaction and collaboration of actors are the most important part of activity management whether the activities are about strategies and contracts or about production and test. Moreover, to address after-sales services, a human-activity centered approach is very important. We believe people aspects are getting more important as digital technologies are utilized in more parts of ship design, production, and operation. Specific research tasks of WP5 are like to following;

Task 5.1: Knowledge management system:

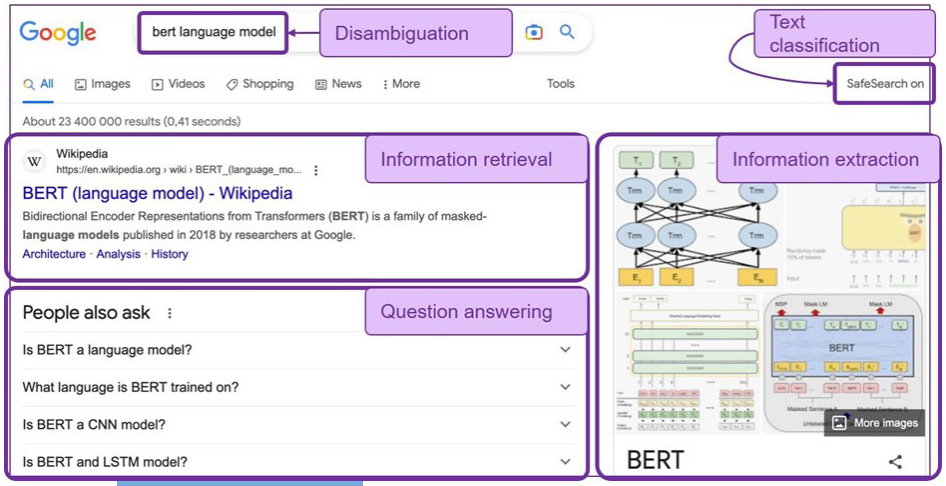
Development of a knowledge management system that contains: stakeholders and their needs according to HCM and SECI and functional requirements, design parameters, and process variables (optional ways to make the system up and running). This will be primarily conducted at UTU.

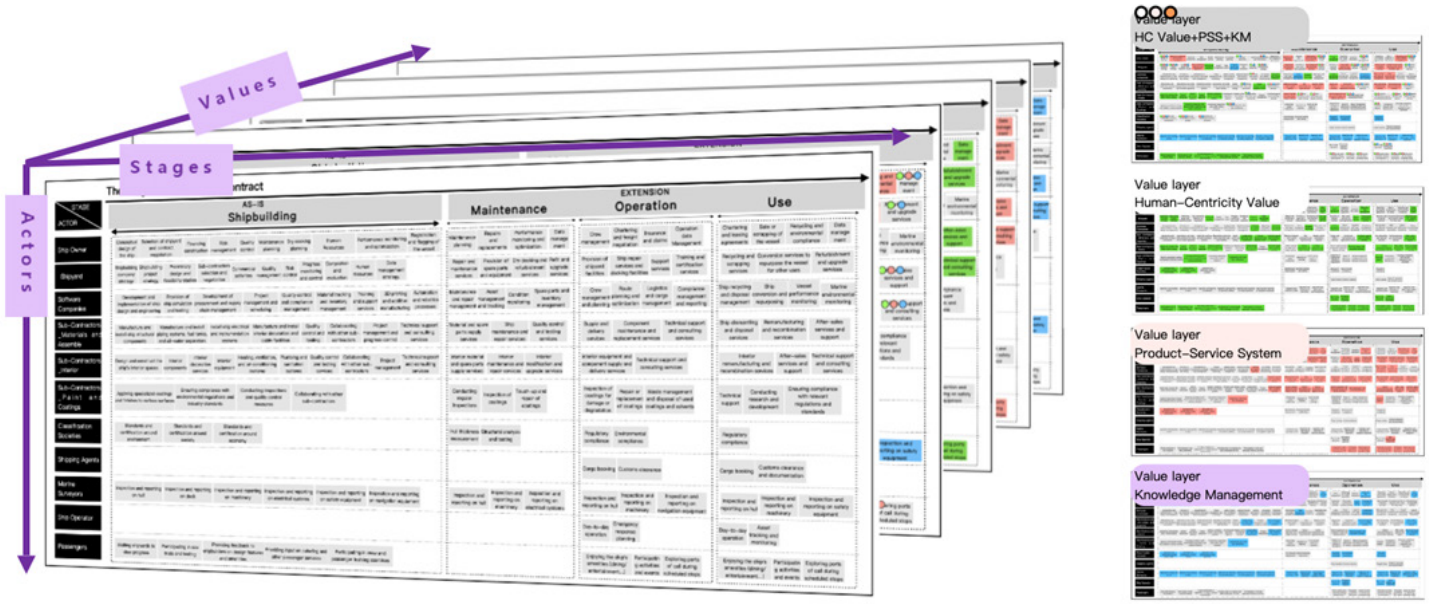
Task 5.2: Requirement and shipbuilding knowledge capture, preservation, management, and development using AI:

The task targets specifically advanced intelligent information retrieval from large textual collections, aiming to provide methods and tools that support search and automated question answering based on a large collection of documents. The concrete aim from the end-user's point of view is to enable and support fast orientation in large requirements document collections, qualitative improving information access. Given a sufficient amount of training data, such methods have been shown to be highly accurate and capable of producing answers comparable in quality to human-given. A representative sample of textual requirements documents will be compiled. An initial proof-of-concept semantic search engine will be developed. Subsequently, an improved, shipbuilding domain-adapted large language models will be developed, taking into account domain vocabulary and other domain specifics, so as to improve the applicability of modern NLP methods specifically in the shipbuilding domain. In addition to semantic search, the adapted language models will also be used as the basis of the development and benchmarking question answering methods and algorithms adapted to the shipbuilding domain. This will be primarily conducted at UTU.

