Project title	Safe, Efficient and Autonomous: Multimodal Library of European Shortsea and inland Solutions		
Project acronym	SEAMLESS		
Project number	101096923		
Project start date	01/01/2024	**Duration**	48 months

D8.8 - SEAMLESS EXPLOITATION AND IP STRATEGY – FIRST REPORT

Due date	31/12/2024	**Delivery date**	20/01/2025
Work package	WP8		
Responsible Author(s)	Anastasiya Azarko (PNO), Michela Apruzzese (PNO)		
Contributor(s)	All partners		
Reviewer(s)	Tomasz Dowgielewicz (ALICE), Nikos Kougiatsos (TUD), Vassilis Podimatas (NTUA)		
Version	Anastasiya Azarko (PNO)		
Dissemination level	Public		

VERSION AND AMENDMENTS HISTORY

Version	Date	Created by	Changes
0.0	29/07/2024	Michela Apruzzese (PNO)	Table of Content
0.1	12/11/2024	Anastasiya Azarko (PNO)	First version, contents filling
0.2	04/12/2024	Anastasiya Azarko (PNO)	Second version, contents filling with the input from partners
0.3	05/12/2024	Michela Apruzzese (PNO), Anastasiya Azarko (PNO)	Content check and update
0.4	09/12/2024	All partners	Content check, adjustments to the chapters 4 and 5
0.5	11/12/2024	Anastasiya Azarko (PNO)	Completed report for a peer review

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

0.6	19/12/2024	TUD and ALICE	Peer review
0.7	20/12/2024	Anastasiya Azarko (PNO)	Revision and final information insertion
0.8	17/01/2025	Vassilis Podimatas (NTUA)	Final review
1.0	17/01/2025	Anastasiya Azarko (PNO)	Final version

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

EXECUTIVE SUMMARY

The SEAMLESS project aims to revolutionize waterborne freight transport through the integration of autonomous navigation systems, smart ports, and advanced logistics technologies. By leveraging 24/7 autonomous vessel operations, automated port infrastructure, and real-time supply chain visibility, SEAMLESS seeks to enhance efficiency, reduce emissions, and enable a modal shift from road to water transport.

A core focus of SEAMLESS is its exploitation strategy, designed to maximize the impact of project innovations through efficient intellectual property management, commercialization plans, and stakeholder engagement. Closely aligned with various WPs, the strategy ensures seamless collaboration between technological development, evaluation, and dissemination. KERs such as autonomous vessel technologies, automated port interfaces, and evaluation methodologies are integral to achieving the project's long-term objectives. This deliverable highlights the exploitation strategy's role in connecting these results with market needs, regulatory requirements, and sustainability goals, paving the way for their adoption across Europe.

This document is the first in a series of 2 editions during the project. Here the main steps, background and actions related to the Exploitation strategy are reported. The **main results of the Deliverable** are:

- **Exploitation Strategy Framework**: A structured plan for identifying, protecting, and managing KERs with a roadmap for their commercial uptake.
- **Key Exploitable Results**: Identification of 24 KERs, detailing their novelty, users, impacts, and intellectual property considerations.
- **IP Management Guidelines**: Strategies for IP protection, ownership distribution, licensing, and freedom-to-operate analyses.
- **Stakeholder Engagement**: Initial workshops and questionnaires to define exploitation strategies tailored to shipowners, operators, policymakers, and other stakeholders.
- **Risk and Barrier Analysis**: Identification of challenges and mitigation strategies for technological, regulatory, and market risks.
- **Partner Exploitation Plans**: Preliminary individual strategies for partners to leverage SEAMLESS results.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

TABLE OF CONTENTS

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

LIST OF FIGURES

LIST OF TABLES

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

List of Abbreviations

Abbreviation	Meaning
AVSPM	Autonomous Vessel's Smart Port Manager
CAPEX	Capital expenditure
CBA	Cost-Benefit Analysis
DX.X	Deliverable number.number
EMSWe	European Maritime Single Window environment
eFTI	Electronic Freight Transport Information
EU	Europe
FtO	Freedom to Operate
GNC	Guidance, Navigation, and Control Scheme
IAS	Integrated Automation System
ICoSSiuM	Integrated Communication Security Simulator for Maritime Operations
IP	Intellectual Property
IWT	Inland Waterway Transport
IWW	Inland Waterways
KER	Key Exploitable Result
KPIs	Key Performance Indicators
OPEX	Operational expenditure
R&D	Research and development
R&I	Research and innovation
ROC	Remote operation center
SME	Small and Medium Enterprise
SSS	Short Sea Shipping
TRL	Technology Readiness Level
WP	Work Package
USP	Unique Selling Point

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

1 INTRODUCTION

1.1 SEAMLESS OVERVIEW

The SEAMLESS project aims to develop and adapt essential building blocks and enablers to create a fully automated, economically viable, and cost-effective waterborne freight feeder loop service for Short Sea Shipping (SSS) and Inland Waterways Transport (IWT). By integrating autonomous systems, SEAMLESS will ensure safe, resilient, efficient, and environmentally sustainable operations, shifting freight movements from road transport to waterways.

The **Building Blocks** include autonomous cargo shuttles operating 24/7 with human oversight from remote control centres, seamlessly integrating with automated shore-side infrastructure and safely interacting with conventional systems. Additionally, the redesigned logistics system will minimize delays at intermodal nodes by providing real-time visibility into the entire supply chain, optimizing planning and enhancing resilience.

The building blocks of the feeder service will be tested through full-scale demonstrations in real-world scenarios, showcasing the transferability of SEAMLESS solutions across different regions and transport applications in Europe. Novel business models will be developed to minimize investment risks for first movers, while regulatory gaps and challenges related to autonomous vessels will be identified, with recommendations provided to policymakers to support widespread deployment.

SEAMLESS will contribute to achieving the following impact targets:

1. **Increased deployment of climate-neutral fuels and electrification in shipping:** SEAMLESS will evaluate and promote the adoption of zero-emission technologies, such as fuel cells and batteries, for autonomous vessels. This effort is expected to significantly contribute to the deployment of climate-neutral fuels in SSS and IWT.

2. **Improved energy efficiency and reduced fuel consumption of vessels:** By optimizing vessel design, incorporating energy-efficient technologies, and enabling 24/7 autonomous operations, SEAMLESS will contribute to increasing energy efficiency and lowering fuel consumption in autonomous vessels.

3. **Enablement of innovative port infrastructure for zero-emission waterborne transport:** SEAMLESS will develop innovative autonomous port interfaces, including automated mooring and cargo handling systems, which will support zero-emission vessel operations and reduce the carbon footprint of port activities.

4. **Facilitating modal shift to sustainable inland and maritime transport:** SEAMLESS will support the shift from road freight to waterborne transport by providing a seamless, highly automated logistics system that enhances the competitiveness and efficiency of IWT and SSS, ultimately reducing road congestion and environmental impacts.

5. **Strengthened European leadership in autonomous and sustainable shipping:** SEAMLESS will leverage the expertise of its European partners to develop cutting-edge

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

autonomous and green technologies, reinforcing Europe's competitive advantage in the global maritime technology sector.

6. **Support for fully automated shipping and logistics integration:** SEAMLESS will integrate its autonomous vessel operations with a fully digitalized logistics network, enabling real-time data exchange, optimized scheduling, and enhanced resilience of the supply chain. This will provide a blueprint for the broader adoption of fully automated shipping and logistics systems.

7. **Enhanced societal understanding and skills development for autonomous shipping:** SEAMLESS will assess the societal impacts of autonomous technologies and address the emerging skills and competence requirements, ensuring that the workforce is adequately prepared for the transition to autonomous waterborne transport.

8. **Reduction of risks for early adopters of autonomous waterborne technologies:** Through extensive testing and validation in real-world demonstrations, SEAMLESS will lower investment risks for first movers, providing proven business models and regulatory guidance to support the smooth deployment of autonomous waterborne services.

The SEAMLESS consortium comprises 26 organizations and 6 affiliated entities from 12 EU countries, including technology providers, research institutions, port authorities, logistics operators, and end-users. This diverse partnership brings together world-class expertise in autonomous systems, green technologies, logistics management, and regulatory frameworks to drive the development and adoption of fully automated, economically viable, and environmentally sustainable waterborne transport solutions. The consortium will receive support from innovation experts (PNO) to effectively tackle market and innovation challenges while incorporating an external perspective through a comprehensive exploitation strategy and stakeholder engagement.

1.2 PURPOSE OF THE DELIVERABLE

The purpose of **Deliverable D8.8: SEAMLESS Exploitation and IP Strategy** is to outline the comprehensive plan for exploiting the project's key results, ensuring the successful commercial uptake and long-term sustainability of SEAMLESS innovations. This document represents the first deliverable of the exploitation and intellectual property strategy, providing a foundation for guiding the successful commercialization and long-term use of SEAMLESS innovations. It outlines a comprehensive framework for managing key exploitable results (KERs), intellectual property, and stakeholder engagement, ensuring alignment with market demands and project goals. The strategy presented in this deliverable will serve as a roadmap for project partners, ensuring that the innovative results generated by SEAMLESS are leveraged effectively in both the short and long term, minimizing risks and maximizing market readiness.

The chapters of this deliverable are structured as follows:

- **Chapter 2** introduces the overall approach to exploitation and innovation management within SEAMLESS, detailing activities performed and next steps.
- **Chapter 3** explores the exploitation strategy and key results (KERs) identified, highlighting their alignment with the project's state-of-the-art technologies and market opportunities.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

- **Chapter 4** focuses on the individual exploitation plans of SEAMLESS partners, illustrating their specific contributions and strategies.
- **Chapter 5** concludes the document with an overview of progress made and planned future actions

1.3 INTENDED AUDIENCE

The intended audience for this deliverable includes multiple stakeholder groups with interest in the successful deployment and commercialization of SEAMLESS technologies. These include **project partners**, who will use this strategy to guide the management and exploitation of intellectual property generated during the project; **technology providers** and **SMEs**, who will leverage the IP and business strategies to commercialize their innovations; and **logistics service providers** and **port operators**, who stand to benefit from the deployment of autonomous waterborne freight solutions. Additionally, **policy makers** and **regulatory bodies** are key stakeholders, as the deliverable outlines the policy and regulatory frameworks that can facilitate the adoption of autonomous shipping technologies in Europe. **Investors** and **venture capitalists** may also use this strategy to assess the commercial viability and scalability of the solutions developed within SEAMLESS.

1.4 STRUCTURE OF THE DELIVERABLE AND ITS RELATIONSHIP WITH OTHER WORK PACKAGES

Deliverable D8.8 plays a crucial role in the overall exploitation of results within the SEAMLESS project by ensuring the innovations and outcomes are efficiently brought to the market and that IP is managed effectively. This deliverable is closely linked to several other WPs within the project:

- **WP2 (System Design and Requirements Definition)**: D8.8 relies on the outputs of WP2, where the system design and requirements for the SEAMLESS building blocks are defined.
- **WP6 (Evaluating Impact and Developing Sustainability-Driven Business Models)**: WP6 provides crucial inputs for the Task 8.3, as it evaluates the technical, financial, and societal impacts of SEAMLESS technologies.
- **WP7 (Demonstrator and Validation Campaign)**: The full-scale demonstrations and validation activities to be carried out in WP7 will generate valuable data on the performance of SEAMLESS technologies. Later in the project, these results will be incorporated into the exploitation and IP strategy, helping to validate the market readiness and potential scalability of the technologies.
- **WP8 (Dissemination, Communication, and Exploitation)**: D8.8 is central to WP8, which is focused on high-impact dissemination, communication, and exploitation. The deliverable ensures that the project's innovations are protected through appropriate IP management and that the exploitation strategy aligns with the broader communication efforts of WP8, maximizing the impact of SEAMLESS results across Europe.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

2 EXPLOITATION AND INNOVATION MANAGEMENT APPROACH IN SEAMLESS

The Exploitation can be considered as “the utilisation of results in further developing, creating and marketing a product or process, or in creating and providing a service, or in standardisation activities”.

The primary goal of exploitation is to leverage project outcomes through scientific, economic, political, or societal channels, with the overarching aim of translating research and innovation (R&I) initiatives into tangible value and impact for society. This involves the practical application of research results, extending beyond mere commercial use. The intended recipients of these efforts include not only the project partners but also external user groups that actively incorporate the project results into their own activities.

Each product, whether it’s a tangible item, service, patent, or other, corresponds to specific outcomes of the project and may play a key role in a particular exploitation strategy for utilizing or benefiting from the project. By thoughtfully examining the potential products arising from a project and formulating a comprehensive exploitation plan, innovators can guarantee that their efforts yield substantial real-world impact. The process of exploitation is indispensable for translating inventive ideas into tangible, meaningful results.

A “Result” is defined by the European Commission as “*any tangible or intangible output of the action, such as data, knowledge and information whatever their form or nature, whether or not they can be protected*”. In the context of EU funded projects, **Key Exploitable Results (KERs) are those outputs generated during the project duration which can be used and can create impact, either by the project partners or by other stakeholders**. The project results can be reusable and exploitable (e.g., inventions, prototypes, services) as such, or elements (e.g., knowledge, technology, processes, networks) that have the potential to contribute to further work on research or innovation.

The workflow for developing the Exploitation strategy (Figure 1) consists of two main components: (i) Key Exploitable Results and IPR Management, and (ii) Innovation Management, focusing on innovation elements and market analysis.

Firstly, after identifying the KER list, the process begins with the analysis of KERs, which involves identifying developers, markets, and users for the exploitable results. This is followed by the creation of exploitation plans and the management of intellectual property rights, addressing ownership and strategies for leveraging these results effectively. The next step involves assembly discussions, where collective explanations, validations, and planning are carried out. If new information arises from these discussions, the KER descriptions and exploitation strategies are updated. If no new information is identified, the process advances directly to the finalization of the exploitation strategy.

The second component addresses innovation management by examining the state of the art and current trends. This involves conducting patent analyses, evaluating R&D projects and private investments, and performing PESTLE and SWOT analyses to define key innovations of interest. The next stage focuses on identifying the value-added elements of the KERs, which includes

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

understanding user perspectives through interviews with practitioners and identifying market players and leaders to gather insights about best practices and competitive positioning. The findings from this stage feed back into the KER identification process to refine and optimize the exploitation strategy based on innovation insights.

Both components of the workflow are interconnected and iterative, ensuring that new information and innovation inputs continuously inform the strategy. This comprehensive process ultimately leads to the development of a cohesive and robust Final Exploitation Strategy.

