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DELIVERABLE 7.2

Overall SmartShip framework demonstration/exhibition activity

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Executive Summary

The SmartShip project aims to revolutionize the maritime industry by establishing a next-generation energy efficiency and emissions control framework. The core mission of SmartShip is to facilitate the exchange of knowledge among experts in complementary technological fields—namely IoT, data analytics, visualization tools, and optimization algorithms. These technologies are applied within energy efficiency and emissions management contexts, culminating in a holistic approach that integrates circular economy principles.

Leveraging Commercial off-the-shelf (COTS) technologies and limited research and technological development (RTD), SmartShip is dedicated to developing an ICT and IoT-enabled cloud-based maritime performance and monitoring system. This system is designed to optimize energy efficiency, reduce emissions, and decrease fuel consumption throughout the entire lifecycle of a ship, promoting sustainability in maritime operations.

Work Package 7 (WP7) is pivotal in the SmartShip initiative, overseeing the coordination, management, and execution of dissemination, exploitation, and training activities. This package is essential for effectively integrating the maritime industry with ICT-oriented industrial and research entities through robust networking and knowledge-sharing efforts.

The project's progress has been showcased through various stages of its implementation. These demonstrations include a final event, interactive sessions with end-users, and extensive training and workshops. Such activities highlight the capabilities of the SmartShip project and facilitate the transfer of knowledge to stakeholders, thereby enhancing collaboration within the consortium and with external partners.

SmartShip's development process features a multi-phase testing regimen enriched by iterative feedback, which has led to significant system enhancements. This responsive approach ensures that the system meets the practical demands and adheres to the regulatory standards of the maritime industry.

In addition to technical demonstrations, SmartShip emphasizes educational initiatives, with multiple sessions conducted at notable institutions such as the Harokopio University of Athens and Ecole des Ponts Business School. These sessions are instrumental in spreading knowledge and fostering collaborative networks that propel the project toward its sustainability and efficiency goals in maritime operations.

In summary, the SmartShip project stands as a beacon of innovation in maritime technology, driving the industry towards sustainable practices through advanced technological integration and comprehensive stakeholder engagement.

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List of Acronyms and Abbreviations

Term	Description
COTS	Commercial off-the-shelf
D	Deliverable
DBM	Dynamic Business Model
GA	General Assembly
ICT	Information and Communication Technology
KPI	Key Performance Indicator
PC	Project Coordinator
WP	Work Package

1. Introduction

1.1 Scope and objectives of the deliverable

Throughout the project's lifecycle, the SmartShip Framework underwent continuous demonstration across various activities. Deliverable D7.2 specifically details these demonstrations, encompassing the showcase during the Final Event, user interactions outlined in D6.2, training sessions, workshops, and a spectrum of dissemination activities. Additionally, it elucidates the strategic utilization of project communication channels, including the project website, social media platforms, and targeted communication campaigns. This comprehensive scope ensures a thorough documentation of the SmartShip Framework's visibility and engagement strategies across diverse contexts.

1.2 Structure of the deliverable

Deliverable D7.2 contains a report of the SmartShip Framework demonstration activities, including the project final event, training and workshops, and other dissemination activities (newsletter and podcasts) performed to exhibit the SmartShip Framework. In this sense, the document is structured as follows:

Section 1 Introduction sets the stage for the deliverable by offering an overview of its scope and objectives, the structure of the deliverable, and its relation to other tasks and deliverables. It serves as a primer for readers, providing essential background information before delving into the subsequent sections.

Section 2, SmartShip Framework Demonstration, provides a more detailed report of the SmartShip demonstration activities, and it is structured as follows:

Section 2.1 Final Event details the closing event of the SmartShip project, and it provides a thorough account of the final demonstration event. It elucidates the key highlights, participants, presentations, and outcomes of this pivotal occasion where the SmartShip Framework was showcased.

