



*(Photo by the author: a view of the canal network around Regent's Park, which once supported industry in London.)*

## **No. 26-06 Trends in European Projects for the Introduction of Maritime Autonomous Surface Ships (MASS) and Related Technologies, Part II**

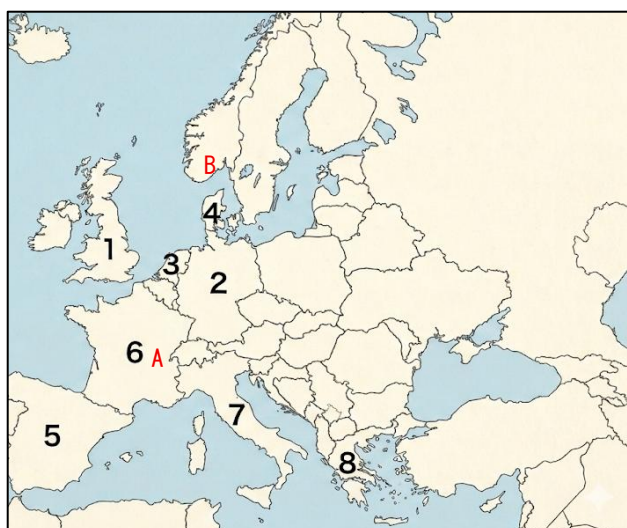
Following No. 25-06, "Feature Article: Trends in European Projects for the Introduction of Maritime Autonomous Surface Ships (MASS) and Related Technologies," this report presents, on the basis of publicly available information and other materials, the status of MASS-related legal frameworks in selected European countries and the current state of ongoing projects.

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Note: Items **A** and **B** were discussed in the previous survey (No. 25-06). Items 1 through 8 are covered in the present survey (No. 26-06).

## Introduction

Ocean-going shipping is inherently international in nature, and the development of MASS must be understood in that context. Accordingly, many of the most significant developments are taking place at the IMO and, to some extent, at the EU level. According to the current schedule, the international MASS Code being developed by the IMO is expected to become mandatory in 2032, while the non-mandatory Code is scheduled to take effect later this year.

At the EU level, the European Commission adopted operational guidelines for MASS trials in October 2020 [0-1]. In its recently published "EU Industrial Maritime Strategy" [0-2], the Commission has stated that it will "pursue regulatory and technical frameworks for unmanned-ship solutions at both IMO and EU levels." In particular, at the EU level, the Commission plans to adopt "EU guidelines and best practices on designated trials, demonstrations and risk assessments at sea, in order to support implementation by Member States and to contribute to the EU's technological leadership."

In addition to such developments at the international and EU levels, individual European countries are also making progress on MASS at the national level.

Following No. 25-06, "Feature Article: Trends in European Projects for the Introduction of Maritime Autonomous Surface Ships (MASS) and Related Technologies," this report examines the development of legal frameworks and the current state of ongoing MASS-related projects in selected European countries: the United Kingdom, Germany, the Netherlands, Denmark, Spain, France, Italy and Greece.

This report is based on publicly available information as of March 2026. Subsequent amendments to laws and regulations, changes in administrative practice, progress in demonstration projects and other developments may mean that the current situation in each country differs from the descriptions below.

## 1. Developments in the United Kingdom

### (1) Status of Legal Framework

#### (a) Basic framework

Rather than enacting dedicated legislation specifically for autonomous ships, as France has done, the United Kingdom is incorporating MASS into the existing regulatory regime by combining merchant shipping legislation with codes, guidance, industry-led standards and limited exemptions. Through this flexible approach, the United Kingdom has established a relatively advanced position in the field of MASS regulation.

#### (b) Application of existing law

The Merchant Shipping Act 1995 [1-1], the principal UK statute governing merchant shipping, was not originally enacted with autonomous navigation technology in mind. Nevertheless, UK authorities have applied the existing regime to MASS through interpretation and administrative practice. For large or novel autonomous vessels, even where conventional manning or equipment requirements cannot be met directly, the Maritime and Coastguard Agency (MCA) may consider applications on a case-by-case basis under the existing framework if the applicant can demonstrate an equivalent level of safety through alternative means. In such reviews, MGN 664 [1-2], which is directed at vessels using innovative technology, has emerged as one of the principal sources of guidance. It should be noted that, on the basis of currently published materials, the Remote Operator and the Master are treated as conceptually distinct, and the Remote Operator is not automatically treated as having the same

legal status as a traditional Master. However, recent legal interpretation by the MCA supports the view that, provided the Remote Operator exercises effective command and control over the vessel concerned, that operator may discharge the legal duties of the Master [1-3].