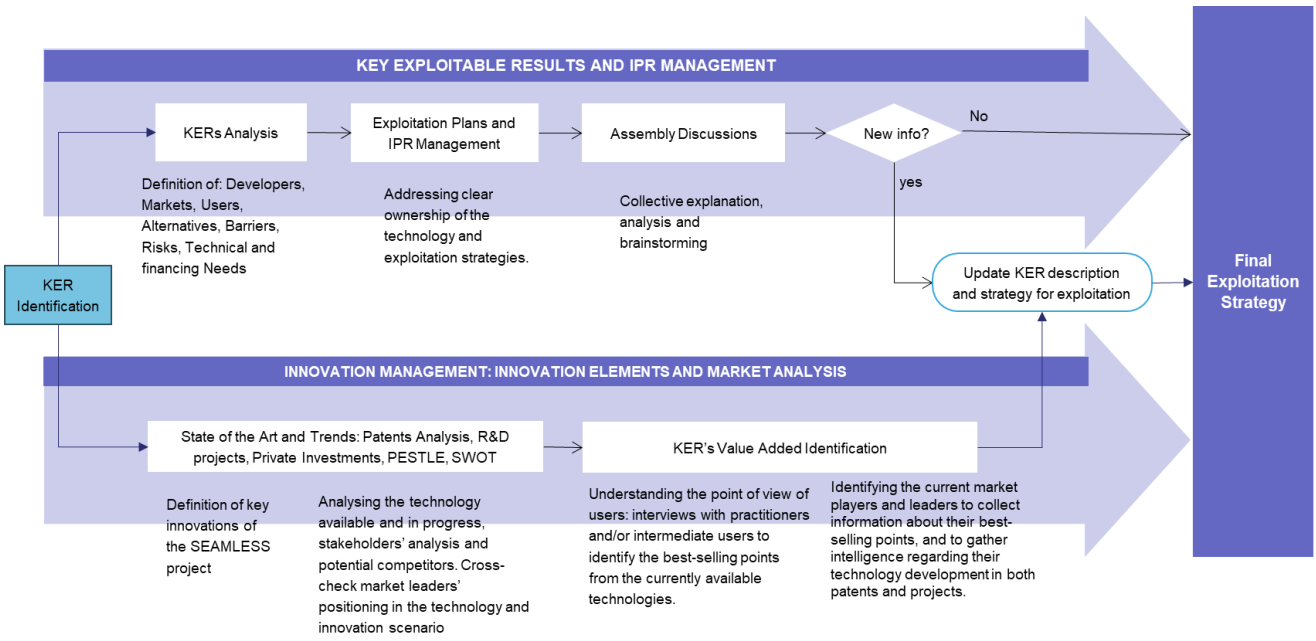

Figure 1 SEAMLESS Exploitation strategy workflow

2.1 PERFORMED ACTIVITIES AND NEXT STEPS

The KERs of the project and their ownership management will be iteratively analysed by workshops and face to face interviews with specific partners groups/teams.

A first "IP and Exploitation Workshop" was run by PNO in October 2024, online. The main objective was to give the partners the key elements to define their KERs and start analysing the key aspects and its elaborated results are described in the next Chapter, consisting in SEAMLESS's Key Exploitable Results analysis.

The work will move forward iteratively, until the result is complete enough. PNO will act as a facilitator and reference point.

To complete the analysis, in the following chapters, based on the input from partners harvested by PNO withing Excel (Annex 1), each KER will be analysed according to specific elements:

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

General Description of the Exploitable Result
Each KER is explained and clearly defined in terms of its main characteristics, novelty, USPs and explaining if a direct or indirect use is foreseen (Table 2).
Users of the results & expected impact
The key potential users/customers type is defined, their needs, expected impact on users and update strategy. This element will be then used as a starting point in the Market Analysis and business plan deliverable.
Risks abd Barriers
Analysis of barriers and acceptance criteria to be addressed or considered to correctly develop the KER and mitigation strategy.
Intellectual Property Rights
Analysis of FtO inside and outside the consortium, in order to set-up the correct access rights (Table 3) and joint agreements, where necessary.

The next phase in the exploitation process will include hosting at least one Exploitation workshop, designed to help partners collaboratively define roadmaps for exploitation and market deployment. These roadmaps will explore pathways for direct exploitation by the consortium, opportunities for technology transfer, and indirect exploitation through dissemination and training activities. The workshop will also involve an in-depth assessment of the developed Intellectual Property Rights and KERs, including the creation of an ownership map. Furthermore, it will serve as a forum to identify and discuss exploitation opportunities, both during the project and after its conclusion, with a focus on leveraging existing results and integrating any new outcomes. Available funding options and potential follow-up initiatives or projects will also be examined to ensure long-term impact and scalability.

The approach offers flexibility, allowing the format to adapt to the project's progress and the needs of its partners. Smaller, targeted face-to-face workshops between PNO and specific partners may be organized as an alternative to consortium-wide sessions, providing a more focused and tailored engagement.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

3 SEAMLESS EXPLOITATION STRATEGY

SEAMLESS offers a comprehensive solution to transform waterborne freight transport through the integration of autonomous navigation, smart ports, and digital logistics technologies. The project aims to significantly enhance the efficiency, cost-effectiveness, and environmental sustainability of SSS and IWT. SEAMLESS delivers a value proposition that:

- **Enhances Logistics Efficiency**: By employing autonomous cargo vessels operating 24/7, and supported by remote operation centres, SEAMLESS provides a fully integrated logistics service that reduces delays at intermodal nodes and optimizes freight flows across the supply chain through real-time visibility and adaptive planning.
- **Supports Green Operations**: SEAMLESS promotes zero-emission transport solutions, minimizing the environmental impact of freight transport while contributing to the decarbonization of the maritime sector in line with EU policy goals.
- **Increases Competitiveness and Scalability**: Through cost-benefit analyses and demonstration projects, SEAMLESS de-risks the adoption of autonomous technologies for first movers, enhancing market confidence and enabling scalability across various European regions.
- **Improves Regulatory Frameworks**: SEAMLESS works closely with policymakers to address legal and regulatory challenges, paving the way for the smooth deployment of autonomous vessels by providing guidelines and recommendations for necessary updates to regulatory frameworks.

The SEAMLESS project aims to serve a broad range of stakeholders across the maritime and inland waterway transport sectors. Key target customers include:

1. **Shipowners and Operators**: These are the primary users of the SEAMLESS autonomous vessel technologies and services, who will benefit from the operational efficiencies and cost reductions associated with automated freight transport.
2. **Port Authorities and Terminal Operators**: As SEAMLESS integrates autonomous vessel operations with automated port infrastructure, port authorities and terminal operators stand to gain from the streamlined operations, improved cargo handling, and reduced turnaround times at ports.
3. **Logistics Service Providers**: LSPs will benefit from enhanced supply chain efficiency and resilience, with the ability to track and manage cargo flows seamlessly between waterborne and land-based transport modes.
4. **Technology Providers and Integrators**: Companies developing autonomous navigation systems, digital twin platforms, and automation solutions for port operations are key partners in implementing SEAMLESS's innovative technologies.
5. **Policy Makers and Regulatory Bodies**: As SEAMLESS seeks to influence the legal and regulatory frameworks for autonomous vessel operations, policymakers and regulatory

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

bodies are important stakeholders in ensuring compliance and promoting widespread adoption of the technologies.

6. **Investors and Financial Institutions**: SEAMLESS will present business models designed to minimize investment risks, making the project attractive to early investors and financial institutions looking to support the adoption of cutting-edge autonomous shipping technologies.

At this stage of the project, **24 KERs** have been identified including: Product, Services, Data and Knowhow and other: the emphasis is placed on outlining the Novel Solution, along with an initial understanding of user categories and intellectual property considerations. However, because some Use Cases and technologies are already under development while others are just starting or remain unclear due to being at very different stages, it is not possible to provide full and equally detailed information for each KER and partner. Further in-depth analysis will be incorporated in the subsequent edition of this deliverable.

The SEAMLESS KERs align strongly with EU policies and the European Green Deal objectives. By fostering automation, efficiency, and sustainability in maritime transport, the project contributes to the **Fit for 55** package's goals of reducing greenhouse gas emissions by 55% by 2030. SEAMLESS also supports the **TEN-T** initiative by enhancing the multimodal transport network, improving connectivity between inland waterways and short sea shipping. Furthermore, the project's focus on zero-emission technologies, such as autonomous and electrified vessels, directly addresses the **European Green Deal's ambition** to achieve climate neutrality by 2050. This alignment ensures that SEAMLESS innovations are not only technologically advanced but also policy-relevant and impactful for sustainable development in Europe.

3.1 KERs LINKED TO STATE-OF-THE-ART ANALYSIS

3.1.1 KER1.1 UC areas analysis: current processes and stakeholders' mapping

Lead: ISL & DST

The KER1.1 provides a comprehensive overview of the existing landscape for each Use Case. It includes a detailed analysis of various critical aspects, such as general logistics market conditions, the processes involved, the key stakeholders, cargo types and flows, information flows, and the IT systems in use. Additionally, it examines vessel operational characteristics, the interconnections between waterborne transport and the hinterland, and the regional degree of inland waterway exploitation.

This analysis is applicable to both further research and industrial use, making it a versatile resource.

The **exploitable route** from this result includes not only the generation of new knowledge but also the strengthening of networks. The primary routes for exploitation are through further research and cooperation agreements.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

3.1.1.1 Users of the Results & Expected Impact

The **potential users** of this analysis are varied, including **academia, technology providers, and strategic policymakers** such as national ministries and the European Commission. Each group benefits uniquely from the findings.

For academia, this result addresses the **need for real-life use cases of autonomous ships**, which are valuable for teaching and applied research. Moreover, it provides insights into underlying structures such as **system interactions, process flows, and tool involvement**. The availability of a comprehensive dataset allows for **precise evaluation of innovations** and can be adapted with minimal effort for academic purposes. Dissemination strategies for this group include the preparation of publicly accessible materials, such as a slide deck under a Creative Commons license.

Technology providers gain a better understanding of individual process steps within the broader logistics framework. This analysis serves as a valuable **reference for subsequent projects, feasibility assessments, and the development of technologies or concepts**. The result's utility is amplified by its role in fostering communication and collaboration between stakeholders.

Strategic policymakers, including national and EU-level organizations, benefit from an enhanced understanding of suitable use cases and corridors for autonomous shipping in Europe. The analysis offers an **overview of ongoing activities in autonomous shipping, the potential impacts on logistics systems, and insights into adopting initiatives** such as EMSWe and eFTI. This improved understanding is crucial for drafting effective policies and legislation, with dissemination forming the backbone of the uptake strategy.

3.1.1.2 Risks and Barriers

Potential risk and barrier to exploitation is that the findings may become outdated over time. To mitigate this, an update is planned at the project's conclusion, if necessary. Another risk lies in the possibility of overestimating stakeholder needs which means assuming stakeholders require more than they actually do. This can lead to inefficiencies, wasted resources, and misaligned solutions.. This will be addressed by maintaining close relationships with stakeholders to continuously validate their requirements and ensure relevance.

3.1.1.3 Intellectual Property Rights Analysis

Background IPR

Title: UC areas analysis: current processes and stakeholders' mapping
Description: Work completed in Tasks 2.1, 2.3, and 2.4
IPR Owners: AWAKE, DST, FTTE, ISL, KMFI, KMNO, MCGFI, PNO, POAB, POB, PODU, SO, TIC4.0, VNF, VPF, ZULU
Subject Matter: Know-how and other data

Foreground IPR

Title: SEAMLESS UC analysis: current processes and stakeholders' mapping
Description: Work completed in Tasks 2.1, 2.3, and 2.4

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

IPR Owners: AWAKE, DST, FTTE, ISL, KMFI, KMNO, MCGFI, PNO, POAB, POB, PODU, SO, TIC4.0, VNF, VPF, ZULU
Jointly Developed: Yes
Country of Establishment of the Owners: Various countries of the EU
Subject Matter: Know-how
Protection Plan: Not applicable
Access Rights: No

3.1.2 KER1.2 Analysis of automated navigation regulatory gaps and challenges

Lead: VNF

The KER provides a comprehensive review of the legal frameworks governing autonomous navigation. This analysis encompasses national regulations for inland waterways, international agreements such as those under the Central Commission for the Navigation of the Rhine (CCNR) and the Danube Commission, as well as European and local regulations. Using comparative law methodology, the task systematically catalogs the current legal landscape relevant to autonomous vessels, SSS, IWT, and hinterland servicing. Furthermore, it identifies and describes the regulatory gaps that must be addressed to enable the broader adoption of autonomous navigation.

The **application area for** this work lies in further research, specifically in developing standards, new legislation, and policy briefs.

As an **exploitable result**, it primarily contributes to the domain of knowledge.

3.1.2.1 Users of the Results & Expected Impact

The **primary users** of this analysis include **regulatory bodies and legal scholars**.

For regulatory bodies, such as CCNR, IMO, EMSA, and flag states, this work serves as an essential input for comparative regulatory analyses. It allows for a **better understanding of the differences between international, national, and local regulations pertaining to inland waterways and short sea shipping**. By clarifying these legislative frameworks, the analysis supports efforts to **align autonomous navigation policies across jurisdictions**. To ensure uptake by this user group, the findings will be presented at public conferences, published on the SEAMLESS documentation platform, referenced in non-scientific press, and directly shared with targeted regulatory entities.

For legal scholars, this analysis serves as a **state-of-the-art reference for further research**. By providing a detailed catalog of current regulations and identified gaps, the result enables faster and more precise academic and applied legal research. The impact on this group is further enhanced by publishing the findings in scientific and legal journals, ensuring accessibility to the academic community.

3.1.2.2 Risks and Barriers

The **risks and barriers** are few: insufficient visibility of the analysis, which could limit its recognition and use. To address this, efforts will be made to optimize the web referencing of SEAMLESS materials, including the use of correct keywords and search engine optimization techniques. Another

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

barrier is the complexity and level of detail in the material, which may lead to it being overlooked. To mitigate this, an executive summary will be published to provide a concise and accessible overview of the findings. Finally, there is a risk of the production timeline lagging behind ongoing regulatory developments, such as the evolving MASS Code. To counter this, updates to the analysis will be carried out until the project's conclusion, ensuring its relevance and currency.

3.1.2.3 Intellectual Property Rights Analysis

No IPR issues have been identified for this KER.

3.2 KERs LINKED TO AUTOMATED PORT INTERFACE (DOCKNLOAD) TECHNOLOGY

3.2.1 KER2.1 Autonomous Cargo Handling module

Lead: MCGSWE

The Autonomous Cargo Handling module represents a groundbreaking innovation within the SEAMLESS project. This novel module centres on the development of an autonomous triple joint crane, designed for versatile application either onboard a vessel or port-side, depending on the cargo type and vessel requirements. The system is engineered to offer enhanced stability, significantly reducing sway motions both during the identification of target positions and while handling cargo. This technological advancement caters to industrial and commercial applications while also contributing to further research.

It encompasses multiple **exploitable aspects**, including technology, methodologies, and knowledge, with **routes for exploitation** spanning the initiation of new projects and continued research.

3.2.1.1 Users of the Results & Expected Impact

The **primary users** of this innovative module include **vessel operating owners and other targeted stakeholders anticipated to utilize the results** concretely.

For vessel operating owners, the autonomous cargo handling module addresses critical operational challenges. Specifically, it **supports vessel routes** with frequent stops at ungeared ports or quays often exceeding one stop per day and achieves autonomy during port visits. The module **eliminates the need for port-side lifting equipment**, enabling smaller ports to accommodate reasonably sized vessels. Furthermore, it **reduces dependency on port-side personnel**, offering significant logistical and operational advantages. To ensure successful uptake, the design will be finalized, followed by the construction of a prototype and its validation in a real-world environment.