Task 5.3: Shipbuilding Activity Map to manage shipbuilding activities from a contract, design to production, test, and delivery as well as aftermarket services:

Representation and management of the overall shipbuilding activities and data reflecting diverse stakeholders' perspectives and life-cycle steps will be developed throughout the shipbuilding processes including the early design stage, production to after-sales MRO, and retrofit.





Accommodation of different shipbuilding contexts and shipyard characteristics will be pursued in a structured manner in shipbuilding activity maps. Representation and management of collaboration and coordination of diverse shipbuilding stakeholders are particularly important for human-centricity in the era of digital transformation. How specific collaborations were done in previous ship building cases can be captured and represented as knowledge so that future shipbuilding cases will exploit this. With digital technologies, collaborations are happening with wider partnership and these kinds of knowledge would be important as closer feedback from various stakeholders are enabled in such a collaboration. Also issues in development of a digitalized shipbuilding activity mapping system with interactive visualization interfaces as well as similarity-based interrogation, retrieval, and transformation functions for various activities will be addressed together with customizable repositories. This will be primarily conducted at UTU.

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 will be primarily conducted at CADMATIC.

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

Customized learning support for continued learning of shipbuilding experts of shipyards and ship design companies will be pursued with effective monitoring of learning and knowledge transfer at both skill and meta-level training and learning. Provision of proper reflection opportunities in customized manners considering learners, topical characteristics, training and learning channel issues, etc, needs to be devised and validated in this WP through intimate iterative training workshop conducted in close collaboration with learning experts, ICT tools developers and learners. Human centric shipbuilding competitiveness model will be developed. This model is to be used in training and skill development and in overall assessment of human centric competency. Comprehensive competency dimensions will be devised including shipbuilding activity, PLM and related tools, data and digital technology, sustainable development, knowledge and skill development with meta-level measures, interaction, and collaboration among stakeholders. This will be primarily conducted at UTU.

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 the partners that lead the 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. In 2023 NTNU has created a SEUS repository of basic commercially useable communication material which is accessible for all SEUS partners. In 2023, communication activities on SEUS were performed during international events such as COMPIT. SEUS gained attention through newsletters from NHL Stenden in the Netherlands and NTNU in Norway in 2023.

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

In 2023 a public website has been created SEUS Project - NTNU. 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 addition to the SEUS consortium agreement, rules need to be created to protect IP rights outside the consortium. In year 1 a survey has been circulated among project partners to identify which products and services they consider to be subject to their intellectual property rights and which type(s) of intellectual property rights partners intend to use. Based on the outcome of the survey IP Rights rules and agreements will be drafted.

5. Connecting project outcomes to education

Teaching and training material on the background and usage of the SEUS software will be 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

The first year of SEUS has been completed, and during 2023, we have established administrative routines for the project to ensure good progress, meet reporting and delivery deadlines, and achieve the project's goals. Furthermore, routines have been established to ensure good communication among partners. All routines have been developed throughout the year based on project needs and feedback from partners. 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 partner, present research-related topics, and address any questions or other matters that may arise. Additionally, two physical workshops are scheduled per year. In 2023, a kick-off/workshop was held in Ålesund/Ulsteinvik (Norway) in May, and in November a workshop was held in Leeuwarden/Terchelling (Netherlands). 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.

Figure 1 : Upload, Review, Finalize and Submit Process in 30 days

During 2023, 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

Photo: Tony Hall

Gökce Yılmaz

Work Package Overview

As a part of WP 7, the important task is to understand and support the project partners with any issues related to their deliverables or tasks. To make this process more efficient, CADMATIC recommended the use of the RACI model, which stands for Responsible, Accountable, Consulted, and Informed. This model enables each partner to access and see their respective tasks and milestones, which ensures clarity of responsibilities.

In order to improve this process, we have sent the partners powerpoints on how to fill the main shared files, with regular reminders to update the status of the project model and continuous reporting tools. This way, everyone is more aware of how the tasks are progressing and the general process. In the meetings, which happen every 6 weeks, the status of the project is also brought up and discussed.

In this regard, the primary responsibility within Work Package 7 is to ensure that all tasks are progressing smoothly.

Main Tasks

Regarding the main tasks, there is also a collaboration with WP6 to gather communication and dissemination materials from the partners, and WP7 also works together with WP6 for the publication and creation of materials such as flyers, posters, and more.

Other essential topics that WP7 covers include;

- Helping the creation of EU reports
- Gathering materials from partners
- Annual report preparation
- Assisting interns
- Communicating with external parties regarding project needs

Diego De León

PHD Candidates

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

Janica Altea Bronson

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 design and production and determining how this can be quantified in terms of time savings in an actual yard.

Research Questions

- What are the current data models in place in ship design firms and shipyards?
- What degree of integration is necessary for different shipbuilding strategies?
- How can a data integration solution be implemented into ship design and shipbuilding?
- How does data integration 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 supporting the development of Work Package 1 (WP1) and is providing ancillary support for other deliverables where additional academic and or literature input is needed. The close collaboration with 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

Human-Centric PSS Design Methods for Shipbuilding Applications

About

Junsong He joins the University of Turku as a Project Researcher/Doctoral Researcher. He received a joint master degree in Product-Service System Design from Politecnico di Milano, Italy and Tongji University, China. He has worked as a digital innovation consultant at Accenture and at Whale after his master degree education.

Project Description

The deliverable addresses an overall shipbuilding process with human-centric representation and management of shipbuilding activities and and interaction and collaboration of various shipbuilding actors including shipowners, operators, and service providers as well as users and passengers. The main research topics are around the following three aspects: Shipbuilding Activity Mapping with Service Blueprint, PSS Design Methods for After-Sales Shipbuilding Applications, and Human-Centricity Related Shipbuilding Evaluation Criteria.

Industrial goals

1. A better and more Efficient Shipbuilding Activity Mapping
2. Innovative After-Sales smart Service Solutions
3. Human-Centric Evaluation Criteria

Research Questions

How can the service blueprint approach and a focus on human-centricity contribute to the shipbuilding activity mapping, and ultimately enhance the competitiveness of the next generation of European shipbuilding?