Section 2.2 Demonstration to end users focuses on end users, and it elucidates the practical demonstrations and interactions conducted to acquaint them with the SmartShip Framework. It explores how the project addressed end users' needs, concerns, and feedback to ensure the framework's relevance and usability.

Section 2.3 Demonstration in training and workshops highlights and describes the role of training sessions and workshops in exhibiting and disseminating the SmartShip Framework.

Section 2.4 Demonstration in other dissemination activities encapsulates the project's outreach efforts to showcase the SmartShip Framework.

Finally, section 3, Conclusions, summarizes the key takeaways of D7.2 and future directions and opportunities.

1.3 Relation to other Tasks and Deliverables

WP7 is responsible for the coordination, management, and execution of the dissemination, exploitation, and training activities for the efficient binding of the maritime industry with ICT-oriented industrial and research beneficiaries. It manages the basic networking and knowledge-sharing activities of SmartShip, which is thus the most critical and demanding WP of the project.

Thus, this deliverable holds significant importance because it marks the culmination of the project, showcasing its results, achievements, and future directions and opportunities. The deliverable also connects and uses inputs from D6.2.

2. SmartShip Framework Demonstration

2.1 Final Event

The SmartShip final event was hosted at ITML premises in Athens on March 28th, 2024. The half-day event was designed in three sessions. The event also included a short workshop and marked the culmination of the SmartShip project journey, demonstrating groundbreaking scientific results and research achievements in maritime energy efficiency, fuel consumption, emissions management, and circular economy. The agenda released in advance revealed the line-up of speakers including SmartShip consortium partners: DANAOS, ITML, Bluesoft, HUA, Epsilon, EPBS-CERC, and SmartShip project sister HS4U consortium.



Figure 1 SmartShip Final Event Communication Campaign

WP7 created a social media campaign as the primary promoting tool for the SmartShip final event. It utilized all project social media platforms, including partners' social media platforms (e.g., Twitter, LinkedIn, and Facebook), to increase the event's visibility and outreach among stakeholders and the public. Social media enabled live interactions with the project audiences through six posts (e.g., event announcement and registration link, final agenda announcement, the line-up of speakers' announcement, consortium, and event highlights), as shown in Figure (1), enabling comments, shares, and likes.

During the event, DANAOS presented SmartShip's innovative system architecture, ITML presented cutting-edge IoT components, and advanced data analytics in the project. It was also a platform for the SmartShip sister project, the HS4U EU project, to share insights and present the details of this project by its consortium members. BlueSoft presented optimization tools, and the Harokopio University of Athens presented AIS-based trajectory clustering. The afternoon session included a presentation introducing the SmartShip integrated framework by Epsilon and a presentation on the circular economy requirements for the SmartShip project by EPBS-CERC.

2.2 Demonstration to the end-users

2.2.1 Summary and main outcomes of D6.2

SmartShip offers a multi-layer optimization in fuel consumption, energy efficiency, and emissions control management, with full respect to the implementation of the requirements of maritime sector regulations while considering applications of circular economy concepts in the maritime. SmartShip is capitalizing on available COTS technologies and building on top of the existing DANAOS infrastructure for fleet performance monitoring, data analytics, and optimization algorithms for voyage planning. SmartShip extends and re-configures services of the existing DANAOS digital ecosystem. This is why

all incremental releases of the deployed system were demonstrated to the DANAOS staff to be evaluated. The primary goal of the SmartShip framework was to constitute a value proposition to the digital governance of a typical and large-scale maritime company such as DANAOS shipping.

The system was developed following an agile approach and managed using the Scrum project management technique. It was deployed in two iterated versions. A team was constructed by seconded staff of SmartShip partners to work as product owners of the system. The team holds a deep understanding of user needs and maritime business logic while knowing the SmartShip tools' functionalities well. This team was the consortium's main contact point with the system's reviewers (also called the SmartShip evaluation team). They demonstrated each version of the system to the reviewers and provided support during the evaluation process. The reviewers were key DANAOS organization users engaged in the decision-making process associated with the designated SmartShip use cases, namely weather routing optimization, route monitoring, condition-based maintenance, and visualization.