### **(c) Regulation of small craft and complementary standards**

Recognising that the uniform application of large-vessel rules to smaller autonomous craft could impede technological innovation, the United Kingdom has developed a tiered regulatory framework based on vessel size. A leading example is the "Workboat Code, Edition 3" [1-4], which contains Annex 2 covering remotely operated unmanned vessels of less than 24 metres in length and sets out technical requirements applicable to such craft. In addition, for very small autonomous vessels, the MCA grants general exemptions on certain conditions through MGN 702(M) Amendment 2 [1-5]. Where formal regulation is not yet fully developed, industry-led standards play an important role. The Industry Conduct Principles and Code of Practice [1-7], prepared by the MASS Regulatory Working Group of Maritime UK [1-6], sets out best practice covering design, operation, ethics, cybersecurity and COLREG compliance. Although it has no legal binding force, it functions in practice as an important complementary standard. Lloyd's Register's standards for unmanned systems [1-8] also provide a flexible certification framework for the design and construction of autonomous systems.

### **(d) International cooperation**

The United Kingdom is among the original signatories of the 2023 Memorandum of Understanding on the operation of MASS in the North Sea [1-9], alongside Belgium, Denmark, Ireland and the Netherlands. The MoU is intended to facilitate the cross-border operation of small autonomous and unmanned surface vessels and to advance the standardisation of approval procedures in respect of small workboats, research vessels and other craft falling outside the scope of SOLAS. France and Germany have subsequently joined. (See [JAMS London Office Report No. 25-10.](#))

## **(2) Status of Individual Requirements**

### **(a) Insurance and liability**

In the United Kingdom, a comprehensive legislative framework dedicated to MASS remains under development. In practical terms, however, insurance products are already on offer. The Shipowners' Club provides liability cover for autonomous vessels, including in respect of collision, third-party property damage, cargo, pollution, towage and wreck removal. The MASS UK Industry Conduct Principles and Code of Practice [1-7] also indicates that local authorities may require third-party insurance and may set minimum levels of cover.

### **(b) Communications and cybersecurity**

In the United Kingdom, the Code of Practice published by Maritime UK treats MASS cybersecurity as a distinct topic. While this represents industry-based guidance rather than a legally binding rule, it sets out the management of cyber risk associated with MASS operations in relatively concrete terms. In addition, MGN 703 [1-10] sets out considerations regarding the training and competence of remote operators and the conduct of communications.

### **(c) VTS / port regulation and applications for trial areas**

In the United Kingdom, a single nationwide set of MASS-specific rules for ports, VTS and pilotage has not been fully established. In practice, the individual conditions imposed by each port authority or

local authority carry considerable weight. The Industry Conduct Principles and Code of Practice [1-7] also addresses operations within waters under port-authority jurisdiction, coordination with VTS, the relationship with local byelaws and traffic management regulations, and the potential applicability of compulsory pilotage in certain cases.

#### **(d) Other**

The United Kingdom is advancing the implementation of MASS not by waiting for the completion of a legislative framework, but by allowing industry codes, the insurance market and port operations to take the lead.

### **(3) Status of Major Projects (see Annex Table 1)**

Projects in the United Kingdom range widely, from active trials to full operation. "Fugro Vaquita" is in the full operational phase and is undertaking commercial subsea inspections. "Mayflower" is preparing for a long-duration mission scheduled for spring and summer 2026, while the "Marine AI" project plans a demonstration in spring 2026. Military projects such as MMCM (RNMB Ariadne) are in a rigorous evaluation phase, with delivery to the Royal Navy scheduled between 2025 and 2026.

## **2. Developments in Germany**

### **(1) Status of Legal Framework**

#### **(a) Basic framework**

In Germany, no comprehensive domestic legislation dedicated to MASS has been identified at the time of writing. However, Germany is taking a case-by-case approval approach while actively engaging in the development of international standards through the IMO [2-1].

This reflects the view that, in light of the planned mandatory entry into force of the IMO MASS Code in 2032, the regulatory framework should be developed flexibly while stakeholders accumulate practical experience, rather than through excessively detailed national regulation in advance. The intention to involve stakeholders actively is also reflected in the establishment of a round-table forum [2-2], jointly created by the Federal Maritime and Hydrographic Agency (BSH) and the German flag-State administration to bring together businesses, research institutions and regulatory authorities and to provide input into rule-making at the national, European and international levels.

#### **(b) Authorities and approval framework**

In Germany, public sources provide only limited detail on a uniform, dedicated approval regime for MASS. Nevertheless, the Federal Maritime and Hydrographic Agency (BSH) [2-3] can be identified as a key authority for flag-State and maritime administration matters.