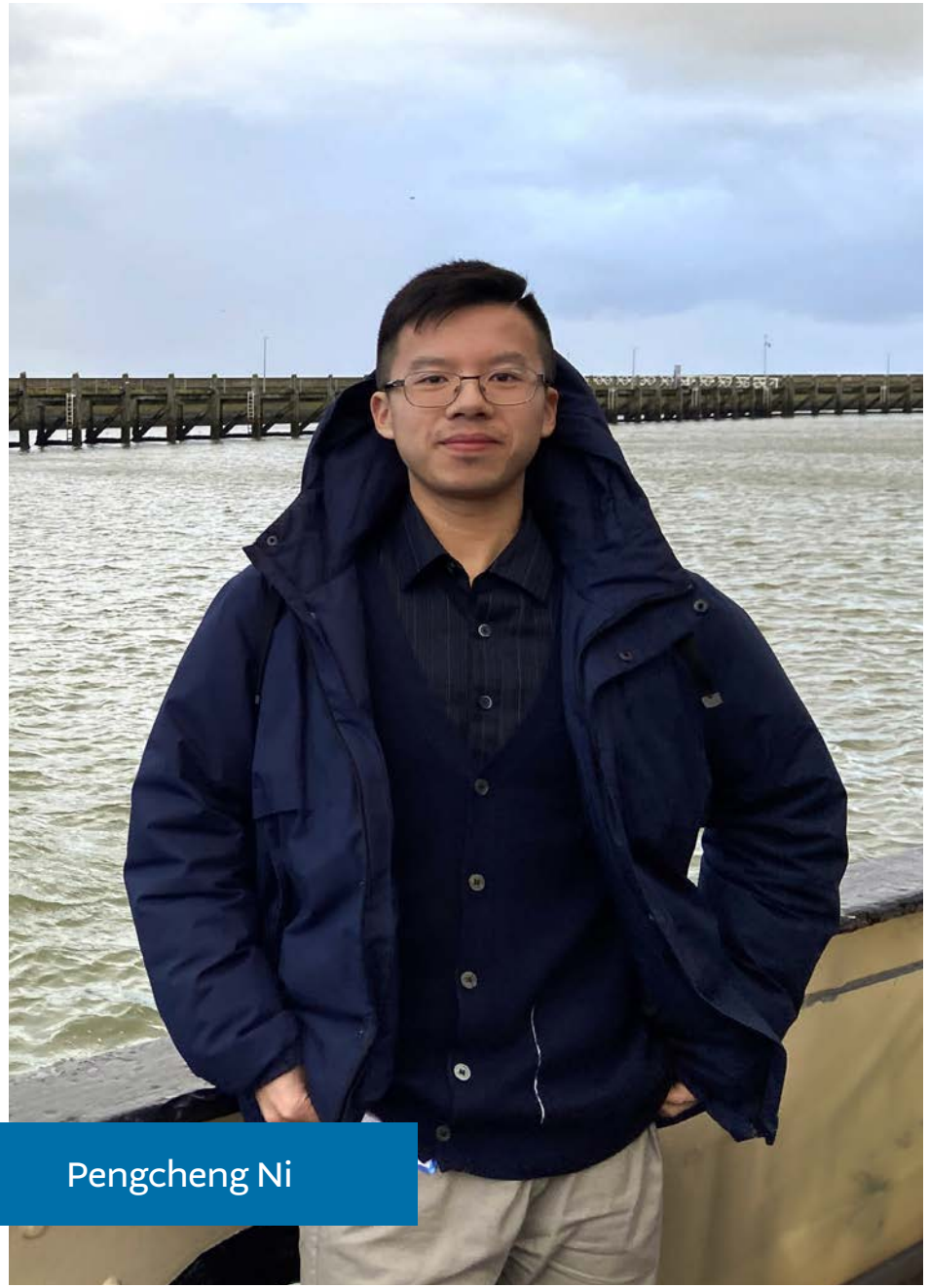
Innovation

Human-centricity design methodology and evaluation criteria

Activity mapping with service blueprint in shipbuilding application

Supervisor Team

1. Yong Se Kim, University of Turku
2. Jussi Kantola, University of Turku



Pengcheng Ni

Human-centric Knowledge Management System

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, shipowners, 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

- What is knowledge management system in shipbuilding?
- Why should we explore and develop knowledge management system in European shipbuilding (SEUS)?
- How could we create the knowledge management system in SEUS?
- What is the output of KMS in SEUS?
- What could we get from KMS in SEUS and its performance evaluation?

Innovation

1. One of the innovation points of developing the KMS in smart European shipbuilding is that it is the first time a KMS application in specific industry in specific region.
2. WP5 in SEUS focuses on the upstream and downstream of the value chain of shipbuilding. The KMS will be the comprehensive system.
3. WP5 will be based on the best practices of European ship design and shipbuilding, which is the first time in shipbuilding field of involving in KMS absorbing best practices concept.

Supervisor team

1. Jussi Kantola, University of Turku

Target Group

MoU between NMRI (Japan) 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 networks
- 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 fields

Tools

To reach out to this target group, the existing sales and marketing channels in the industry via all partners are utilized. The aim for the first year is to have 1-3 new shipyards using the platform, with an overall market capacity estimation of about 140 shipyards in the EU. The platform will also be offered to shipowners already using CADMATIC's Information Management solutions, and the shipyard's influence and wider communication channels will be used to reach industrial players.

In addition, training courses will be provided by participating universities, and direct involvement in project activities and dissemination in IT professional forums and conferences will take place. There will be a number of professionals involved in the project and junior/summertime developers, estimated over 75 in total from three countries. Educational materials will also be provided via academic partners, including training courses and common events with industrial partners, and summer job positions for students allowing them to try work in a project and IT environment. The platform will be disseminated through scientific publications in engineering, IT, AI, and NLP researchers, establishing a link between these research areas.