3.2.1.2 Risks and Barriers

The exploitation of the autonomous cargo handling module faces several **potential risks and barriers**. One critical challenge is the possible resistance from labor unions toward autonomous operations. To address this, vessel operators, rather than the equipment provider, must engage with

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

unions and develop a comprehensive understanding of the operational environment. Another barrier involves variations in legislation across different countries, which could restrict operations. This challenge requires vessel operators to navigate and comply with the specific legal frameworks of each operational region. Safety concerns also pose a risk, particularly in ensuring that operational areas are secure. This will necessitate the integration of fencing or object detection and classification processes into the autonomous operations system. Lastly, the total cost of the solution, including both capital expenditure (CAPEX) and operational expenditure (OPEX), may surpass existing alternatives. To mitigate this, a thorough cost analysis will be conducted to demonstrate the long-term value and efficiency of the system. Additional risks and barriers related to specific stakeholder groups remain to be described in greater detail, along with corresponding mitigation strategies.

3.2.1.3 Intellectual Property Rights Analysis

Background IPR

Title: Jib Crane Control System
Description: Antipendulation and path-planning algorithm developed for jib-type crane kinematics.
IPR Owner(s): MacGregor Sweden AB
Subject Matter: Software

Foreground IPR

Title: Triple Joint Crane (3JC) Control System
Description of Foreground IP: Antipendulation and path-planning algorithm to be developed to comply with new 3JC kinematics.
IPR Owner(s): MacGregor Sweden AB
Jointly Developed: No
Country of Establishment of the Owner(s): Sweden
Subject Matter: Software
Protection Plan: Trade secret / Confidential information
Access Rights: No

3.2.2 KER2.2 Autonomous Mooring Module

Lead: MCGSWE

The Autonomous Mooring Module is a state-of-the-art innovation aimed at enhancing the efficiency and safety of mooring operations for autonomous vessels. Central to this module are the development of a bollard detection algorithm and a real-time trajectory adjustment algorithm, which enable precise and reliable autonomous mooring. This module is versatile, with applications across commercial, industrial, and research domains.

The **exploitable outputs** include advanced knowledge, technology, and methodologies, making it a pivotal tool for the future of autonomous vessel operations.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

The primary **routes for exploitation** involve continued development, integration into new projects, and leveraging for further research initiatives.

3.2.2.1 Users of the Results & Expected Impact

The autonomous mooring module is designed to address the needs of several key stakeholders, including **vessel operating owners, port operators, and shipbuilders/designers**.

For vessel operating owners, the module eliminates the **need for personnel during mooring or winch operations**. It also stabilizes vessel sway caused by passing ships and supports mooring actions during lock passages. These capabilities add significant operational value, **improving safety and making operations more predictable** compared to human performance. The uptake strategy involves developing a design tailored for IWW vessels, followed by the construction of a prototype and validation in real-life scenarios.

Port operators benefit from reduced personnel requirements at the quayside, as well as the elimination of the need to upgrade or modify existing port mooring infrastructure to support autonomous vessels. This results in **minimum infrastructure investment for port operators**, who can also advocate for the technology's adoption due to its low impact on current operations. The technology's potential to require less investment aligns with the ports' strategic goals of promoting automation among vessels.

For shipbuilders and designers, the autonomous mooring module offers a valuable addition to their portfolios. **This solution is designed to be compatible with existing port infrastructure**, would therefore be appealing to vessel operators seeking modular, adaptable technology. The expansion of shipbuilders' portfolios is coupled with identifying initial entry markets and vessels that demonstrate the technology's benefits, enabling them to position the solution effectively.

3.2.2.2 Risks and Barriers

The development and adoption of the autonomous mooring module face **several risks and barriers**:

- Cost Concerns: The total cost of the autonomous mooring setup may exceed that of existing solutions. Mitigation involves optimizing the design to make it cost-competitive while emphasizing its long-term value.
- Mechanical Design Limitations: The current mechanical design is not finalized, which necessitates compact and efficient integration of components like the winch and mooring arm. Continuous refinement is essential to address these challenges.
- Diverse Mooring Scenarios: The system must be capable of handling various mooring venues, such as lock passages and alongside mooring. This requires the software to understand and adapt to multiple mooring locations, ensuring versatility and reliability.

3.2.2.3 Intellectual Property Rights Analysis

Foreground IPR

Title: Bollarding

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Description of Foreground IP: Ability to recognize suitable bollards without predefined positions. The system can also perform path planning and real-time adjustments.
IPR Owner(s): MacGregor Norway AS
Jointly Developed: No
Country of Establishment of the Owner(s): Norway
Subject Matter: Software
Protection Plan: Trade secret / Confidential information
Access Rights: No

3.2.3 KER2.3 Automated Stowage Planning System

Lead: MCGSWE

The Automated Stowage Planning System is an advanced container planning software designed for multiport operations. It offers the capability to manage transshipment calls and generate alternative stowage plans in response to last-minute changes, ensuring flexibility and efficiency in dynamic shipping environments. This software is integrated with other supply chain logistics platforms, facilitating seamless information exchange across the logistics ecosystem.

Its primary **application areas** are in commercial and industrial contexts, with the exploitable outcomes categorized as both technology and methods. The system's commercial potential lies in its capacity for direct commercialization and incorporation into new projects.

3.2.3.1 Users of the Results & Expected Impact

The Automated Stowage Planning System targets several user groups, each deriving distinct value from its capabilities. For vessel operating owners, the software **eliminates the need for manual stowage planning and terminal information exchange, streamlining operations onboard**. This allows the first officer to focus on more critical responsibilities, while a single stowage planner can efficiently manage multiple vessels. The uptake strategy involves testing the software in collaboration with vessel operating owners to refine its practical application and validate its benefits.

Terminal operators benefit from predefined discharging and loading sequences, which are transmitted directly from the vessel cargo operation planning (VCOP) system to the terminal operating system (TOS). This integration **ensures that cargo bookings and stowage plans are accepted and synchronized with terminal operations**. The uptake strategy for this group includes establishing robust connections to TOS systems to facilitate seamless data exchange.

A broader target group of stakeholders is anticipated to make direct use of the results, although their specific needs, impacts, and strategies for adoption require further detailing.

3.2.3.2 Risks and Barriers

The successful exploitation of the Automated Stowage Planning System faces several **risks and barriers**:

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

- Integration Challenges: The system may encounter difficulties in connecting to vessel operators' operating systems or TOS. To mitigate this, REST API connections will be deployed at the earliest stages of development to allow for thorough integration testing.
- Unspecified Barriers: Additional risks or barriers related to specific user groups remain to be identified and addressed through tailored mitigation strategies.

3.2.3.3 Intellectual Property Rights Analysis

Background IPR

Title: VCOP software created within AEGIS project
Description: [Description of the Background IPR linked to the result]
IPR Owner(s): MacGregor Finland Oy
Subject Matter: Software

Foreground IPR

Title: Transshipment and Restowage Algorithm
Description of Foreground IP: Enables the inclusion of multiple vessels in a single container voyage within the platform. It also facilitates the creation of new stowage scenarios in case of last-minute changes.
IPR Owner(s): MacGregor Finland Oy
Jointly Developed: Yes, with Kalmar Finland Oy
Country of Establishment of the Owner(s): Finland
Subject Matter: Software
Protection Plan: Trade secret / Confidential information
Access Rights: no

3.2.4 KER 2.4 Autonomous Vessels' Smart Port Manager (AVSPM)

Lead: AWAKE.AI

The Autonomous Vessel's Smart Port Manager (AVSPM) introduces a groundbreaking solution for managing information exchange between remotely controlled or autonomous inland barges, their remote operation centres (ROCs) and port-side systems. This system enables seamless communication via APIs, covering the initiation and conclusion of port calls and their execution. Key information, such as vessel position, route, weather, and traffic conditions, is exchanged to ensure optimal coordination between all parties. One key aspect is for the port side to know that inland smart vessel is in nominal controls of its operations and safe state is hold.

Designed for commercial application, this result focuses on technological advancement and can be exploited through commercialization and patenting.

3.2.4.1 Users of the Results & Expected Impact

The Autonomous Vessel's Smart Port Manager primarily **targets medium to large maritime ports**.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

These ports require the ability to accommodate remotely controlled and autonomous inland barges, as well as later extending this capacity to onshore and eventually ocean-going vessels. By integrating the AVSPM, ports **can position themselves as attractive hubs for modern shipping lines that increasingly utilize remote-controlled and autonomous vessels**. The expected impact is significant, enhancing the port's competitiveness and appeal in the evolving maritime sector.

To ensure the result's adoption, **targeted demonstrations will be conducted**, and tailored sales packages will be prepared for pioneering maritime ports actively developing new digital services. This approach not only highlights the AVSPM's capabilities but also aligns with the forward-looking strategies of these ports.

3.2.4.2 Risks and Barriers

Several **risks and barriers** could hinder the successful exploitation of the AVSPM:

- Extended Development Timeline: The development of robust, mission-critical software may take several years, potentially extending to a decade.
    - Mitigation Strategy: A realistic roadmap for software development will be established, supported by diversified funding sources to sustain progress. Partnerships with stakeholders for prototyping will also be prioritized.
- Legislative Challenges: Adopting this technology requires legislative changes, especially when port operations involve crossing national borders.
    - Mitigation Strategy: Collaborations with large ports to influence national legislation and engagements with international maritime organizations to advocate for the safety and functionality of the software will be pursued.
- Human Behaviour and Cultural Shift: Resistance from stakeholders accustomed to traditional port operations may slow adoption.
    - Mitigation Strategy: A thorough understanding of human behaviour and perceptions will inform robust messaging to communicate the benefits and necessity of adapting to the evolving maritime landscape.

3.2.4.3 Intellectual Property Rights Analysis

Background IPR

Title: Awake.AI Cloud Platform for Maritime Planning and Operations Digitalisation
Description: Extensive, modern, and scalable cloud platform for planning, optimizing, executing, and analyzing maritime sea and port operations.
IPR Owner(s): Awake.AI
Subject Matter: Software, Know-How

Foreground IPR

Title: AVSPM Software & Key System Two-Way Messaging
Description of Foreground IP: Autonomous Vessel Smart Port Manager (AVSPM) cloud and web software solution, particularly focusing on communication interfaces and messaging between key systems.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

IPR Owner(s): Awake.AI
Jointly Developed: No
Country of Establishment of the Owner(s): Finland
Subject Matter: Software
Protection Plan: Patent
Access Rights: No

3.3 KERs linked to Modular Vessel and Operations Concepts

3.3.1 KER3.1 Rapid Prototyping Tool (SIMPACT)

Lead: SO

The Rapid Prototyping Tool (SIMPACT) is a software solution designed to evaluate vessel and transport system concepts in terms of cost, emissions, and logistical KPIs. By enabling comprehensive assessments, SIMPACT supports research and decision-making processes in the maritime and transport sectors.

The tool is primarily intended for further research applications, delivering valuable insights into the performance implications of design choices.

The **exploitable outcomes** of SIMPACT include knowledge and methods, making it a key resource for evaluating innovative concepts.

3.3.1.1 Users of the Results & Expected Impact

The **primary users of SIMPACT span both scientific and commercial domains**, addressing distinct needs and generating significant impacts.

For scientific users, SIMPACT fulfills the **need to understand how ship and transport system design choices influence performance.** It provides a **robust framework for evaluating case studies**, offering improved methodologies for research and academic exploration. The uptake strategy involves integrating SIMPACT into research proposals, ensuring its use as a foundational tool for analyzing innovative transport concepts.

For commercial users, the software **supports the evaluation of concrete cases**, particularly as part of investment decision-making processes. By offering decision-makers enhanced tools for assessing the financial and environmental implications of their investments, SIMPACT **improves decision-making accuracy and efficiency**. Its commercial adoption is promoted through targeted projects and non-scientific presentations. Notably, SIMPACT has already demonstrated its utility in the AEGIS project, where it contributed to NCL's investment decisions based on detailed studies using the tool.

Other target groups expected to make practical use of SIMPACT will benefit from tailored adoption strategies, which require further elaboration based on specific stakeholder needs and operational contexts.

3.3.1.2 Risks and Barriers

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Despite its potential, the exploitation of SIMPACT is not without challenges:

- Funding Challenges: A primary risk is the difficulty of securing funding for new projects that utilize SIMPACT.
    - Mitigation Strategy: Disseminating and publishing methods and case studies using SIMPACT will establish it as a credible and effective tool for case evaluation, thereby enhancing its visibility and appeal to funding bodies.
- Additional risks and barriers specific to other target groups or operational scenarios may emerge and will require tailored mitigation strategies as they are identified.

3.3.1.3 Intellectual Property Rights Analysis

Background IPR

Title: SIMPACT
Description: Software for evaluating ship and transport system concepts in terms of cost, emissions, and logistical KPIs.
IPR Owner(s): SO
Subject Matter: Software, Know-How

Foreground IPR

Title: SIMPACT
Description of Foreground IP: Paper publishing method, expansion of functionality: support for Battery container as energy supply (update to vessel machinery type, added battery container model to enable evaluation of battery container logistics, such as tracking battery container state of charge both on vessel and on land while charging - does the vessel need to wait for the the container being charged or not. Updated location models for charging battery containers, and for cold ironing. Updated vessel battery consumption logic such that consumption is from location, not battery, during cold ironing).
IPR Owner(s): SO
Jointly Developed: No
Country of Establishment of the Owner(s): Norway
Subject Matter: Software, Scientific Article
Protection Plan: To be determined or specified
Access Rights: No

3.3.2 KER 3.2 Green Power Plant Evaluation for Ship Propulsion

Lead: ESI

The *Green Power Plant Evaluation for Ship Propulsion* provides a comprehensive assessment of green power plant technologies, including battery-powered systems and hydrogen fuel cells, to support the transition to zero-emission ships. This evaluation aims to identify and promote sustainable propulsion solutions tailored to specific ship types and operational requirements.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

The result applies to both commercial and research domains, offering valuable knowledge and methodological approaches.

Key exploitation routes include cooperation agreements, commercialization, and the initiation of new projects.

3.3.2.1 Users of the Results & Expected Impact

The **primary users of this result are shipyards, design offices, and shipowners**, who are seeking innovative solutions for greening ship power plants. The evaluation directly addresses their **need for sustainable propulsion technologies**, such as batteries and hydrogen fuel cells, capable of reducing emissions and enhancing sustainability.

By adopting these technologies, users can **achieve zero-emission ships**, which align with emerging environmental regulations and market demands. This shift not only positions these stakeholders as leaders in sustainable shipping but also fosters industry-wide innovation. To ensure effective uptake, strategies include forming industry partnerships, fostering R&D collaboration, and driving consumer awareness and education about the advantages of green propulsion systems.