The reviewers assessed the SmartShip system's add-in services and features in two successive pilot testing rounds following the deployment of each SmartShip version. The first round run between M42 and M45 followed the release of the 1st version, and the second run between M54 and M60 followed the launch of the second integrated version. Users validated the system by executing scenarios drafted and specially designed to address the use cases' functional and non-functional requirements as depicted in D2.1 and included in the project's backlog of users' stories.

The first version of the system was evaluated only against the non-functional qualitative attributes with the use of relevant questionnaires shared with the evaluation team (reviewers). The results showed a moderate overall experience and interaction of the users with the system, triggering many suggestions for further improvements. The user's recommendations were incrementally embedded in the next and final version. The second version was finally assessed against both functional and non-functional requirements. The functional requirements were validated against designated KPIs drafted in D2.1 and associated with each use case and corresponding digital services of the tool, while the non-functional ones were validated by using the same questionnaires as in the first pilot round.

Users appreciated the inclusion of all their suggestions from the first pilot test. Their appreciation is reflected in the high score they have appointed to their overall experience with the system (scored with a maximum of 5 by 80%).

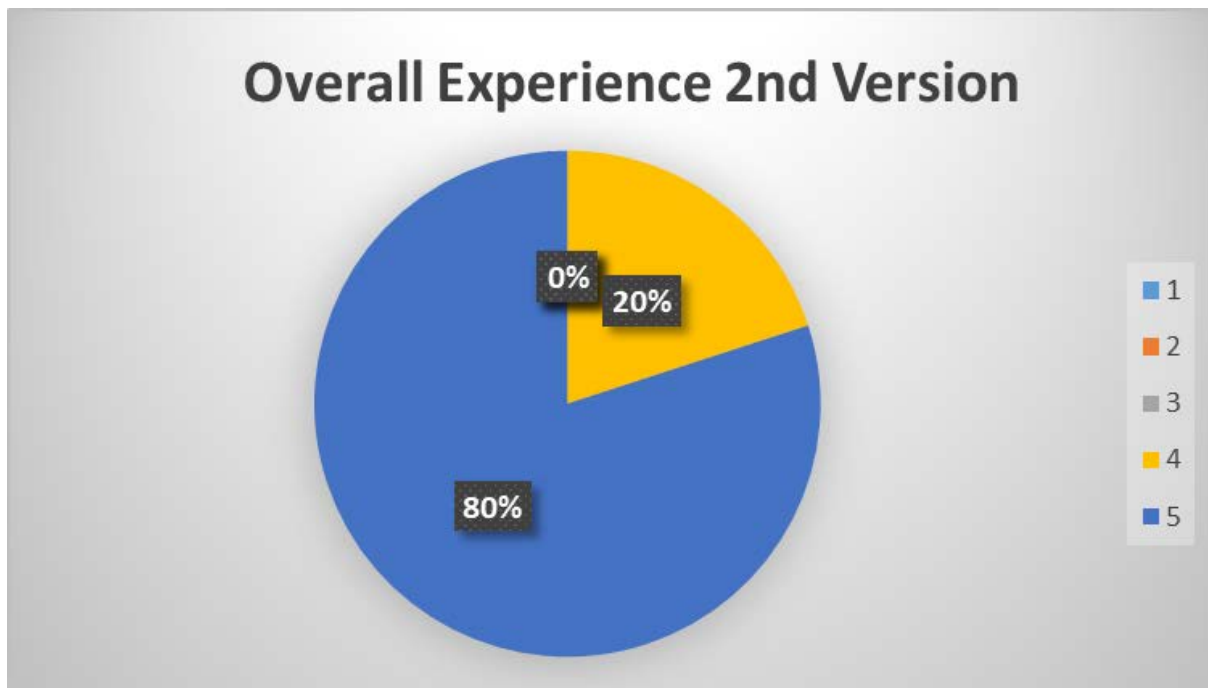


Figure 2 Evaluation results of non-functional attributes based on User’s feedback (2nd pilot round)

Finally, the functional requirements per use case were fully addressed and validated through the satisfaction of the associated KPIs. A consolidated view of the satisfaction level of the validated KPIs linked to functional requirements per use case is presented in Table 1.