Communication & Dissemination

MEDIA

Marius Rosbarch
Forskar fram framtidas måte å bygge skip på; 24.02.2023
NTNU

Eli Anne Tvergrov
Smartare europeisk skipsbygging; 10.03.2023
NTNU

Herbert Koelman, Casimir Koelman
The Smart European Shipbuilding project (SEUS); 17.01.2023
SARC

Elisabeth Brandenburg
CONTACT researches new technologies for Europe's shipbuilding industry; 22.05.2023
CONTACT

Mariska Buitendijk
MIWB wins Horizon grant for major European shipbuilding project; 18.04.2023
NHL Stenden

MIWB receives Horizon funding for major European shipbuilding project; 14.04.2023
NHL Stenden

Cadmatic is part of consortium leading EU-funded SEUS project for smarter and more productive shipbuilding; 12.01.2023
CADMATIC

SEUS Workshop in Norway explores the future of smart European shipbuilding; 10.05.2023
CADMATIC

Elisabeth Brandenburg
Smart European Shipbuilding; 22.09.23
CONTACT

Jose Jorge Garcia Agis
PDM and PLM in Ulstein: 01.02.2023
ULSTEIN

Jose Jorge Garcia Agis
Workshop SEUS project in Sunnmøre:; 10.05.2023
ULSTEIN

GONDAN participates in SEUS project; 26.05.2023
GONDAN

SEMINARS

Henrique M. Gaspar, Hans Petter Hildre
Årsmøte 2023 i bransjeorganisasjonen Norske Skipsverft, Bergen; 24.03.2023
NTNU

Herbert Koelman
Europort, Rotterdam NL; 07-10.11.2023
SARC

Icaro Fonseca
Waterborne EU, Brussels; 26.-27.9.2023

Ludmila Seppälä
Sname Maritime Convention; San Diego, CA, USA; 27-29.09.2023
CADMATIC

Ludmila Seppälä
Nor-shipping Event; Oslo, Norway; 6-9.06.2023
CADMATIC

Juha Asanti
Shipbuilders unite – highlights from the Cadmatic Digital Wave Forum; 31.10.2023
CADMATIC

Ludmila Seppälä
Europort - Turning data into a tangible asset in the maritime industry; Rotterdam NL; 09.10.2023
CADMATIC

SCIENTIFIC ARTICLES

Henrique M. Gaspar, Ludmila Seppälä, Herbert Koelman, Jose Jorge Garcia Agis
Can European Shipyards be Smarter? A Proposal from the SEUS Project - COMPIT; 23-25.05.2023
NTNU, CADMATIC, SARC, ULSTEIN

Ludmila Seppälä
Integrated Shipbuilding Data Management - COMPIT; 23-25.05.2023
CADMATIC

Herbert Koelman
Tell Me More - COMPIT; 23-25.05.2023
SARC

Fonseca, Icaro Aragao; Ferrari de Oliveira, Felipe; Gaspar, Henrique Murilo
Open Framework for Digital Twin Ship Data: Case Studies on Handling of Multiple Taxonomies and Navigation Simulation. International Journal of Maritime Engineering 2023 ;Volum 165.(1) s. A23-A42
NTNU

Teodoro, Pedro; Marta-Mendes, Rosa; Assunção, Mário; Alves, Nuno; Sanguino, Beatriz; Gaspar, Henrique Murilo.
Instigating maritime studies via rapid prototyping and robotics: a case from the smartboat initiative. Proceedings - (ECMS) 2023
NTNU