3.3.2.2 Risks and Barriers

Several risks and barriers could impact the exploitation of green power plant technologies:

1. Technology Readiness Levels (TRLs): The readiness of green technologies varies. Battery-powered systems are already being deployed for small and coastal ships, where the technology is well-established. However, hydrogen fuel cells are at TRLs 6-8, requiring further development and assessment, particularly for large ocean-going ships.
    - Mitigation Strategy: The evaluation will include a detailed assessment of power plant requirements for different ship types, recommending viable solutions based on their TRL. Hybrid solutions, such as internal combustion engine (ICE)-fuel cell combinations and combined cycle power plants, will also be evaluated.
2. Regulatory and Government Incentives: The lack of financial or policy incentives may slow the adoption of green technologies.
    - Mitigation Strategy: Proposals will be developed for relevant authorities to introduce financial incentives for manufacturers and consumers, reducing cost barriers. Additionally, stricter emissions regulations will be advocated to encourage investment in green technologies.
3. Cost Comparisons with Conventional Solutions: The CAPEX and OPEX of green technologies may initially appear higher than conventional ICE power plants.
    - Mitigation Strategy: A lifecycle cost analysis will be conducted, showcasing the advantages of green solutions, including fuel efficiency, reduced emissions, and long-term cost savings. This will also account for the continued development and improvement of green technologies.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

3.3.2.3 Intellectual Property Rights Analysis

Background IPR

Title: ESI Method for assessment of power plants for ships
Description: Method and know-how for the assessment of alternate (green) power plants for ships.
IPR Owner(s): ESI
Subject Matter: Know-How

Foreground IPR

Title: Green Propulsion Technologies
Description of Foreground IP: Assessment of green propulsion technologies.
IPR Owner(s): ESI
Jointly Developed: No
Country of Establishment of the Owner(s): Cyprus
Subject Matter: Know-How
Control of Third Owners' Software, Hardware, or IP Control: Commercial Software
Protection Plan: Not applicable
Access Rights: No

3.3.3 KER 3.3 SEAMLESS Ship Design Approach

Lead: NTUA

The *SEAMLESS Ship Design Approach* introduces a novel methodology developed by NTUA to design concept vessels tailored to the SEAMLESS use cases. This methodology will be instrumental in producing ship designs optimized for simulation purposes within the project. By addressing specific operational requirements, such as geographical limitations, capacity, autonomy levels, engine configuration, and mooring arrangements, the approach generates a family of conceptual hull designs suitable for varied scenarios. Its **exploitation area** lies predominantly in further research, with potential for commercialization and integration into education and training initiatives.

3.3.3.1 Users of the Results & Expected Impact

The *SEAMLESS Ship Design Approach* is designed for **academic and professional stakeholders**, offering distinct benefits. For academia, this methodology addresses the **need for a streamlined process to develop ship design concepts for simulation purposes**. By significantly reducing the time required to produce these designs, it enables researchers and educators to focus on refining and analyzing vessel performance. The methodology will be incorporated into academic courses and offered in EU-funded research proposals, enhancing its integration into the academic ecosystem.

Other targeted user groups, anticipated to benefit from the methodology, require further specification of their needs, impacts, and strategies to ensure successful adoption.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

3.3.3.2 Risks and Barriers

The **primary challenge** to the exploitation of the *SEAMLESS Ship Design Approach* is insufficient or limited funding, which may hinder its development and dissemination. Mitigation Strategy is that NTUA will maximize dissemination efforts by participating in conferences and publishing findings in academic and industry journals. This will enhance the methodology's visibility and attract funding for further research and development. Additional risks or barriers may arise for specific user groups or operational scenarios, necessitating tailored mitigation strategies as the methodology evolves.

3.3.3.3 Intellectual Property Rights Analysis

Foreground IPR

Title: SEAMLESS Ship Design Approach
Description of Foreground IP: The methodology will consider a series of operational requirements such as the use case area (incl. potential geographical limitations), capacity, autonomy level, main engine configuration, and mooring arrangements. It will be capable of producing a family of conceptual hulls which will be capable of being used for simulation purposes.
IPR Owner(s): NTUA
Jointly Developed: No
Country of Establishment of the Owner(s): Greece
Subject Matter: Invention (e.g., device, process, method), Know-How
Control of Third Owners' Software, Hardware, or IP Control: Commercial Software (Use of commercial software packages like AVEVA Marine and/or NAPA)
Protection Plan: Not applicable
Access Rights: No

3.3.4 KER 3.4 Guidance, Navigation and Control (GNC) Scheme

Lead: TUD

The *Guidance, Navigation, and Control (GNC) Scheme* provides a cutting-edge framework for ensuring the safe interaction of autonomous SSS and IWW vessels with conventional, manned vessels. The GNC scheme integrates regulation-aware collision avoidance mechanisms, aligned with established standards such as COLREGS, BPR, and CCNR. Additionally, fault-tolerant control capabilities ensure operational safety, even in scenarios involving malfunctions or system failures. This versatile scheme is applicable for industrial use and further research, supporting the evolution of autonomous maritime operations.

3.3.4.1 Users of the Results & Expected Impact

The KER targets several key user groups, each benefiting uniquely from its innovative solutions. **Autonomous vessel technology providers** can apply the GNC scheme to autonomous SSS and IWW vessels. This modular system ensures safe and seamless operations across diverse environments, enhancing reliability and scalability by enabling robust functionality even during

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

malfunctions. To reach these providers effectively, related research and technological solutions will be disseminated through conference presentations and journal publications.

Vessel operators, both remote and on-site, benefit from the fault-tolerant, regulation-aware, and situation-aware control capabilities that simplify information flow and support critical safety decisions. This improves decision-making processes, enabling one-to-many remote operations and reducing operational complexity. Collaboration with key operators, such as ASKO, Seafar, and Zulu, will tailor the GNC system to their specific needs and demonstrate its value through case studies and pilot programs.

Regulatory bodies, including shipping registries, are another key user group. The GNC scheme features a semantic registry for regulations, facilitating faster and more efficient approval procedures for autonomous vessels. By simplifying compliance processes and ensuring seamless integration of regulatory updates, the scheme offers significant value. Engagement with regulatory authorities, such as the Dutch government's maritime regulatory body, will highlight these benefits and streamline approval workflows.

3.3.4.2 Risks and Barriers

Several risks and barriers may affect the successful exploitation of the GNC scheme:

1. Unforeseen Faulty Events: Not all potential faults, such as sensor errors or cyberattacks, can be addressed without human intervention.
    - Mitigation Strategy: Focus on diagnosing and mitigating the most critical faulty events to minimize impact while prioritizing system reliability.
2. Data Availability: Limited access to real-world sensor or route data (e.g., from ASKO) may hinder validation.
    - Mitigation Strategy: Utilize alternative data sources, such as TUD Tito-Neri (a small-scale test vessel) or other documented test vessels in the literature, to ensure robust testing and validation.

3.3.4.3 Intellectual Property Rights Analysis

Foreground IPR

Title: Guidance, Navigation, and Control (GNC) Scheme
Description of Foreground IP: The GNC scheme will ensure safe interactions of autonomous SSS and IWW vessels with conventional, manned vessels by implementing Regulations-aware (e.g., COLREGS, BPR, CCNR) collision avoidance. Safety will be further ensured by fault-tolerant control capabilities.
IPR Owner(s): TUD
Jointly Developed: No
Country of Establishment of the Owner(s): The Netherlands
Subject Matter: Invention (e.g., device, process, method), Scientific Article
Protection Plan: Copyright

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Access Rights: No

3.3.5 KER3.5 Risk-based Safety Assessment

Lead: NTNU

The *Risk-based Safety Assessment* introduces an innovative methodology aimed at reducing approval efforts and costs for autonomous ship systems. This novel approach employs a systematic and standardized process for describing ship systems and their operational envelopes, which includes intended operational conditions and a defined "capability limit." The methodology integrates a verifiable safety assessment process with quantitative targets while considering humans-in-the-loop interactions. Its application spans commercial and research domains, supporting both the development and validation of cutting-edge autonomous maritime technologies.

3.3.5.1 Users of the Results & Expected Impact

The **primary users** of the KER methodology include **autonomous ship prime contractors, technology vendors, classification societies, approval authorities, and research institutions**.

For **autonomous ship prime contractors and technology vendors**, the methodology addresses the **need for streamlined system validation and approval processes**, particularly for innovative autonomous systems. By reducing the time and effort required for approval, the approach enables faster iteration and testing of autonomous systems in real-world conditions, ultimately shortening development cycles. The uptake strategy involves participation in joint industry projects to validate and refine the methodology in collaboration with key stakeholders.

Parties responsible for approval, such as classification societies and regulatory authorities, benefit from a **systematic and standardized way to describe ship systems and their operational envelopes**. This ensures clarity, reproducibility, and consistency in testing and validation while providing a clear pathway for compliance with emerging regulations. Joint industry projects serve as a primary platform for validation and adoption of the methodology.

For **research institutions**, the methodology facilitates **effective communication and collaboration with industry stakeholders**, such as regulators, shipyards, and technology providers. Adoption of this standardized framework positions research institutions at the forefront of autonomous ship development, attracting partnerships and funding opportunities. Uptake strategies include promoting the methodology's inclusion in publicly funded research projects, publishing findings in high-impact journals, and presenting at key industry conferences.

3.3.5.2 Risks and Barriers

Several **risks and barriers** could impact the successful exploitation of the *Risk-based Safety Assessment* methodology:

1. **Regulatory Challenges**: Regulatory bodies may be slow to endorse or adapt their standards to incorporate novel methodologies.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

- **Mitigation Strategy**: Continuous engagement with regulators to gather feedback, align with their understanding of the problem, and ensure compatibility with existing and emerging standards.

2. **Industry Resistance**: Contractors and developers may be hesitant to adapt their processes to include novel methodologies, potentially delaying adoption.
    - **Mitigation Strategy**: Ongoing engagement with contractors to address their concerns, refine the methodology, and align it with their operational needs.
3. **Research Misalignment**: Divergent views within the research community on suitable methods for safety assessment may hinder widespread adoption.
    - **Mitigation Strategy**: Active participation in conferences and collaborative events to align methodologies and foster consensus across research communities.

3.3.5.3 Intellectual Property Rights Analysis

Foreground IPR

Title: Risk-based Safety Assessment
Description of Foreground IP: The resulting methodology will be fully published in a series of open-access journal publications.
IPR Owner(s): NTNU
Jointly Developed: Yes, with NTNU, SO, KMNO, BV, NTUA, VFN
Country of Establishment of the Owner(s): Norway
Subject Matter: Methodology
Protection Plan: To be defined by NTNU
Access Rights: Yes (the methodology will be openly accessible through publications in peer-reviewed journals, ensuring public availability for academic, research, and professional use without restrictions).

3.3.6 KER 3.6 Sensor Improvement, Technology Development, Kongsberg Integrated Automation System (IAS)

Lead: KMNO

Unmanned and low-manned vessels require advanced "ears and eyes" to ensure safe navigation and operation. This result focuses on developing and improving sensors to enhance situational awareness, compensating for the reduced presence of crew onboard. The Kongsberg Integrated Automation System (IAS) will incorporate these advancements, enabling autonomous or semi-autonomous vessels to operate safely and efficiently in various conditions.

This result applies to commercial maritime operations by supporting automation in shipping and to industrial use by enabling technological upgrades for reduced or unmanned shipbuilding and operations.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

The **exploitable outcomes** include advanced technology, enhanced knowledge, and refined methods for implementing and supporting autonomous maritime operations.

The results will be exploited through patenting and development of Standards and Policy Briefs (supporting regulatory frameworks to ensure safe and widespread use of autonomous technologies).

3.3.6.1 Users of the Results & Expected Impact

The project targets key stakeholders benefiting from autonomous vessel technologies. **Ship designers and builders** must adapt to reduced or no-manning requirements by eliminating crew facilities and integrating advanced sensors. Though initial costs may be high, wider adoption will lower expenses, supported by targeted marketing to showcase the technology's capabilities.

Ship owners and operators can reduce operational costs by minimizing crew needs and optimizing operations. Eliminating crew facilities further cuts costs, with initial high expenses expected to decline as adoption grows. Promotional efforts will highlight these benefits to encourage uptake.

Classification societies and **regulatory authorities** require rigorous testing and validation of technologies to ensure trust and compliance. Transparent evaluations and shared results will build confidence, supporting regulatory approval and industry acceptance.

3.3.6.2 Risks and Barriers

- Cost of New Technology: High initial costs may deter adoption.
    - Mitigation Strategy: Focus on increasing production volume to reduce costs over time.
- Trust in Technology: Concerns about the ability of technology to replace crew functions may limit acceptance.
    - Mitigation Strategy: Conduct extensive concept evaluations and rigorous testing. Proactively involve stakeholders in trials and share test results to build trust and confidence.

3.3.6.3 Intellectual Property Rights Analysis

There are several IP-related topics associated with the systems and sensors, which are relevant to the project's objectives. Given the extensive scope of these assets, detailed information has not yet been included in this analysis. The detailed information on key intellectual property elements, focusing on those that are most critical to achieving the project's goals, will be provided in the next version of the Deliverable.

3.3.7 KER 3.7 Integrated Communication Security Simulator for Maritime Operations (ICoSSiuM)

Lead: IRTSX

The Integrated Communication Security Simulator for Maritime Operations (ICoSSiuM) is a cutting-edge platform designed to raise awareness about cyber threats within the maritime community. It enhances situational awareness by simulating maritime communication systems and the potential cyberattacks they may face. The platform is a critical tool for fostering education, enabling research, and supporting the development of advanced cybersecurity solutions tailored to maritime operations.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

The platform is intended for use in maritime cybersecurity research and educational programs. It provides a realistic environment for testing, training, and raising awareness about communication security in maritime contexts, thereby addressing both industrial and academic needs.

ICoSSiuM is categorized as a technological innovation, offering simulation capabilities to researchers, educators, and training professionals in the maritime domain.

The platform will be utilized primarily for **further research and educational purposes**. It can also be integrated into **academic and professional training programs** to enhance understanding and preparedness for maritime cybersecurity challenges.

3.3.7.1 Users of the Results & Expected Impact

There are two main groups of users that this KER will be addressing: **researchers and teachers and training professionals**.

For researchers, ICoSSiuM addresses the **need for reliable data to support the development of AI-based cybersecurity solutions**. By simulating realistic maritime communication scenarios and cyberattack vectors, it enables researchers to design and validate innovative security methods. This fosters advancements in cybersecurity that can mitigate emerging threats. Dissemination activities, such as publications and presentations at academic conferences, will ensure the platform's capabilities reach a wide audience in the research community.

For teachers and Training Professionals, the platform provides an **educational environment where maritime communication scenarios can be simulated**, along with associated attack scenarios. This enables educators to enhance training programs and raise awareness among students and professionals. By **incorporating ICoSSiuM into "Train the Trainers" programs** and executive education initiatives offered by SystemX Academy and its partners, the platform will play a key role in fostering a cybersecurity-conscious maritime workforce.