Table 1 KPIs

No (#)	KPI	Measurement	Applied Use Case	Result (KPI satisfaction)
1.	Assessment of Results in Voyage performance in terms of fuel consumption and emission control compliance due to SmartShip routing advice	At least 5% enhancement in environmental performance due to SmartShip routing scenarios against existing algorithmic-based routing advice	Weather routing optimization#1, Route monitoring #2	FULLY (7-8%)
2.	Improvements in performance % of the existing weather routing optimization tool	At least 5% improvement in accuracy of routing advice and voyage performance evaluation due to SmartShip build-in functionalities	Weather routing optimization#1, Route monitoring #2	FULLY (6%)

3.	Improvement in results of the existing vessel performance monitoring tool	At least 5% enhancement in anomaly detection and failure prediction of vessel machinery components due to SmartShip build-in functionalities	Condition-based (predictive) maintenance #3	PARTIALLY (3%)
4.	Introduction of Circular Economy criteria in maritime operations	At least 5% improvement in Engine fatigue treatment and performance monitoring to prolong asset lifetime and retain value.	Condition-based (predictive) maintenance #3	FULLY (10%)
5.	Monitoring Energy efficient operations performance	Identify at least a 5% improvement on the Fuel Operational Consumption (FOC) model	Weather routing optimization#1, Route monitoring #2	FULLY (6%)
6.	Reuse and remanufacturing strategies and operations.	Development of at least 1 reuse and remanufacturing database of materials for engine components	Condition-based (predictive) maintenance #3	FULLY (re-use of 5 components)

Following the conclusion of the second pilot round, the reviewers and users of the system drafted a set of recommendations for continuous improvements of the SmartShip system, supporting an incremental change towards a market-ready digital service provided in the future to the industry through a comprehensive and solid business model. More details and insights on the demonstration and evaluation of SmartShip’s ecosystem of advanced tools are thoroughly presented in D6.2

2.3 Demonstration in Training and Workshops

The SmartShip trainings and workshops served as a platform to showcase the SmartShip Framework. Figure (3) shows the social media campaign implemented for the training and workshop activities to reach the project's target audience and the general public.