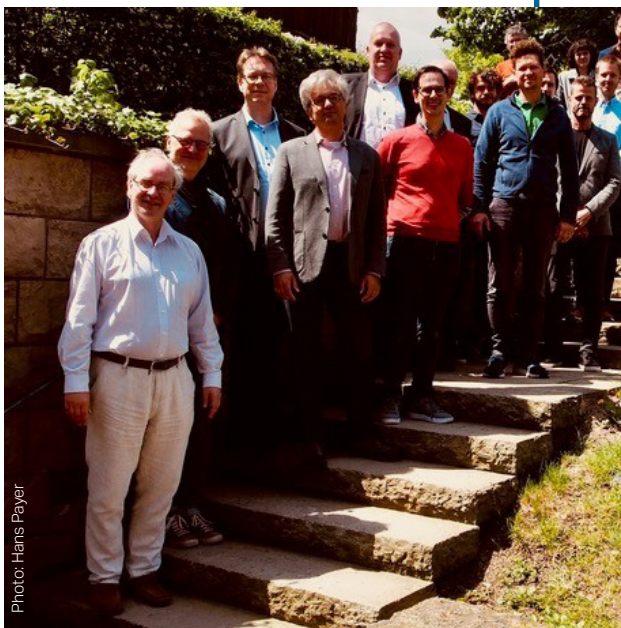
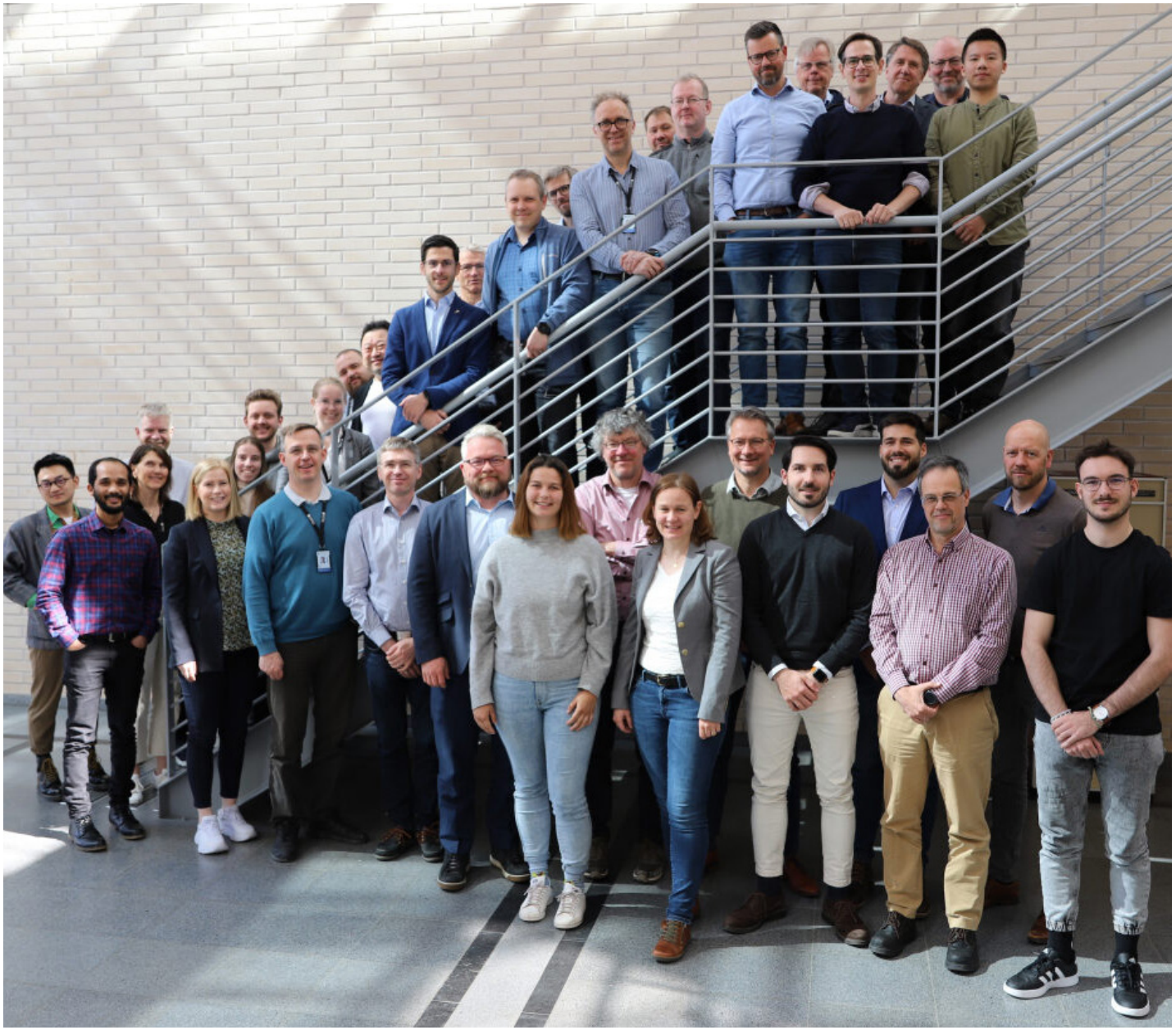