3.3.7.2 Risks and Barriers

While the ICoSSiuM platform has significant potential, its adoption may face certain risks and barriers:

- Cost of License: The high cost of licensing the platform could deter adoption, particularly among academic and training institutions with limited budgets.
    - Mitigation Strategy: To overcome this barrier, a freeware version of the platform will be offered to academic partners, encouraging widespread use and fostering collaboration.
- Platform Maturity: A lack of maturity in the platform during its initial stages may limit its effectiveness and applicability.
    - Mitigation Strategy: The platform will undergo continuous development and refinement, incorporating feedback from early adopters to enhance its reliability and utility.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

3.3.7.3 Intellectual Property Rights Analysis

Background IPR

Title: OMNET++, SUMA, and VEINS
Description: Open-Source Network Tools
IPR Owner(s): Open-Source
Subject Matter: Software

Foreground IPR

Title: ICoSSiuM: An Integrated Communication Security Simulator for Maritime Operations
Description of Foreground IP: A cybersecurity simulator specifically designed to demonstrate and evaluate the impact of cyberattacks on maritime communications. The initial version focuses on the AIS (Automatic Identification System) protocol.
IPR Owner(s): IRTSX
Jointly Developed: No
Country of Establishment of the Owner(s): France
Subject Matter: Software
Protection Plan: Copyright
Access Rights: Yes, to be specified

3.3.8 KER 3.8 Reference logistics system architecture (for waterborne logistics using autonomous vessels)

Lead: DST

The Reference Logistics System Architecture for Waterborne Logistics Using Autonomous Vessels introduces a modern framework designed to transform logistics operations in the inland and short sea shipping sectors. This architecture encompasses updated process flows, integrates key actors and stakeholders, and incorporates innovative technologies. It is specifically tailored for operations involving autonomous vessels, promoting efficiency, cost savings, and access to new market opportunities. The architecture serves as a foundation for further research, education, and commercial applications.

The system architecture is **applicable in** further research (supporting innovation and the development of autonomous vessel logistics frameworks), commercial applications (offering practical, state-of-the-art solutions for shipping companies, ports, and terminal operators), education and Training (providing a knowledge base for academic and professional learning initiatives).

This result is categorized as knowledge and methods, delivering actionable insights and frameworks for improving waterborne logistics operations.

The architecture will be used in **further research projects, educational initiatives, and training programs**. It will also support technology development and adoption within commercial logistics systems.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

3.3.8.1 Users of the Results & Expected Impact

The Reference Logistics System Architecture offers significant benefits for **shipping companies, port and terminal operators, and technology providers**, particularly in the context of autonomous vessels.

For shipping companies, the architecture provides a **strategic upgrade**, enabling the development of modern, automated operations that enhance efficiency, reduce OPEX, and unlock new market segments by positioning these companies as leaders in autonomous logistics. Adoption will be encouraged through presentations at national and European conferences and trade fairs.

For port and terminal operators, the architecture **facilitates a transition to state-of-the-art operations, improving efficiency and reducing costs** through automation while enhancing service delivery. Adoption strategies include targeted information events on specific topics, such as remote operations, and leveraging word-of-mouth engagement.

Technology providers can use the architecture to expand their portfolios, creating **solution suites that incorporate multiple innovations**, which **generate follow-up business opportunities, broaden market potential**, and access new customer segments. Collaborative development in future research and development projects will further strengthen uptake and market reach.

3.3.8.2 Risks and Barriers

There are few risks identified for this KER:

- Small Market Size: the IWT and inland ports market size may limit widespread adoption.
    - Mitigation Strategy: Focus on introducing specific assistance functions and individual (semi-) automated features to easily adoptable segments ("reaping the low-hanging fruits").
- High Costs of Change Management: the cost of investments, organizational changes, and new interfaces may deter adoption, especially by consignors.
    - Mitigation Strategy: Adopt a gradual approach, starting with assistance systems and progressively upgrading to (semi-)automated solutions.
- Opposition from Stakeholders: resistance from stakeholders within the IWT ecosystem, such as regulatory bodies or conflicting interests among ports and shippers, may pose challenges.
    - Mitigation Strategy: Actively host and participate in industry roundtables to share insights, results, and experiences. These events will address concerns and foster collaborative engagement, positioning the architecture as a shared industry asset.

3.3.8.3 Intellectual Property Rights Analysis

The IPR framework for this item is currently under discussion, with key aspects such as ownership distribution, licensing terms, and potential commercialization strategies yet to be finalized.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

3.3.9 KER 3.9 Simulation-based logistics analysis model for autonomous vessels

Lead: DST

The Simulation-based Logistics Analysis Model for Autonomous Vessels provides a powerful tool for analyzing the cost and performance effects of vessel transport services using autonomous vessels. By simulating logistics operations, the model enables stakeholders to make informed decisions about adopting and deploying autonomous technologies. It is designed for application in further research, commercial use, and supporting the development of new projects.

The model is suited for further research (supporting innovation in logistics and autonomous vessel operations), commercial applications (providing actionable insights for stakeholders considering the integration of autonomous vessels) and strategic development (facilitating decision-making for the introduction of new services and routes).

This result delivers both methods and knowledge, offering a simulation framework to optimize logistics involving autonomous vessels.

The model will be utilized in **research initiatives, commercial planning, and new project developments**, supporting stakeholders in making evidence-based decisions about adopting autonomous vessel technologies.

3.3.9.1 Users of the Results & Expected Impact

The *Simulation-based Logistics Analysis Model for Autonomous Vessels* offers significant benefits to **shipping companies, consignors, and regulatory bodies**, supporting the adoption and integration of autonomous vessel technologies.

For shipping companies, the model provides **decision support for fleet modernization**, addressing strategic questions such as deploying new services or routes. It delivers recommendations for optimizing transport services, clarity on performance levels, and insights into cost elements, enabling strategic and cost-effective planning. Adoption will be driven through information events, project-specific engagements, and presentations at conferences and trade fairs, with further refinement through collaborative R&D projects.

Consignors gain similar decision-support capabilities, offering clarity on service performance, cost structures, and optimized configurations, enabling them to evaluate the feasibility and benefits of autonomous logistics solutions. Adoption strategies include targeted information events, trade fairs, and involvement in R&D collaborations.

For regulatory bodies, the model facilitates **informed policy-making** by providing insights into the technical and operational implications of autonomous vessel adoption, ensuring alignment with market trends and industry needs. Engagement in regulatory consultations, participation in standardization bodies and roundtables, and the dissemination of findings through white papers will ensure the model's relevance and impact across stakeholders.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

3.3.9.2 Risks and Barriers

While the model holds significant potential, its adoption may face challenges:

- Complexity of Integration: Stakeholders may find it challenging to integrate simulation results into existing decision-making frameworks.
    - Mitigation Strategy: Offer tailored support and training to ensure stakeholders can effectively utilize the model.
- Resistance to Change: Traditional operators and regulators may hesitate to adopt recommendations derived from simulation models.
    - Mitigation Strategy: Organize awareness campaigns and pilot projects to demonstrate the model's reliability and benefits.
- Lack of Real-World Data: Limited access to data on autonomous vessel operations may hinder the model's accuracy.
    - Mitigation Strategy: Collaborate with early adopters and research initiatives to validate and refine the model using real-world data.

3.3.9.3 Intellectual Property Rights Analysis

Background IPR

Title: Internal Tool (tool name not to be disclosed)
Description: A simulation and cost/performance analysis tool for the operation of inland vessels, designed to be expanded for use in scenarios involving varying levels of vessel automation.
IPR Owner(s): DST
Subject Matter: Software, Know-How.

3.4 KERs LINKED TO SUPPLY CHAIN SUPPORT

3.4.1 KER 4.1 ModalNET Platform

Lead: VPF

The *ModalNET Platform* is a cutting-edge digital platform designed to provide a comprehensive macro-level view of logistics chains, encompassing freight flow, transport modes, and connected physical assets. Beyond monitoring, it enables users to perform critical operations such as booking, vessel schedule creation, and exploration of alternative routing options. This solution is tailored for industrial use and serves as a transformative tool for optimizing transport and logistics operations. The exploitation route – commercialisation.

3.4.1.1 Users of the Results & Expected Impact

The ModalNET Platform caters to key users in the logistics and transport industry, including **consignors, freight-forwarders, and shipping lines**, offering tailored benefits for each group.

Consignors can simplify bookings and select optimal routes and vessels through a unified interface, accessing multiple providers for greater flexibility. This streamlines the booking process and

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

improves decision-making with route optimization. Training sessions will demonstrate the platform's core functionalities and benefits.

Freight-forwarders managing complex operations can monitor multiple shipments on a single platform, improving efficiency by centralizing processes and reducing reliance on multiple systems. Training will focus on the platform's monitoring capabilities and alignment with operational needs.

Shipping lines gain increased visibility and bookings by showcasing services to a broad client base. Integration with their internal systems enhances both customer acquisition and operational efficiency. Dedicated training will facilitate system integration and highlight key advantages.

3.4.1.2 Risks and Barriers

The exploitation of the *ModalNET Platform* faces several risks and barriers:

1. Integration Challenges: Successful monitoring and tracking depend on integrating data from various real-world sources.
    - Mitigation Strategy: Establish agreements with data source and platform owners, emphasizing the mutual benefits of integration with ModalNET.
2. Competition from Proprietary Solutions: Large companies may rely on existing proprietary solutions for specific activities, such as booking.
    - Mitigation Strategy: Highlight the advantages of a multi-shipping line platform that offers greater flexibility and alternative transport options.

3.4.1.3 Intellectual Property Rights Analysis

Background IPR:

Title: *DataPorts Platform*
Description: A digital platform providing a macro-level view of freight flows, transport modes, and connected physical assets.
Owner: Fundacion Valenciaport
Subject Matter: Software

Foreground IPR:

Title: *ModalNET Platform*
Description: An enhanced platform with functionalities for booking, vessel scheduling, and alternative route exploration, in addition to monitoring logistics chains.
Owner: Fundacion Valenciaport
Jointly developed: no
Country of establishment of the owner(s): Spain
Subject Matter: Software
Control of Third Owners Software, Hardware or IP: Third Owner Intellectual Property Rights (the Computal Engine is developed by NTUA)

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Protection Plan: Copyright
Access Rights: No

3.4.2 KER 4.2 Computational engine for resilient logistics

Lead: NTUA

The CERL algorithm provides alternative multimodal routes between two points of interest (origin and destination), tailored to specific cargo quantities and characteristics, such as general cargo, refrigerated goods, or dangerous materials.

The CERL algorithm is designed for industrial use, supporting logistics operations and transport planning. The result is categorized as a technology, offering practical solutions for resilient logistics planning. The CERL algorithm is intended for commercialization, enabling logistics operators to optimize their services and enhance operational efficiency.

3.4.2.1 Users of the Results & Expected Impact

The CERL algorithm is designed to address the needs of various user groups, providing tailored solutions and delivering significant benefits. **Transport operators** can utilize the algorithm to report their transport schedules and available cargo capacities, enabling them to fill available space efficiently. By integrating transport schedules with their systems, operators can attract more clients and optimize capacity usage. To support this, training sessions will be organized to present the API for transmitting transport schedules, demonstrating its ease of integration and operational benefits.

Consignors benefit from the ability to book transport through ModalNet, selecting the most suitable route and vessel. This simplifies the booking process by allowing them to interact with different providers on a single platform while offering multiple route options. Training sessions will be held to showcase ModalNet's main functionalities, focusing on addressing consignors' specific needs.

Freight-forwarders, managing multiple transport operations for various clients, can monitor and control these activities through a single platform. This centralized approach improves operational efficiency and streamlines the management of different transport activities. ModalNet's functionalities will be demonstrated in training sessions, emphasizing its utility for freight-forwarders.

Shipping lines can leverage the platform to offer their services to a large and diverse client base, enhancing visibility and attracting more bookings. The integration of bookings with their systems allows shipping lines to improve client acquisition and service utilization. Training sessions will focus on ModalNet's functionalities, tailored to meet the operational needs of shipping lines and encourage widespread adoption.

3.4.2.2 Risks and Barriers

Potential Risks and Barriers:

- Integration of Real Data Sources: The platform requires integration with several real-time data sources to monitor and track transport operations.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

- Mitigation Strategy: Reach agreements with data providers or platform owners, showcasing the benefits of using ModalNet for comprehensive logistics management.

- Competition from Proprietary Solutions: Some large companies already use their own booking solutions.
  - Mitigation Strategy: Highlight the benefits of using a multi-shipping-line platform, providing greater flexibility and alternatives for transport operations.

3.4.2.3 Intellectual Property Rights Analysis

Background IPR

Title: MOSES Logistics Matchmaking Platform
Description: A platform designed to enable modal shift to Short Sea Shipping and provide matchmaking opportunities for container traffic.
IPR Owner(s): NTUA
Subject Matter: Software

Foreground IPR

Title: CERL Algorithm
Description: The algorithm provides alternative multimodal routes between two points of interest (origin and destination) for specific cargo quantities and characteristics (e.g., general cargo, refrigerated goods, dangerous materials).
IPR Owner(s): NTUA
Country of Establishment of the Owner(s): Greece
Subject Matter: Software
Control of Third Owners' Software, Hardware, or IP: The CERL algorithm may rely on Third Owner Intellectual Property Rights, which will be addressed in its deployment.
Protection Plan: Copyright
Access Rights: No

3.5 KERs LINKED TO EVALUATION

3.5.1 KER5.1 KPI Identification and Evaluation Methodology

Lead: NTUA

The *KPI Identification and Evaluation Methodology*, developed by NTUA, provides a systematic approach for identifying and evaluating Key Performance Indicators (KPIs) tailored to specific project needs. The methodology ensures that the selected KPIs are pertinent, measurable, and ideally quantifiable, enabling effective monitoring and assessment of project objectives.

It is designed for **further research applications** and is suitable for integration into **new projects and educational initiatives**.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

3.5.1.1 Users of the Results & Expected Impact

The primary users of the methodology are aca**demic and scientific stakeholders involved in research projects**, as well as other target groups requiring KPI evaluation tools. For the scientific community, the methodology provides a credible, structured approach for identifying and evaluating KPIs, ensuring alignment with project objectives and enabling robust evaluations. This enhances research credibility and outcomes by offering a reliable process for KPI development and assessment. Adoption will be supported by integrating the methodology into EC-funded proposals and academic courses.

Other target groups, anticipated to benefit directly from the methodology, require further specification of their needs and the impact of the results. Measures to promote adoption for these groups will also be tailored as required.

3.5.1.2 Risks and Barriers

The exploitation of the *KPI Identification and Evaluation Methodology* faces potential risks and barriers, primarily related to funding and dissemination:

1. Insufficient or Limited Funding: A lack of resources may hinder the dissemination and adoption of the methodology.
    - Mitigation Strategy: Efforts will focus on maximizing dissemination through participation in conferences, journal publications, and other academic forums to enhance visibility and attract funding.

Additional risks or barriers for other user groups or specific contexts may arise and will require tailored strategies to ensure successful adoption and application.

3.5.1.3 Intellectual Property Rights Analysis

Foreground IPR

Title: KPI Identification and Evaluation Methodology
Description: Methodology for identifying and evaluating KPIs that - depending on the project at stake - are pertinent, measurable, and (ideally) quantifiable. The methodology includes the review of KPIs from past relevant projects, the development of a preliminary KPIs lists, the development of a questionnaire, the development of a consolidated list of KPIs, and finally utilising sorting KPIs-criteria and correlating them with the project's objectives, developing the Final KPIs list.
IPR Owner(s): NTUA
Jointly Developed: No
Country of Establishment of the Owner(s): Greece
Subject Matter: Invention (e.g., device, process, method)
Protection Plan: Not applicable
Access Rights: No

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

3.5.2 KER 5.2 CBA Results

Lead: PNO

The Cost-Benefit Analysis (CBA) results provide a detailed financial and economic evaluation of the SEAMLESS building blocks in the context of the SEAMLESS Use Cases. These results help identify potential business environments where SEAMLESS solutions can be effectively adopted, offering valuable insights for further research and commercial applications.