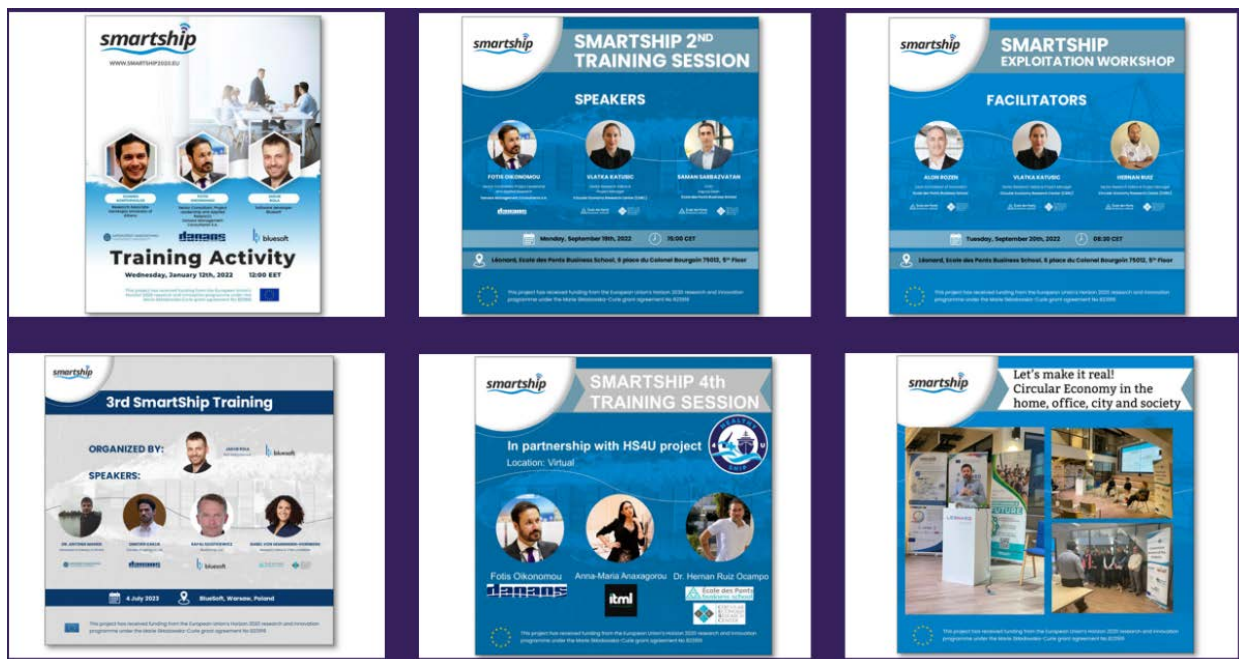


Figure 3 SmartShip Training and Workshops

The following subsections describe, more in detail, the training sessions and workshops.

2.3.1 Harokopio University of Athens - HUA

On January 12th, 2022, the 1st training session of the SmartShip project took place at Harokopio University of Athens. Even though the new COVID restrictions did not allow for a complete physical meeting, a hybrid training session was held where 21 people from SmartShip partners gathered to learn about novel methodologies of storing and querying trajectory data and developing micro-services.

During the three-part training session, Harokopio University of Athens introduced a novel and open-source database called MobilityDB, which is suitable for storing and querying trajectory data. Then, DANAOS presented its tools in the field and their applications in the Smartship project. Finally, Bluesoft presented Kubernetes, an open-source system for automating deployment, scaling, and management of containerized applications that could prove helpful in Smartship applications.

2.3.2 Ecole des Ponts Business School - EPBS

On September 19th and 20th, 2022, the 2nd training session of the SmartShip project took place at Ecole des Ponts Business School (EPBS) in Paris. The event aimed to bring together SmartShip consortium partners and the public to discuss the project's societal impact and challenges.

During the training session, DANAOS showcased the SmartShip framework and architecture, and the Ecole des Ponts Business School and CERC presented the concept and principles of the circular economy enabled by new technologies and its implementation in the SmartShip framework.

2.3.3 Exploitation Workshop - EPBS

On September 19th and 20th, 2022, the SmartShip Exploitation Workshop was held at Ecole des Ponts Business School in Paris. The workshop introduced and used the Dynamic Business Models (DBM) framework developed by the Ecole des Ponts Business School dean to improve go-to-market strategies for analytical platforms proposed within the SmartShip project for holistic energy efficiency, fuel consumption, and emissions management of vessels. The workshop, thus, transferred knowledge on DBMs to the attendees and identified possible collaboration avenues between project partners. Figure 4 shows the results of the exploitation workshop. Almost all the elements of DBM Canvas were developed except for the marketing, sales, and growth. Therefore, attendees agreed that it is necessary to explore

further collaboration possibilities using the Dynamic Business Models (DBM) framework to enhance growth, sales, and marketing strategies.