Photo: Hans Payer

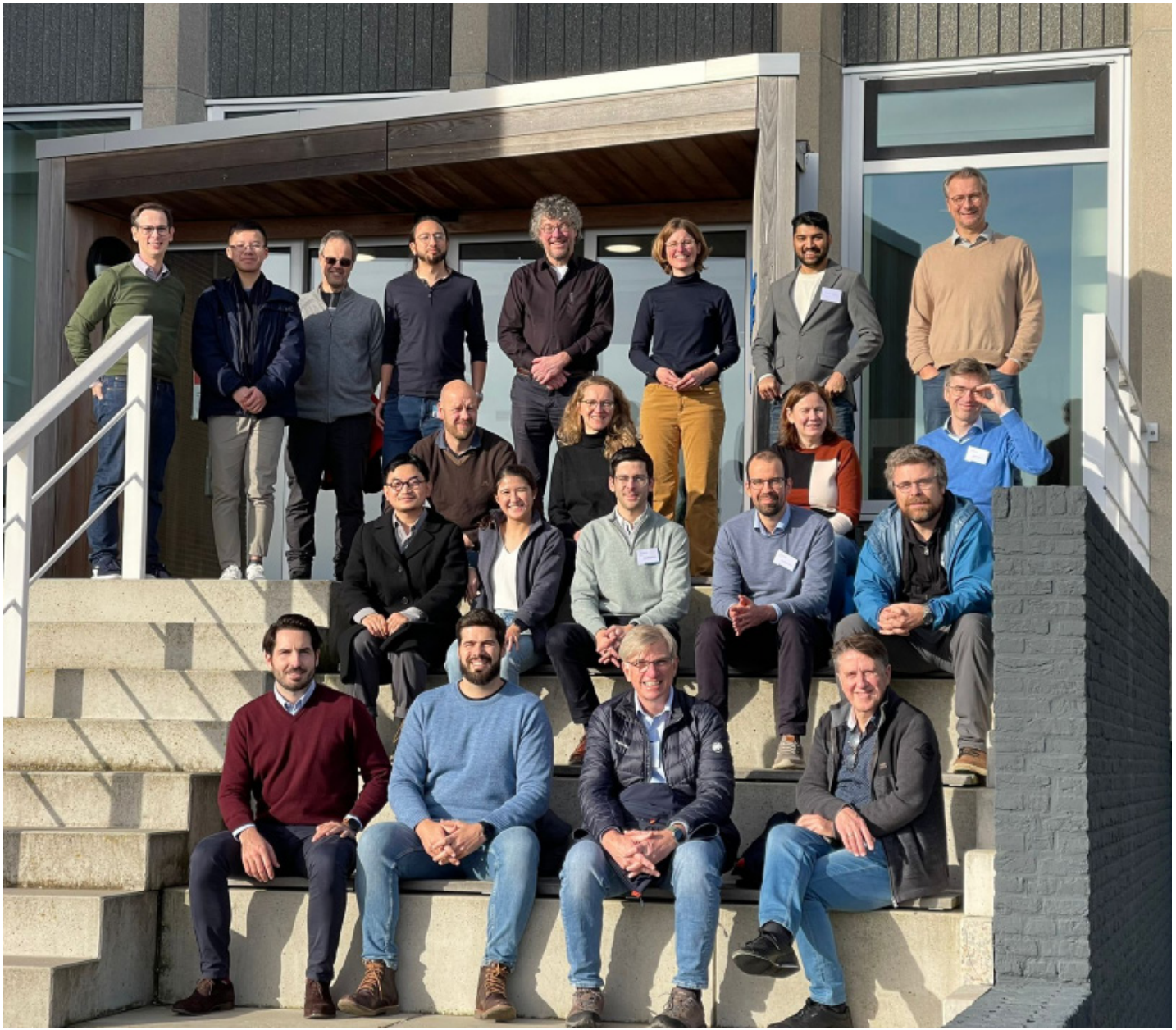
SEUS workshops



SEUS Workshop in Norway Ålesund & Ulsteinvik

The first workshop for the SEUS (Smart European Shipbuilding) EU Project was a two-day event held in Norway on May 3-4. The first day was open to the general public, and it was held at NTNU in Ålesund. The agenda included input and presentations from all partners on a range of topics. These included the digitalization of the maritime industry and the challenges and opportunities that come with it, data models for maritime structures, innovation in shipbuilding practices, and technology trends in the industry.

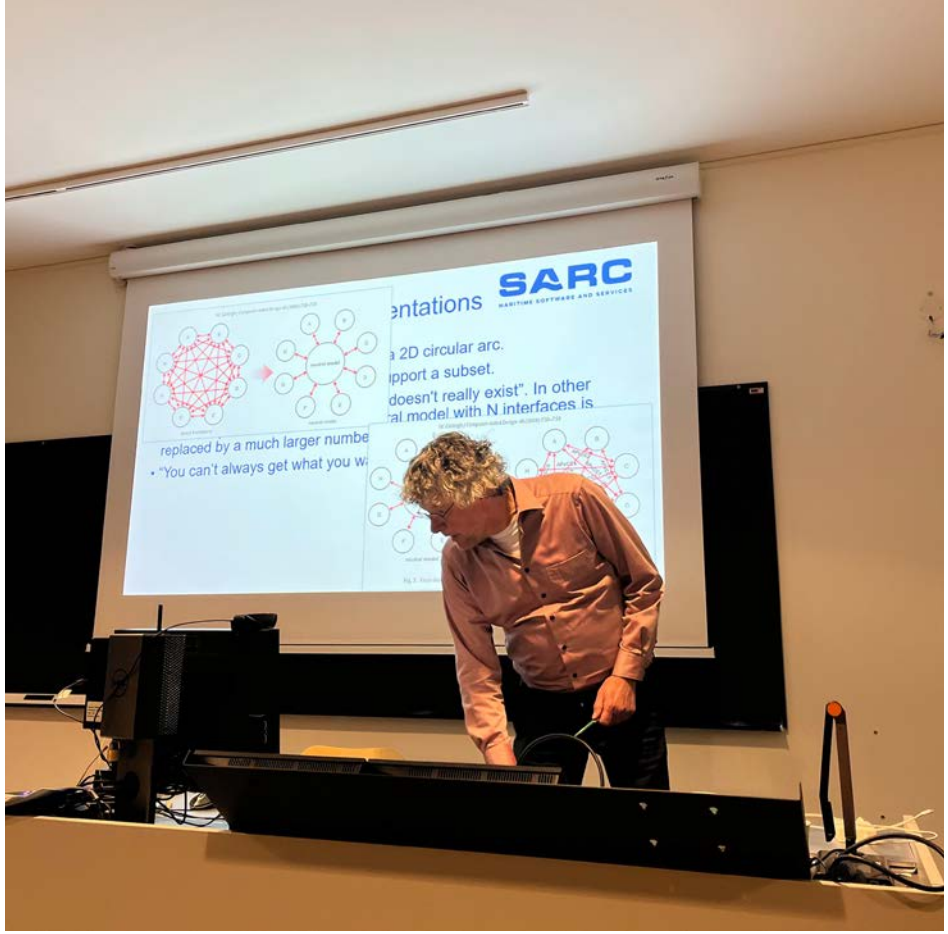
On the second day, the partners had a consortium meeting at the shipyard of Ulstein Group, which is located in Ulsteinvik. This was a closed-door meeting where the partners discussed the progress of the project and shared their insights and opinions on the way forward.



SEUS Workshop in Netherlands - Leeuwarden & Terschelling

The SEUS EU Project held its second workshop in the Netherlands from November 15 to 16, 2023. During the workshop, partners discussed shipbuilding digital tools, business exploitation, cybersecurity, and research activities.

On the first day, the workshop focused on PhD updates from NTNU, UTU, and NHL Stenden. The discussion covered multi-domain taxonomies in ship design, activity mapping and knowledge management systems. Additionally, there was a Cybersecurity educational training session by NHL Stenden. On the second day, CADMATIC, SARC, and CONTACT made presentations on software development and open platform development. CADMATIC presented their SEUS Roadmap and introduced CADMATIC Wave. CONTACT talked about administrative and human-centric models for integration, while SARC presented updates on the SEUS data model. At the end of the workshop, there was a tour of The Maritime Institute Willem Barentsz (MIWB).