The CBA results are applicable in further research to validate and refine methodologies and explore additional use cases, and commercial applications to assess and support the adoption of SEAMLESS solutions in real-world business scenarios.

The result is categorized as a method and knowledge. The CBA results provide a **route for exploitation** through their use as a foundation for new research or innovation projects and as a basis for refining methodologies or exploring additional domains.

3.5.2.1 Users of the Results & Expected Impact

The CBA results are designed to address the needs of two primary target groups. **Academic and research institutions** benefit from access to comprehensive financial and economic assessments of SEAMLESS solutions. These assessments are essential for validating methodologies and exploring future innovations. The results provide valuable data for modelling, conducting further research, and contributing to academic publications. To ensure uptake, the findings will be disseminated through academic journals, conferences, and collaborative research initiatives, fostering widespread engagement and application within the research community.

Technology providers and developers gain critical insights into the economic viability of SEAMLESS technologies, supporting their integration into existing and future solutions. These results encourage the adoption and refinement of SEAMLESS technologies to align with market demands. The uptake strategy includes organizing workshops, webinars, and industry-specific presentations, which will promote understanding of the findings and their practical applications, thereby driving technology development and commercialization efforts.

3.5.2.2 Risks and Barriers

- Lack of Engagement from Stakeholders: There is a risk of insufficient involvement from key stakeholders, including policymakers and industry representatives.
    - Mitigation Strategy: Tailored communication strategies and fostering direct interactions with stakeholders can mitigate this risk.
- Limited Access to Reliable Data: Insufficient data for analysis and validation could impact the robustness of the CBA results.
    - Mitigation Strategy: Partnering with data providers and establishing transparent and inclusive data-sharing agreements will address this challenge.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

3.5.2.3 Intellectual Property Rights Analysis

Background IPR

Title: Guidance on Economic Appraisal for CEF Transport Projects
Description: A proven methodology and framework for conducting Cost-Benefit Analysis, developed to evaluate financial, economic, and operational aspects of maritime innovations.
Owner: CINEA
Subject Matter: Invention (e.g., device, process, method).

Foreground IPR

Title: CBA for SEAMLESS Solutions
Description: This enhanced Cost-Benefit Analysis builds upon the foundational framework developed in the EU and previous projects like AUTOSHIP, tailoring it to the specific needs and contexts of SEAMLESS Use Cases.
Owner: PNO
Jointly Developed: No
Country of Establishment: Italy
Subject Matter: Scientific article, know-how.
Protection Plan: Not applicable.
Access Rights: No.

3.5.3 KER 5.3 Business Model

Lead: VPF

The *Business Model* developed under the SEAMLESS project provides a comprehensive framework for identifying marketing opportunities and addressing barriers to the adoption of autonomous transportation technologies. This model outlines essential components, including key partners, activities, resources, customer segments, cost structures, and revenue streams. It is designed to facilitate the implementation of innovative solutions by enabling stakeholders to understand the market dynamics and develop effective strategies for commercialization. Its applications span both **commercial and research** domains.

3.5.3.1 Users of the Results & Expected Impact

The Business Model is designed to cater to diverse users, offering unique benefits to each group.

Transport and logistics companies can use the model to identify market opportunities, develop adoption strategies, and craft value propositions. This enhances competitiveness, optimizes resource allocation, and fosters innovation to meet emerging market trends and customer demands. Adoption will be encouraged through workshops, training sessions, case studies, and best practices. Collaborative efforts among industry stakeholders will further support knowledge sharing and implementation. **Policymakers and regulators** benefit from the model's insights for informed decision-making, standard-setting, and stakeholder analysis. This supports the creation of effective

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

policies to ensure the safe and efficient adoption of autonomous transport, fostering industry growth, public safety, and regulatory compliance. Policy briefs, stakeholder consultations, and workshops will communicate findings and provide practical guidance for regulatory development. **Investors and venture capitalists** gain a tool for assessing investment viability, understanding market trends, and managing risks. The model enables strategic investment decisions, portfolio diversification, and better risk management in autonomous technologies. Adoption will be promoted through investment pitches, financial impact reports, and market trend analyses, highlighting business opportunities and ROI potential.

3.5.3.2 Risks and Barriers

The exploitation of the *Business Model* faces several challenges, including:

1. Regulatory Uncertainty: The absence of clear regulatory frameworks for autonomous technologies could delay adoption.
    - Mitigation Strategy: Close collaboration with policymakers and regulators to develop and promote clear, supportive regulatory frameworks.
2. High Upfront Costs: Implementing autonomous solutions and adapting business models may be prohibitively expensive, particularly for SMEs.
    - Mitigation Strategy: Advocate phased funding models or public-private partnerships to distribute costs over time and make solutions more accessible.
3. Resistance to Change: Companies operating with traditional business models may hesitate to adopt autonomous technologies due to trust issues or ROI concerns.
    - Mitigation Strategy: Awareness campaigns and workshops will educate stakeholders about the benefits and proven success of autonomous transport. Financial incentives and grants will help reduce resistance and encourage adoption.

3.5.3.3 Intellectual Property Rights Analysis

Background IPR:

Title: *Business Model Analysis*
Description: Work developed under Task 6.4, providing foundational insights for the SEAMLESS business model.
Owner: Fundación Valenciaport
Subject Matter: Know-how

Foreground IPR:

Title: *SEAMLESS Business Models*
Jointly developed business models by Fundación Valenciaport, SO, PNO, ALICE, VNF, IDIT, KMNO, and DST,
Country of establishment of the owner: Spain.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Subject Matter: Know-how
Access rights: No.

3.6 KERs LINKED TO DEMONSTRATIONS

3.6.1 KER 6.1 Best Practices and Standardisation for Highly Automated and/or Autonomous Technologies for SSS and IWT

Lead: NTUA

The *Best Practices and Standardisation for Highly Automated and/or Autonomous Technologies for SSS and IWT* provides a comprehensive framework for understanding and enhancing the implementation of automated and autonomous technologies in SSS and IWT. This result draws on insights from the SEAMLESS demonstrations to produce detailed assessment reports. These reports summarize lessons learned, problems encountered, mitigation strategies, and align the findings with project requirements, baseline scenarios, and KPIs. This outcome is designed to support **further research, education, and the development of new projects**.

3.6.1.1 Users of the Results & Expected Impact

The primary users of the results are stakeholders in the maritime industry, particularly those involved in SSS and IWT. The methodology provides enhanced understanding and practical insights into the adoption and operationalization of highly automated and autonomous technologies in maritime contexts. This accelerates the development and adoption of such technologies by equipping stakeholders with actionable recommendations. To maximize uptake, the results will be disseminated through publications, presentations, academic courses, and direct engagement with industry stakeholders to ensure practical application. Other target groups anticipated to benefit from the findings require further specification, including the challenges they address and the strategies to promote adoption.

3.6.1.2 Risks and Barriers

The exploitation of this result faces potential risks and barriers:

- Demonstration Challenges: SEAMLESS demonstrations may not occur as planned, impacting the generation of data and insights.
    - Mitigation Strategy: Detailed planning and proactive identification of potential disruptions will ensure demonstrations proceed as intended, minimizing risks.

Additional risks specific to certain user groups or scenarios may arise, and tailored mitigation strategies will be developed as needed.

3.6.1.3 Intellectual Property Rights Analysis

Foreground IPR:

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Title: *Best Practices and Standardisation for Highly Automated and/or Autonomous Technologies for SSS and IWT*
Description: This IP encompasses the reports derived from SEAMLESS demonstrations, which detail lessons learned, challenges, mitigation measures, and their relation to project requirements and KPIs.
Owner: NTUA
Country of establishment of the owner: Greece
Subject Matter: Know-how
Protection Plan: Not applicable
Access Rights: No.

3.7 KERs LINKED TO IMPACT BOOSTING ACTIVITIES

3.7.1 KER 7.1 Synergies and Cross-Fertilisation with Relevant EU Projects and Initiatives

Lead: ALICE

The *Synergies and Cross-Fertilisation with Relevant EU Projects and Initiatives* aims to foster collaboration and engagement with the logistics sector, particularly decision-makers regarding transportation modes and services. By leveraging tools and frameworks developed within the SEAMLESS project, this result supports the alignment of industry practices with cost-efficiency, sustainability, and operational reliability goals. The application of this outcome spans **commercial, industrial, and research domains**, facilitating the integration of innovative solutions across various stakeholders.

3.7.1.1 Users of the Results & Expected Impact

This result provides tools and frameworks tailored to **logistics providers, policymakers, industry associations, and research agencies**, enhancing decision-making, sustainability, and innovation in freight transport.

Logistics providers can balance cost, efficiency, and sustainability, improving operational reliability and competitive positioning. Adoption is supported through pilot projects, case studies showcasing cost and efficiency improvements, and targeted training sessions. Policymakers gain insights to craft sustainable transport regulations aligned with industry needs, promoting economic growth and positioning regions as sustainability leaders. Uptake strategies include workshops, scenario analyses, and collaborations with advocacy groups.

Industry associations benefit from standardized best practices and innovative strategies, driving consistency, policy influence, and sector-wide competitiveness. Adoption efforts include webinars, conferences, and member toolkits. Research agencies can integrate insights from SEAMLESS and related projects to align outputs with real-world challenges. Collaborative workshops, cross-project publications, and EU-wide conferences support adoption and dissemination.

3.7.1.2 Risks and Barriers

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

1. Reluctance from Logistics Providers: Complexity or perceived misalignment with operational priorities may hinder adoption.
    - Mitigation Strategy: Conduct targeted outreach emphasizing clear, quantifiable benefits, such as cost savings and efficiency improvements. Engage early adopters to demonstrate success and advocate for the framework.
2. Overlap with EU-Funded Projects: Perceived redundancy with other initiatives could dilute the value of the results.
    - Mitigation Strategy: Organize cross-project collaboration workshops to integrate findings with related projects, highlighting SEAMLESS's unique contributions.
3. Regulatory Variability Across EU Member States: Diverse frameworks may create adoption hurdles.
    - Mitigation Strategy: Collaborate with policymakers to ensure alignment with EU policies and directives. Develop standardized guidelines for easy integration into operations.

3.7.1.3 Intellectual Property Rights Analysis

The intellectual property rights (IPR) framework for this item is currently under discussion, with key aspects such as ownership distribution, licensing terms, and potential commercialization strategies yet to be finalized.

3.7.2 KER 7.2 Market and Technology Outlook

Lead: PNO

The *Market and Technology Outlook* provides a comprehensive analysis of the SEAMLESS value chain, identifying key stakeholders and assessing their positions regarding the project. This systematic analysis enables the development of engagement strategies tailored to each stakeholder group. To facilitate market integration of SEAMLESS results, technology trends and associated markets are continuously monitored and analyzed. The outcome is a detailed report comprising insights into international technology trends, societal and market dynamics, segmentation, competition, and relevant national and international markets. This resource supports strategic decision-making and fosters innovation in the autonomous shipping sector. Routes for exploitation are further research, new projects and commercialisation.

3.7.2.1 Users of the Results & Expected Impact

The primary users of KER7.2 are **R&D-intensive corporates, maritime stakeholders, and policymakers**, each benefiting from tailored insights and strategies. For R&D-intensive corporates and maritime stakeholders, the report delivers strategic market information and consultancy to support the evaluation of autonomous shipping business cases. This enhances decision-making for autonomous shipping initiatives through comprehensive market and technology insights. Adoption will be driven by publishing and promoting the business canvas and market report, showcasing

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

PNO's expertise and its strategic value for the sector. Policymakers gain essential insights into regulatory and market dynamics, enabling the creation of frameworks that foster innovation and sustainable growth in autonomous shipping. The findings will be disseminated in tailored formats, highlighting how autonomous shipping aligns with industry needs and societal objectives.

3.7.2.2 Risks and Barriers

Exploitation of this KER may encounter the following challenges:

1. Limited market interest or slow adoption rates: The market may be hesitant to adopt autonomous shipping solutions due to perceived risks or low demand.
    - Mitigation Strategy: Maintain continuous engagement with stakeholders and incorporate early feedback to refine findings and recommendations in line with market needs.
2. Competition from other Market Analysis Firms: Rival firms may offer similar consultancy services.
    - Mitigation Strategy: Leverage PNO's unique resources, including its proprietary data and insights from R&D projects and patents, to distinguish the report as a high-value deliverable.
3. Rapid Technological Shifts: Evolving technology trends may render parts of the report obsolete.
    - Mitigation Strategy: Regular updates to the report and an innovation data repository will ensure alignment with current trends and maintain its relevance.

3.7.2.3 Intellectual Property Rights Analysis

Background IPR

Title: Wheesbee
Description: A software instrument for Market Analysis integrated into an existing framework and methodology for stakeholder and market analysis. It includes tools and methodologies for data collection, patent tracking, and trend analysis.
IPR Owner(s): PNO
Subject Matter: Software

Foreground IPR

Title: SEAMLESS Market and Technology Outlook Report
Description: A comprehensive, data-driven report incorporating findings from the SEAMLESS Stakeholder Analysis and Market Analysis. The report provides insights into: Technology trends, Market segmentation, Competitive landscape, Policy implications in the autonomous shipping sector
IPR Owner(s): PNO
Jointly Developed: No

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Country of Establishment of the Owner(s): Italy
Subject Matter: Know-How, Report
Protection Plan: Copyright
Access Rights Granted: Yes (members are allowed to use the report but cannot distribute it without prior approval)

3.7.3 KER7.3 Policy recommendations

LEAD: VNF

The *Policy Recommendations* provide a comprehensive roadmap tailored to regulatory and legal parties, aiming to address the challenges and opportunities associated with autonomous navigation. This result consolidates insights into a structured framework to support regulatory reform and streamline legislation, thereby facilitating the deployment of automation in maritime operations. The recommendations are a key resource for fostering legal and regulatory innovation in the autonomous navigation sector. The Policy Recommendations can be exploited by engaging regulatory bodies for shaping policies, guiding industry stakeholders to align innovations with legal standards, and influencing international standardization for autonomous maritime operations.

3.7.3.1 Users of the Results & Expected Impact

The primary users of these policy recommendations are **regulatory bodies and project owners or funders,** benefiting from tailored guidance to support autonomous navigation initiatives.

Regulatory bodies, such as CCNR, IMO, EMSA, and flag states, can use the roadmap as a key resource to initiate and advance regulatory reforms. This accelerates the development and streamlining of legislation, facilitating the smoother deployment of automation technologies. Uptake will be supported through public conferences, law and shipping journal publications, references on the SEAMLESS documentation platform, and direct presentations to regulatory stakeholders.

Project owners and funders gain valuable insights into legal and regulatory risks, enabling more informed risk analysis for autonomous projects. This improves planning and funding decisions by reducing regulatory uncertainties. The recommendations will be made accessible through presentations at public conferences and inclusion on the SEAMLESS documentation platform.