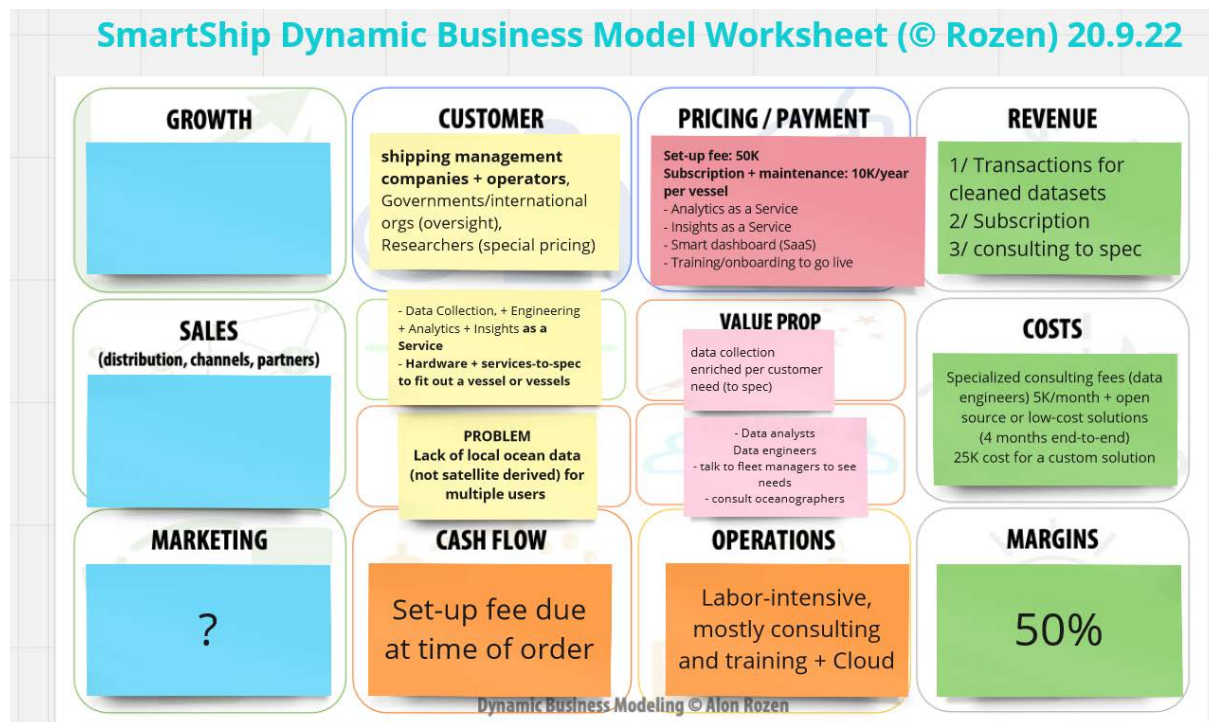


Figure 4 Exploitation workshop: Circular Business Model approach.

2.3.4 BlueSoft

On the 4th of July 2023, BlueSoft hosted the 3rd Smartship Training in Poland. The event took place in a hybrid format and reached almost 30 participants. This event gathered consortium partners and enabled a robust exchange of knowledge and ideas.

During the session, the Harokopio University of Athens presented the development and use of TraClets, an open-source Python library for trajectory representation and classification. DANAOS showcased its revolutionary ship management and trajectory optimization tool, and BlueSoft presented the benefits of employing the SCRUM methodology in project management. Their expertise shed light on how this agile approach can drive greater efficiency and success in maritime projects. Finally, the Circular Economy Research Center, presented an enlightening perspective on the evolution of supportive systems within the maritime industry.

The 3rd Smartship training provided an exceptional platform to showcase the SmartShip Framework, exchange ideas, and present advancements within the maritime industry.

2.3.5 HS4U EU Project

From the 13th to the 15th of December, the SmartShip 4th training session took place during the HS4U EU project's 2nd General Assembly (GA) meeting at Columbia Blue – The Leisure Group headquarters in Hamburg (Germany).

During the event, the SmartShip Project Coordinator (PC), DANAOS, delivered a presentation on the SmartShip architecture, use cases, and the tools powering the project. ITML presented the SmartShip Data Analytics Module, focusing on the design and development of the Advanced Data Analytics, and the Circular Economy Research Center presented the Circular Economy on the SmartShip project, shedding light on its significance and how SmartShip took advantage of it.