Presentation highlights

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NTNU \ Manager, WP7 Coordinator

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NTNU \ Advisor

Gökce Yilmaz
NTNU \ Technical Manager

Hans Petter Hildre
NTNU \ Head of Department

Janica Altea Bronson
NTNU \ PhD Candidate

Harald Godø Gjerdahl
NTNU \ Finance

Icaro Fonseca
NTNU \ Adjunct Associate Professor

Flora Joelle Mbuebue Larsen
NTNU \ Finance Advisor

Robert Leszczynski
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Felipe Ferrari de Oliveira
NTNU \ Researcher

Toney Thamby
NTNU \ Young Researcher

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Onne Bakker
CADMATIC \ Financial Advisor

Atte Peltola
CADMATIC \ Industry

Paul Filius
CADMATIC \ Industry

Ankit Talati
CADMATIC \ Industry

Mikko Yllikäinen
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Evgenii Egorov
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CONTACT \ Researcher & Analyst

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CONTACT \ Industry

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Junsong He
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Pirjo Kopra-Ojansuu
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Account

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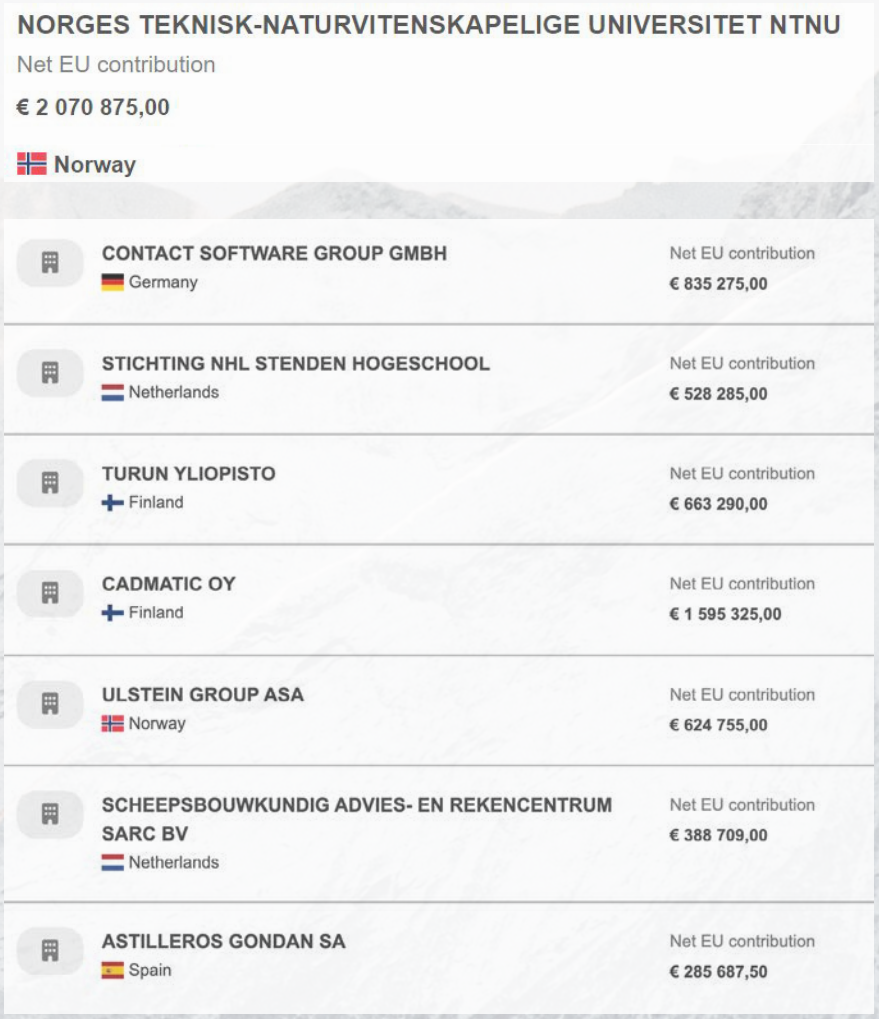
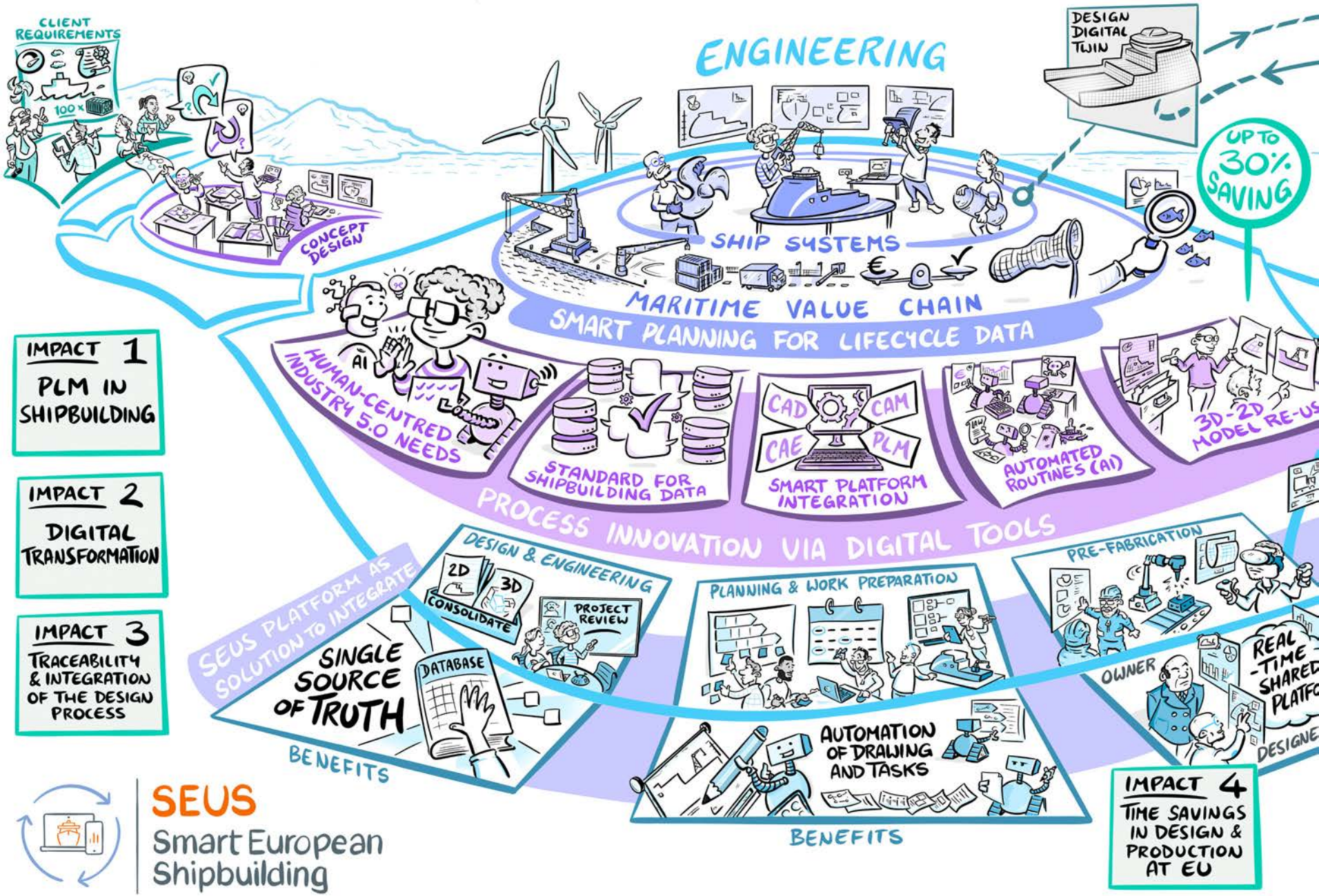
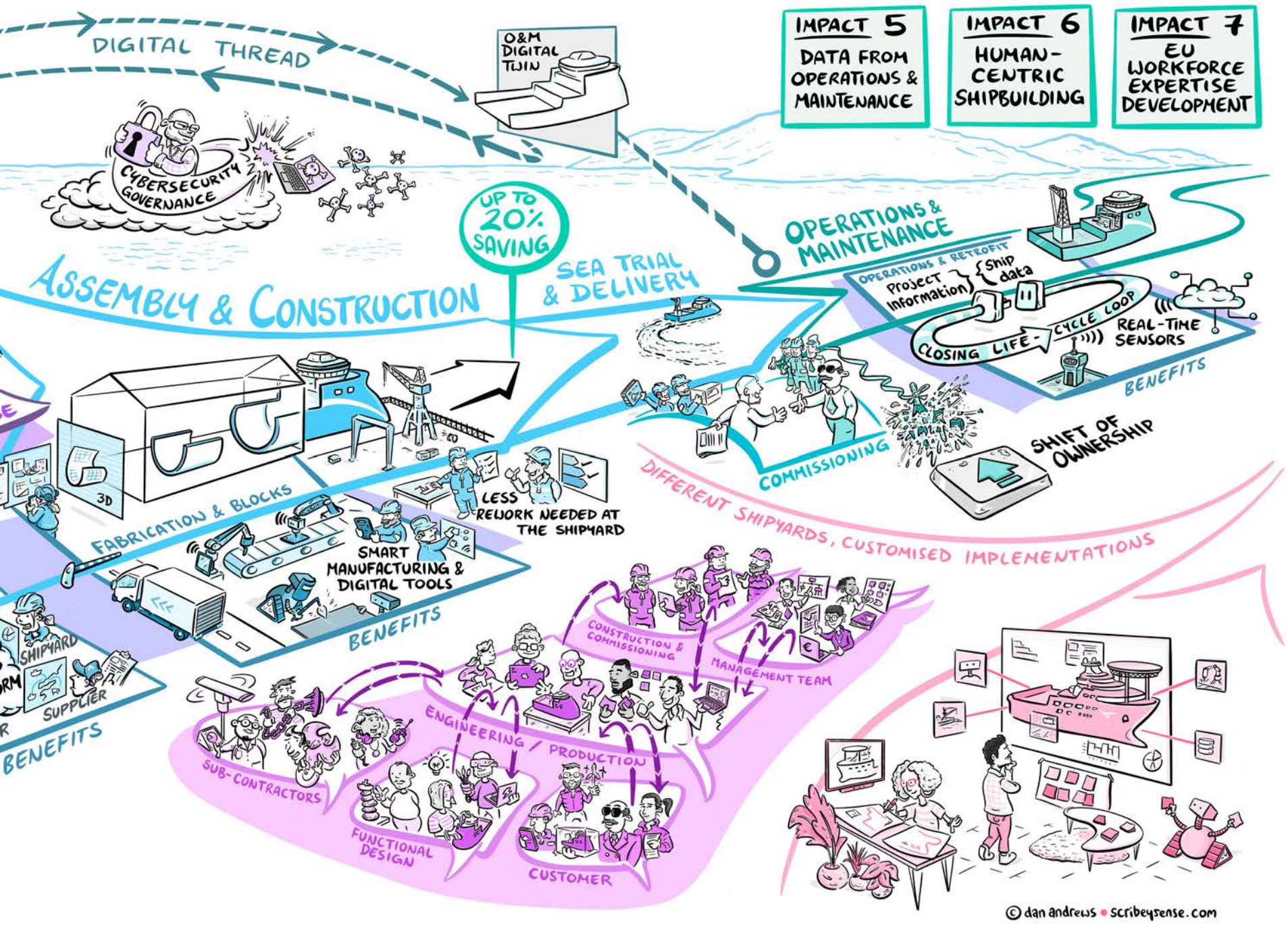



CLIENT REQUIREMENTS
100 x
CONCEPT DESIGN
ENGINEERING
DESIGN DIGITAL TWIN
UP TO 30% SAVING
SHIP SYSTEMS
MARITIME VALUE CHAIN
SMART PLANNING FOR LIFECYCLE DATA
AI
HUMAN-CENTRED INDUSTRY 5.0 NEEDS
STANDARD FOR SHIPBUILDING DATA
CAD
CAM
CAE
PLM
SMART PLATFORM INTEGRATION
AUTOMATED ROUTINES (AI)
3D-2D MODEL 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


DIGITAL THREAD
O&M DIGITAL TWIN
IMPACT 5
DATA FROM OPERATIONS & MAINTENANCE
IMPACT 6
HUMAN-CENTRIC SHIPBUILDING
IMPACT 7
EU WORKFORCE EXPERTISE DEVELOPMENT
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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