3.7.3.2 Risks and Barriers

The exploitation of the policy recommendations faces several challenges:

1. Insufficient Awareness: Limited recognition of the proposals may hinder their adoption.
    - Mitigation Strategy: Enhance the online presence of SEAMLESS materials using correct keywords and search engine optimization techniques to improve visibility.
2. Complexity of Materials: Detailed and technical content may deter stakeholders from engaging with the recommendations.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

- Mitigation Strategy: Publish an executive summary to provide a concise and accessible overview of the recommendations.

3. Timing Challenges: Regulatory developments, such as the MASS Code, may outpace the production of the recommendations.
    - Mitigation Strategy: Circulate pre-versions of the recommendations to relevant stakeholders, including those in the steering committee (flags and inland waterway regulators), to ensure alignment with ongoing regulatory work.

3.7.3.3 Intellectual Property Rights Analysis

The IPR framework for this item is currently under discussion, with key aspects such as ownership distribution, licensing terms, and potential commercialization strategies yet to be finalized.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

4 EXPLOITATION PLANS OF SEAMLESS PARTNERS

The SEAMLESS project brings together diverse partners, each contributing unique expertise and perspectives to drive innovation in autonomous waterborne transport systems. The partners represent a mix of academic institutions, industry leaders, technology providers, regulatory bodies, and end-users. Each has identified specific project outcomes that align with their long-term objectives, whether through further research, commercial applications, regulatory advancements, or educational initiatives.

Table 1 outlines the exploitation plans of the SEAMLESS partners, detailing how each organization intends to leverage project results to achieve strategic goals, drive innovation, and promote the broader adoption of autonomous technologies in the maritime sector.

Table 1 Individual exploitation strategies of SEAMLESS partners

Partner acronym	Description of an Individual Exploitation strategy
NTUA	The SEAMLESS Project will enhance NTUA's expertise in autonomous technologies for SSS and IWT. NTUA plans to utilize key results beyond the project's duration, including: • ModalNET – CERL (Computational Engine for Resilient Logistics): For advanced logistics solutions. CERL will be further developed after the project's end, adding interactive features to better address supply chain disruptions, and refine the Ship Design methodology for advanced concepts. • SEAMLESS Ship Design Methodology: As a foundation for future more mature autonomous vessel design concepts in future projects. Methodology for Identifying KPIs: To ensure performance-driven project planning.
TUD	As the leader of Tasks 4.2 and 8.2, and a contributor to Tasks 2.3, 4.1, and 6.1, TUD actively supports the development of autonomous maritime technologies within SEAMLESS. Through SEAMLESS, TUD aims to advance its expertise in developing modular and fault-tolerant Guidance, Navigation, and Control (GNC) schemes for autonomous vessels. TUD plans to leverage KER 3.2 beyond the project, although specific applications are yet to be defined. Additional exploitable results are also not yet identified. By participating in key tasks, TUD strengthens its role in pioneering resilient and innovative technologies for autonomous maritime systems.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Partner acronym	Description of an Individual Exploitation strategy
Port of Bergen	The SEAMLESS Project will significantly enhance the Port of Bergen's (POB) readiness for autonomous waterborne freight services by introducing cutting-edge technologies and streamlined logistics. Autonomous mooring systems, cargo handling cranes, and the ModalNET digital twin platform will optimize port operations, reduce berthing and cargo handling times, and ensure real-time tracking and planning of cargo flows. These innovations will address growing cargo demands in the Bergen-Ågotnes corridor while reducing emissions and urban congestion through a modal shift to waterborne transport. Additionally, SEAMLESS supports the development of zero-emission vessels and provides a framework for simplified regulatory processes and business models, reducing operational risks and costs. As a demonstration site, POB will position itself as a leader in autonomous shipping, driving sustainability, efficiency, and innovation in the maritime sector.
TIC4.0	As a participant in Work Packages 2, 3, 5, 6, and 7, TIC4.0 contributes to advancing standardization and digitalization in the maritime sector. SEAMLESS allows TIC4.0 to acquire valuable knowledge from the project's diverse topics and partners while providing an opportunity to validate and expand its standards through active participation in various tasks. This aligns with TIC4.0's goal of improving efficiency in the sector through standardized approaches. TIC4.0 plans to utilize KER 2.3 beyond the project, incorporating technical knowledge gained from Task 3.3 into its standards.
ZULU	In the SEAMLESS Project, ZULU leads the Central European demonstration by providing its X-Barge, a highly automated, zero-emission inland vessel, to showcase the potential of autonomous transport. ZULU also contributes by testing technologies like autonomous mooring and cargo handling, promoting sustainable inland waterway transport. The SEAMLESS Project will provide significant benefits to ZULU by supporting the development and deployment of its autonomous inland vessel solutions, such as the X-Barge. By integrating ZULU's vessels into the Central European demonstration case, the project will validate the potential of autonomous and zero-emission barges for IWT, showcasing their role in reducing congestion, emissions, and logistics costs along key corridors like Lille-Antwerp and Antwerp-Duisburg. SEAMLESS will also enhance ZULU's operational capabilities by testing the ModalNET logistics platform, enabling seamless communication and optimized operations. Furthermore, the project's focus on regulatory frameworks and simplified approval processes will lower barriers to market entry, positioning ZULU as a pioneer in the autonomous IWT market and strengthening its competitiveness across Europe.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Partner acronym	Description of an Individual Exploitation strategy
SO	As the technical coordinator of SEAMLESS and leader of WP7, SINTEF Ocean expects to gain significant knowledge and competence in autonomous shipping, automation systems, inland waterway transport, and stowage optimization, as well as enhanced networks within the maritime industry and academia. Key results for exploitation include the *Rapid Prototyping Tool SIMPACT* (KER3.1), which will be used for studies in ongoing and future projects, serve as a basis for new research, and potentially provide services to shipowners, and KER3.5, which aims to contribute to standardization processes and support approval procedures. Additionally, improvements to the SIMPACT simulator and participation in VCOP development, particularly in optimizing the handling of dangerous cargo, may yield further exploitable outcomes, though this remains uncertain at this stage. Through these efforts, SINTEF Ocean aims to advance innovation in autonomous shipping and maritime technology.
PNO	As the Dissemination and Exploitation Manager, Ambassador of TUC3, and leader of innovation management activities, PNO - Ciaotech plays a pivotal role in SEAMLESS. Its participation provides strategic access to cutting-edge innovations in autonomous waterborne transport, enhancing its technological portfolio and strengthening its position in logistics solutions. PNO expects to leverage KER 7.1, specifically the stakeholder analysis and market insights report, to identify key players, analyse competitive landscapes, and monitor trends in the autonomous transport sector. This will enable strategic positioning of SEAMLESS innovations and optimize partnerships for greater commercial impact. Through its active role, PNO enhances its visibility in the European maritime sector and fosters opportunities for future collaboration.
NTNU	The Norwegian University of Science and Technology (NTNU) contributes to SEAMLESS by conducting research and educating a PhD, focusing on advancing autonomous maritime technologies. Through SEAMLESS, NTNU aims to deepen its expertise in risk assessment and the approval process for autonomous technologies in the maritime domain. The university plans to leverage the SEAMLESS ship design methodology and the risk-based approval process in future research initiatives within the same field. Additionally, NTNU anticipates generating a series of scientific papers that will disseminate insights and findings derived from its work in SEAMLESS.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Partner acronym	Description of an Individual Exploitation strategy
MCGSWE	As technology providers in SEAMLESS, MCGFI and MCGNO focus on testing and validating innovative solutions in real-world environments, enhancing their technological capabilities. Key results expected to be utilized beyond the project include bollard detection technology, stowage platform software (VCOP), and insights for the further development of the 3-joint crane. Bollard detection technology will be adaptable to other solutions, while VCOP aims to become a commercially and technologically viable product. For the 3-joint crane, operational insights gained will inform further development and studies. Participation in SEAMLESS enables MCGFI and MCGNO to advance their technology portfolio and market readiness.
ISL	As the leader of Work Package 2 and a contributor to numerous tasks across most work packages, the Institute of Shipping Economics and Logistics (ISL) gains valuable insights into automation technologies in shipping and ports. SEAMLESS provides ISL with a comprehensive overview of the technological state-of-the-art, business implications, and an enhanced network to support practitioners in adopting automation solutions. ISL plans to leverage KER 1.1 by showcasing SEAMLESS use cases in teaching classes and practitioner conferences, further disseminating knowledge and promoting automation technologies. ISL's involvement strengthens its expertise and network within the maritime automation domain.
VPF	As the leader of Work Package 5 and Task 6.4, Fundación Valenciaport (VPF) plays a significant role in SEAMLESS by contributing to the development of autonomous shipping business models. The project enhances VPF's know-how in Logistics and Maritime Autonomous Surface Ships (MASS) business models. VPF expects to utilize KER 4 and KER 5.3 beyond the project, though specific applications are yet to be defined. VPF's participation strengthens its expertise in autonomous logistics and reinforces its position in advancing maritime innovation.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Partner acronym	Description of an Individual Exploitation strategy
IRTSX	IRT SystemX plays a key role in SEAMLESS by ensuring cybersecurity requirements are addressed across the project's development and deployment phases. The institute provides tools and methods to assess cyber risks, identify effective countermeasures, and contribute to logistics-related activities through its expertise in multi-agent simulation and econometrics models for sustainable decision support. SEAMLESS enables IRTSX to enhance its expertise in maritime systems and infrastructures, bolstering its reputation among French and European stakeholders. The institute also leverages the project's simulator to establish itself as a central figure in the maritime cybersecurity community, facilitating threat analysis, testing attack scenarios, and generating datasets to train AI for anomaly detection and behavioral analysis. IRT SystemX plans to further develop and extend CARAT (Computer Aided Risk Assessment), COLABE (Confidential data Outsourcing enabLed by Attribute-Based Encryption), and the Cyber Attack Catalog for application in other projects and integration into its service catalog for French and European cybersecurity stakeholders. These tools will also support professional training through SystemX Academy and external programs. Additionally, IRTSX will be generating and leading the development of an exploitable result, ICoSSiuM: an Integrated Communication Security Simulator for Maritime Operations, further establishing its leadership and expanding its offerings in the cybersecurity domain.
PODU	As an end-user in SEAMLESS, the Port of Duisburg (PODU) focuses on preparing for the accommodation and integration of autonomous ships into its harbour operations. The project supports PODU in achieving readiness for autonomous ships, including potential adaptations to harbour regulations and business models. PODU plans to utilize KER 7.3 and KER 5.3 to guide these transitions and ensure smooth implementation of autonomous technologies.
DST	As a key contributor in SEAMLESS, DST leads T2.3, T6.6, and scientific evaluation of DUC2 (as part of T7.5). DST is also actively involved in use case analysis, business model development, planning, and dissemination activities. Through SEAMLESS, DST gains a deep understanding of the technical, economic, and organizational aspects of integrating autonomous vessels into waterborne logistics services. The project also enables the development of a simulation-based logistics analysis model for autonomous vessels, designed for broad application with minimal adaptation. DST plans to utilize several SEAMLESS results, including KET 1.3, KER 5.1, KER 5.2, KER 5.3, KER 7.1, and KER 7.3, through methods such as information events, conference presentations, participation in regulatory consultations, and publication of white papers. These results will also serve as a basis for future joint research and development projects. Additionally, DST anticipates generating exploitable results beyond the project, specifically concepts for various automated functions of (inland) vessel operations, further advancing innovation in the field.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Partner acronym	Description of an Individual Exploitation strategy
IDIT	IDIT contributes to SEAMLESS by analysing international, European, and local regulatory frameworks for autonomous vessels, addressing challenges, and providing recommendations. Through SEAMLESS, IDIT enhances its knowledge of autonomous navigation, builds expertise by conducting studies and gathering data, and strengthens its network through collaboration within the consortium. IDIT plans to leverage project use case results and gathered regulatory data for future studies and partnerships. IDIT's involvement reinforces its role as a key player in regulatory research and advisory services for autonomous navigation.
VNF	VNF's role in SEAMLESS includes analysing regulatory gaps, studying the social acceptability of technologies, evaluating required skills, and leading the development of TUC1. The project enables VNF to facilitate the adoption of autonomous vessels on French IWW. VNF plans to utilize policy recommendations, the roadmap, and the simplified risk-based regulatory approval process to work with institutional partners and support the introduction of autonomous boats on the French network. VNF's participation strengthens its capacity to promote innovation and sustainability in inland waterway transport.
ESI	As a contributor to naval architecture, modelling, and zero-emission power plant assessments, Engitec Systems International Ltd. (ESI) supports the development of innovative solutions in SEAMLESS. The project enhances ESI's expertise in autonomous and zero-emission ship technologies. ESI plans to leverage the modelling methods and knowledge gained from SEAMLESS for commercial projects involving ship design and retrofitting. ESI's participation strengthens its capabilities in advancing sustainable and autonomous maritime solutions.
ASKO	Within the SEAMLESS consortium, ASKO Maritime AS contributes its expertise in zero-emission maritime transport, focusing on the development and implementation of sustainable logistics solutions. This role involves collaborating with other partners to integrate autonomous technologies into short sea shipping and inland waterways transport, aiming to create a fully automated, economically viable, and resilient waterborne freight feeder service. The SEAMLESS Project is poised to significantly impact ASKO Maritime AS by advancing the development and deployment of zero-emission maritime transport solutions. By participating in SEAMLESS, ASKO will integrate autonomous systems into its operations, enhancing the efficiency and sustainability of its logistics services.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Partner acronym	Description of an Individual Exploitation strategy
ALICE	As a key contributor to dissemination, demonstration, transferability, and business model feasibility activities in SEAMLESS, ALICE leverages project results to advance its mission of fostering innovation and collaboration in sustainable logistics. The project equips ALICE with valuable tools, including KER 7.1 (Synergies and Cross-Fertilization) to connect logistics stakeholders with cutting-edge solutions, KER 5.3 (Business Models) to guide members toward sustainable and economically viable practices, and KER 5.1 (Evaluation Methodology) for assessing the impact of new technologies. Additionally, KER 7.3 (Policy Recommendations) strengthens ALICE's influence on regulatory frameworks, while KER7.2 (Market and Technology Outlook) provides actionable insights to help members adapt to evolving market trends. ALICE will utilize these results through consultations with policymakers, publication of reports and whitepapers, and recurring meetings with members to align them with EU-funded projects and sustainability goals. This ensures ALICE continues to drive innovation and collaboration in achieving zero-emission logistics.
INLS	As an end user in SEAMLESS, INLAND SHIPPING SRL supports logistics redesign (WP2), evaluates transferability cases (WP6), and contributes to Demonstrators, providing real-world insights and validation. The project enhances the company's market competitiveness by enabling fleet renewal on the Danube River, adapting to autonomous technologies and modern logistics models. ISL plans to utilize results such as the logistics cost and time analysis model for fleet management and route optimization, as well as concepts for automated port interfaces and intermodal cargo forwarding, to reduce manual labour and improve efficiency across its operations. ISL's participation positions it to lead in adopting innovative solutions for inland shipping logistics.
POA	As a contributor to SEAMLESS, the Port of Antwerp-Bruges focuses on preparing for the integration of autonomous ships into its harbour operations. The project enhances the port's readiness for accommodating autonomous vessels, with the potential for adapting regulations and business models. The Port of Antwerp-Bruges plans to utilize results such as 2.4, 5.3, and 7.3 to guide these adaptations and ensure smooth implementation of autonomous technologies. No additional exploitable results are foreseen. Participation in SEAMLESS strengthens the port's position as a forward-looking hub ready for the future of autonomous maritime operations.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Partner acronym	Description of an Individual Exploitation strategy
FTTE	As an enabling partner for TUC5, FTTE contributes to SEAMLESS by supporting the evaluation of transferability cases and the logistics redesign process. The project significantly advances FTTE's research capabilities in autonomous and automated waterborne transport systems. Engagement with SEAMLESS provides access to cutting-edge technologies, enabling the preparation of impactful publications, international presentations, and the development of new academic courses on sustainable and autonomous transport. FTTE also strengthens collaboration with top-tier universities, research institutions, and industry stakeholders across Europe, positioning itself for future EU-funded research in autonomous systems, digital transformation, and green logistics. FTTE plans to leverage results such as KER 1.1, KER 5.1, KER 5.2, KER 5.3, and KER 7.3. These results will be integrated into academic curricula, assist in supporting national transport authorities with inland waterway improvements, and serve as benchmarks for assessing innovative solutions' financial and economic viability in the Danube region. FTTE will also work with stakeholders to adapt business models and promote SEAMLESS policy recommendations to align national policies with EU standards. FTTE's involvement enhances its academic and research influence in autonomous and sustainable waterborne transport.
KMNO	As a technology provider, Kongsberg Maritime AS (KMNO) plays a pivotal role in the SEAMLESS project, contributing advanced technological expertise and supporting the development and integration of innovative solutions for autonomous maritime operations. Kongsberg Maritime anticipates significant benefits from participating in SEAMLESS, including enhanced knowledge, new applications of existing technologies, and opportunities to improve and further develop cutting-edge maritime solutions. This aligns with the organization's commitment to shaping the future of the maritime industry. Kongsberg Maritime plans to leverage several key results from SEAMLESS beyond the project's completion. KMNO collaborates with other partners to develop and implement the ModalNET platform, a digital tool designed to optimize logistics operations within the SEAMLESS framework.
BV	As a Classification Society, Bureau Veritas Marine & Offshore plays a critical role in SEAMLESS by supporting the safety assurance of autonomous vessels (WP2) and contributing to the demonstrators (WP7). The project enables Bureau Veritas to benefit from a systematic design and risk assessment method, reducing the complexity and time required for approval processes. Additionally, SEAMLESS provides insights into regulatory compliance, liability, and insurance implications, allowing Bureau Veritas to propose relevant guidelines and recommendations to regulatory bodies. Bureau Veritas's involvement strengthens its capacity to facilitate the safe and efficient adoption of autonomous maritime technologies.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Partner acronym	Description of an Individual Exploitation strategy
AWAKE.AI	As a contributor to SEAMLESS, Awake.AI focuses on the development of the AVSPM software solution, bringing it to early alpha/sandbox readiness and testing it in the Central Europe demonstration in collaboration with the Port of Antwerp-Bruges. The project provides Awake.AI with a prototype of the AVSPM software, laying the foundation for further development. Beyond SEAMLESS, Awake.AI plans to advance the software to a full beta state by continuing development through a new project in partnership with the Port of Antwerp-Bruges. Awake.AI's involvement solidifies its role in pioneering smart port solutions and advancing maritime digitalization.
PCT	Within the SEAMLESS consortium, PCT serves as an end-user, focusing on the transferability of project results to the Eastern Mediterranean. This role involves assessing and implementing SEAMLESS-developed solutions in PCT's operations, thereby facilitating the adoption of cutting-edge technologies in the region's port logistics. The SEAMLESS Project is poised to significantly impact Piraeus Container Terminal Single Member SA (PCT) by introducing advanced autonomous and zero-emission technologies into port operations. This integration is expected to enhance operational efficiency, reduce environmental impact, and position PCT as a leader in innovative port management within the Eastern Mediterranean region. As a key partner in SEAMLESS, Piraeus Container Terminal (PCT) aims to leverage project results to enhance its readiness for integrating autonomous vessel technologies into its operations. PCT anticipates utilizing several Key Exploitable Results (KERs) to advance its objectives. By applying insights from KER 1.1 and KER 1.2, PCT will address operational challenges, stakeholder mapping, and regulatory gaps to streamline its processes and ensure compliance with emerging legal frameworks. The Automated Stowage Planning System (KER 2.3) and Autonomous Vessels' Smart Port Manager (KER 2.4) will improve cargo handling efficiency and facilitate safe and seamless port calls by autonomous vessels. PCT also plans to adopt the Evaluation Methodology (KER 5.1) and Cost-Benefit Analysis Results (KER 5.2) to measure the technical, logistical, and financial viability of these innovations. Furthermore, the Business Models (KER 5.3) will enable PCT to align its operations with sustainability-driven strategies, while Policy Recommendations (KER 7.3) will support regulatory alignment for smoother adoption of autonomous technologies. These outcomes will strengthen PCT's role as a forward-looking port operator, ready to meet the demands of modern, automated logistics systems.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