2.3.6 *Let's make it real! EPBS*

On November 7th, 2022, EPBS-CERC hosted the Let's Make it Real! Circular economy in the Home, Office, City & Society interactive event, gathering excellent speakers who addressed the four key themes of the event. The event also included a workshop.

The panel of speakers included Elizabeth Soubelet, co-founder of Ma Bonne Étoile and board member at B Lab France. Elizabeth presented the Circular Economy at home, highlighting how the small changes we make at home can significantly impact the environment. Maïka Chretien Nuti, director at Ulter'ia Formation, discussed the Circular Economy in the office. Antoine Bagur, founder of CircularX, discussed the Circular Economy in the city and how the company is working toward implementing circularity in retail businesses across all product families. Finally, Dr. Giorgos Dimitriou from the Circular Economy Research Center discussed the Circular Economy in society, introducing the SmartShip project as an example of how the circular economy concept covers the different sectors of our economies.

During the workshop, attendees had the opportunity to discuss their views on the transition to a circular economy in society.

2.4 Demonstration in Dissemination Activities

2.4.1 *Newsletter*

In August 2023, the SmartShip project launched its newsletter to communicate and provide project stakeholders with regular updates, insights, and developments related to the SmartShip's framework progress. The goal was to keep stakeholders informed about the latest achievements, research breakthroughs, events, and collaborative efforts within the SmartShip community and inspire them to participate actively in the conversations and initiatives of the project.

The newsletters included a section dedicated to updating the project partners and audience on the project's latest news, such as partnerships. There was also a section dedicated to introducing each consortium partner and their role in the project so the audience could better know the project's organizations and activities. Finally, there was a section dedicated to disseminating the project publications.

2.4.2 *Podcast*

The Smartship project launched its podcast hosted by the Circular Economy Research Center (CERC).

The 1st episode¹ dove deep into maritime transformation with Project Coordinator DANAOS. During this episode, it is possible to discover how the SmartShip project integrates data analytics, decision support, and circular economy principles for a holistic approach to enhancing vessel energy efficiency, reducing fuel consumption, and managing emissions. DANAOS also shared his journey, the objectives and challenges of the project, the collaboration between partners, and the impact and future directions of Smartship.

The 2nd² episode discussed data analytics, circular economy, and use cases with ITML, Harokopio University, and CERC experts. The podcast shared insights on advanced maritime technologies and sustainability, focusing on energy efficiency, emissions management, and circular economy integration for environmental and economic benefits.

¹ <https://youtu.be/VDngxPlejZw?si=N6RvTUGuIDACESIA>

² <https://youtu.be/KcRLEh2Da4E?si=d6UPgKFLimQKzuzK>

The 3rd episode³ discussed Smartship Decision Support and multi-layer optimization module with experts from BlueSoft and integrated Smartship framework, validation, and piloting with experts from Epsilon.

3. Conclusions

- The SmartShip framework was comprehensively demonstrated through several activities, including the final event, user interactions, training sessions, workshops, and other dissemination activities like newsletters and podcasts.
- Direct engagement with end-users, primarily through demonstrations to DANAOS staff, helped refine the system. The feedback received was crucial in making iterative improvements to the system, ensuring it met practical maritime needs.
- Multiple training sessions and workshops were held to educate and involve stakeholders from the maritime industry, enhancing their understanding and ability to utilize the SmartShip framework effectively.
- The project encourages continuing the partnerships formed during its implementation and exploring further collaboration possibilities using the Dynamic Business Models (DBM) framework to enhance growth, sales, and marketing strategies.
- The integration of circular economy principles within the maritime sector presents a significant opportunity for future projects and initiatives, suggesting a broader application and deeper impact.
- Exploring how the SmartShip framework can be adapted and scaled to different maritime operations sizes and types.
- Continuous incorporation of cutting-edge technologies like IoT and advanced analytics to enhance system capabilities.

³ <https://youtu.be/MXF2FtyfDAo?si=uCNIbNr9i-nUj6sT>