5 CONCLUSIONS

This document represents the first version of the SEAMLESS Exploitation and IP Strategy, laying the groundwork for the project's exploitation framework. A second, updated version will be delivered at the end of the project, incorporating further refinements based on ongoing developments and feedback.

By M24, significant progress has been achieved:

- A first Exploitation Workshop was conducted to define the exploitation strategy engaging all partners.
- A list of 24 Key Exploitable Results was identified and agreed upon, detailing their potential impacts, users, and intellectual property considerations.
- Monitoring of these KERs will continue throughout the project to ensure their alignment with market needs and scalability.
- Partner-specific exploitation plans outlining their roles and objectives.

Moving forward, SEAMLESS will focus on monitoring the progress of KERs, refining exploitation strategies, and validating results through real-world demonstrations. To that end, a market analysis of the most promising innovative KERs will be conducted, to ensure their alignment with market demands and maximize their commercialization potential.

These efforts will culminate in the final version of the exploitation strategy, ensuring the project's innovations achieve widespread adoption and long-term sustainability.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

ANNEX 1

Converting knowledge resulting from publicly funded research activities can be realised in various ways, including sale of technology, licencing, joint venture, spin-off, etc. The below table provides a non-exhaustive summary of potential exploitation channels / strategies for the SEAMLESS project results. commercialisation, cooperation agreements, use for further research, new project, education and training, patenting, selling IP rights/selling the IP based business, Licencing IP rights (out licensing), spin-off company generation, joint venture, development of standards/new legislation/policy briefs

Table 2 Example of Exploitation Routes

Exploitation Route	Description
commercialisation	Bringing a product or service to market to generate financial returns. This route involves manufacturing, marketing, and selling the innovation directly to end-users or integrating it into existing business operations with the purpose to monetize project outcomes by making them accessible to target markets.
cooperation agreements	Formal partnerships between entities (e.g., companies, research institutions, or governments) to jointly develop, improve, or exploit innovations. These agreements often outline how the involved parties will share resources, risks, revenues, and intellectual property with the purpose to pool expertise and resources for efficient exploitation of results or further development.
use for further research	Leveraging the project's outcomes (e.g., prototypes, datasets, methodologies) as foundational elements for new studies, experiments, or academic research. This can include academic publications or incorporation into larger-scale research initiatives.
new project	Using project results to initiate or support subsequent research and innovation projects, often funded by public or private entities. This route builds on existing outputs to address new objectives or challenges. The purpose is to extend the life of innovations by exploring additional use cases or improving readiness for market adoption.
education and training	A subset of new spin-off research based on the definition of new training courses, new PhD thesis and research
patenting	Securing legal protection for intellectual property, such as inventions, designs, or methodologies, through patents. This prevents others from using, manufacturing, or selling the innovation without authorization with the purpose to protect the uniqueness of the innovation, create opportunities for licensing, or provide a competitive edge in the market.
selling IP rights/selling the IP based business	Transferring ownership of intellectual property (e.g., patents, designs, trademarks) or an IP-based company to another entity, usually for a financial gain. This route is common when the original creators do not have the resources or intention to commercialize the innovation themselves.
Licencing IP rights (out licensing)	A licence agreement is a contract that grants a third party (licensee) the right to use the IP of the IP holder for a defined purpose, within the limits set by the provisions of the contract. In general licensing will provide the IP holder with certain financial provisions. Various types of licensing are known, including exclusive (only the licensee), non-exclusive (multiple licensees) and sole (only licensee and licensor).
spin-off company generation	Commercialisation of research results through collaboration of academia with one or more industrial partners. Issues involving the ownership of IP are facilitated through contracts, covering ownership scenarios, exploitation of results and licensing rights issues
joint venture	Joint ventures are a type of collaborative commercialisation. It is a situation where two or more parties jointly commit resources and research efforts to projects. Joint venture may range from short-term projects to long-lasting strategic partnerships with multiple members and stakeholders. More specifically, the parties to the joint venture share risks and contribute with their intellectual capital to technology research and development, production, marketing and further commercialisation
development of standards/new legislation/policy briefs	Leveraging research outputs to influence industry standards, inform legislation, or create policy recommendations. This route is essential for regulatory alignment and broader adoption of innovative technologies.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

IP and Knowledge protection measures and tools

There are several protection measures and tools that can be used by the partners to protect the generated innovation and knowledge. Each tool is suitable for a specific situation.

In the following, the most used terms for protecting innovation and the most common types of protection measures and tools that that may be considered for project Intellectual Property (IP) protection[1].

IP refers to the creations of the mind: inventions; literary and artistic works; and symbols, names, images used in commerce. Intellectual property is divided into two categories:

- **Industrial Property** includes patents for inventions, industrial design and geographical indications
- **Copyright** covers literary works (such as novels, poems and plays), films, music, artistic works (e.g. drawings, paintings, photographs and sculptures) and architectural design.

Intellectual Property Rights are like any other property right. They allow creators, or owners of patents, trademarks or copyrighted works to benefit from their own work or investment in a creation. Common types of Intellectual Property Rights include Patents, Trademarks, Industrial Design, Copyright, Trade secrets, etc. In the following table the most common types of protection tools and measures will be described more in detail

Table 3 Intellectual Property Rights list

Protection Measure	Description	Time Limitation
Patents	An exclusive right granted for an invention-a product or process that provides a new way of doing something, or that offers a new technical solution to a problem. A patent provides owners with protection for their inventions. Patent protection means an invention cannot be commercially made, used, distributed or sold without the patent owner's consent. In return for patent protection, all patent owners are obliged to publicly disclose information on their inventions in order to enrich the total body of technical knowledge in the world. Once a patent expires, protection ends and the invention enter the public domain	Protection is granted for a limited period, generally 20 years
Trademarks	Trademarks are distinctive signs that identify certain goods or services produced or provided by an individual	The period of protection varies, a trademark can be renewed upon payment of the corresponding fees.

[1] What is Intellectual Property? Publication of WIPO (World Intellectual Property Organization) www.wipo.int/freepublications/en/intproperty/450/wipo_pub_450.pdf

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

	or a company. Trademarks may be one or a combination of words, letters and numerals. They may consist of drawings, symbols or three-dimensional signs, such as the shape and packaging of goods. Trademark protection ensures that the owners of marks have the exclusive right to use them to identify goods or services, or to authorize others to use them in return for payment.	
Copyright	Copyright laws grant authors, artists and other creators protection for their literary and artistic creations. The creators of works protected by copyright, and their heirs and successors ("right holders") have certain basic rights under copyright law, and hold the exclusive right to use or authorize others to use the work on agreed terms	Rights have a limited duration, and last for not less than 50 years after the creator's death
Trade Secret	A trade secret is information of any type that is actually or potentially valuable to its owner and not generally known or readily ascertainable by the public, and which the owner has made a reasonable effort to keep secret. A trade secret generally has some cost associated with its development, and is not common knowledge in the industry. Even negative information, such as research options that have been explored and found worthless, can be a trade secret. Practically any type of technical and business information can be protected as a trade secret provided that it meets these requirements	Trade secrets are protected without registration, that is, trade secrets are protected without any procedural formalities. and can be protected for an unlimited period of time. Trade secrets are by definition not disclosed to the world at large

IP monitoring during the project

Task 8.3 will monitor IPR needs and practice among the consortium members and facilitate possible controversies. Each KER will be described in terms of ownership and IPR. A specific format will be used among several available and already used by PNO.

- The IPR settlement and analysis will proceed along with KER identification and will be monitored in at least two exploitation workshops by PNO in coincidence with SEAMLESS project meetings/workshops or online, where all partners: i) identify and analyse the exploitation potentials of the projects results and main assets (tangible and intangible) during and after their validation ii) identify main risks for exploitation; iii) discuss and validate the above mentioned exploitation strategy; iv) monitor exploitation activities; v) discuss IPR strategy.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

- Besides, all partners are assumed to contribute and take over the tasks that concern them: they particularly take over all patent filling action for technologies they are developing.

Table 4 KER description Table Example

General Description of the Exploitable Result			
Name of the Result	*Name of the result*		
Short description	*Describe the result in brief.*		
Application area	Commercial / industrial use / further research / other		
Type of exploitable result	Knowledge/ methods/ agreemenrs / network / technology / data/ standard/ other		
Routes for use/exploitation	Commercialisation / cooperation agreemenrs / use for further research / new project / education and training / patenting / selling IP rights or business / licensing IP rights (out-lisensing) / spin-off company generation / joint venture / development of standards, new legislation or policy briefs / other		
Users of the results & expected impact			
Potential users of the result	**Users's need addressed by the result**	**Expected Impacts on users' group**	**Uptake strategy**
Target group that is expected to make concrete use of results (Target Group I)	*Describe the needs tackled by the result*	*Describe the direct and/or indirect value and impact for different stakeholders provided the result*	*Describe the planned measures to ensure the result is up taken by the target group*
Risk and Barriers			
Potential risks and barriers for exploitation		**Mitigation strategy**	
Describe the potential risks and barriers for the exploitation of results (I)		*Describe the mitigation strategy*	
Intellectual Property Rights analysis			
Background IPR			
Title of the IP item	*Name of the Background IPR related to the result*		

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Description	*Description of the Background IPR linked to the result*		
IPR owner(s)	*Owner(s) of background IPR*		
Subject Matter	Software / hardware / firmware / invention (device, process, method) / scientific article / design of a product / name of a technology or of a product / know how / website / other		
Foreground IPR			
Title of the IP item	*Name of the Foreground IP item*		
Description of Foreground IP	*Describe the foreground IP*		
IPR owner(s)	*Owner(s) of foreground IPR*		
Jointly developed	Yes / no	*If yes, by which other partner?*	
Country of establishment of the owner(s)	*Name of the Country*		
Subject Matter	Software / hardware / firmware / invention (device, process, method) / scientific article / design of a product / name of a technology or of a product / know how / website / other		
Control of Third Owners Software, Hardware or IP	Commercial software / open-source software / commercial hardware / third owner intellectual property rights / not applicable / other	*describe, if relevant*	
		describe, if relevant	
Protection Plan	Patent / copyright / trademark / trade secret or confidential information / not applicable / other		
Access Rights	Yes / no	*If yes, describe the Access Right*	

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923

Available Support (email, website, info)	*describe, if relevant*

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Grant Agreement No. 101096923