#### **(c) Application of existing law and review practice**

In the absence of dedicated MASS legislation, existing general maritime law is applied on a case-by-case basis. Existing rules on manning and vessel safety provide the baseline, but in MASS trial operations, operators may obtain specific exemptions from the BSH by demonstrating an "equivalent level of safety." The assessment process is taking shape in practice through demonstrations and trial operations [2-4]. At present, Germany does not have a fully completed nationwide system; rather, experience concerning safety, operational concepts and collision avoidance is being accumulated

through port and research projects [2-5].

#### **(d) Policy support and international cooperation**

In addition to measures on the legislative side, Germany supports MASS and the digitalisation of shipping through grant programmes and research projects. Representative examples include the development of digital test areas and demonstration projects in ports.

Internationally, Germany also takes part in regional cooperation among North Sea littoral states, advancing research and demonstration in parallel with international harmonisation [2-5].

### **(2) Status of Individual Requirements**

#### **(a) Insurance and liability**

For Germany, the existence of a dedicated nationwide insurance and liability regime for MASS cannot be clearly confirmed.

#### **(b) Communications and cybersecurity**

In Germany, port-integration projects such as iPORTUS treat cybersecurity, alongside navigational safety, as a central issue. Emphasis is placed on integration with the remote operation centre (ROC) and on the establishment of secure communications and monitoring arrangements in complex port environments [2-6].

#### **(c) VTS / port regulation and applications for trial areas**

In Germany, the integration of autonomous and remotely monitored vessels into port environments is a key priority. iPORTUS aims to establish the approval procedures and regulatory foundations needed to enable routine operation in the future. The current position is therefore not that of a completed port regulation regime; rather, the framework is being shaped on the basis of port-operation use cases.

#### **(d) Other**

A distinctive feature of Germany is that, rather than advancing a uniform nationwide system first, the country is seeking — through port-based demonstrations — to build the regulatory and approval foundations required for practical operation.

### **(3) Status of Major Projects (see Annex Table 2)**

Germany has a strong portfolio of research and development projects continuing until 2027, including iPortus (port integration), CAPTN, AutoGnom (passenger ferry) and MUM (underwater mother ship).

## **3. Developments in the Netherlands**

### **(1) Status of Legal Framework**

#### **(a) Basic framework**

In the Netherlands, the inland-navigation regulations were amended in 2025, establishing a regime under which, for certain vessels, operation without a master physically on board may be permitted on

specified conditions [3-1]. This represents the most significant recent development in the country's MASS-related legislation and marks a substantial step forward in the institutional acceptance of highly automated navigation and remote vessel control.

### **(b) Inland waterways, territorial sea and open sea**

As regards inland waters, under the amended inland-navigation regime, vessels of less than 20 metres in length may be eligible for exemption from the requirement to have a master on board, subject to specified conditions, and operators may now submit formal applications for such exemptions. In parallel, the Ministry of Infrastructure and Water Management has adopted regulations specifying the exemption requirements, including both the application requirements and the conditions to be imposed by the competent authority [3-1].

By contrast, for the territorial sea and the open sea, the regulatory framework is not as concretely developed as for inland waters; trials and demonstrations on an individual basis appear to remain the principal mode of operation [3-5].

### **(c) Approval procedure and safety requirements**

As regards MASS operations and trials in the Netherlands, a framework exists under which applications are reviewed and evaluated by the competent authority. Applicants are required to demonstrate that the vessel concerned achieves a level of safety at least equivalent to that of a manned vessel, while the competent authority reviews safety, the operating environment and communications requirements. Under current practice, particular emphasis is placed on the remote operator being able to intervene at any time, and in the initial phase it is common for safety measures to be applied in combination [3-2].

### **(d) Promotion arrangements and international cooperation**

In parallel with development of the regulatory framework, the Smart Shipping Forum (SMASH!) [3-3], a public-private partnership formed by industry, government and research institutions in the Netherlands, is promoting the implementation of highly automated and autonomous navigation at sea, in ports and on inland waterways. Such public-private partnerships illustrate the bottom-up approach adopted by the Dutch authorities.

In addition, as one of the original signatories of the 2023 Memorandum of Understanding on the operation of MASS in the North Sea, the Netherlands plays an important role in regional international cooperation.

## **(2) Status of Individual Requirements**

### **(a) Insurance and liability**

In the Netherlands, an exemption application under the 2025 regulations [3-4] requires the submission of information concerning insurance of the vessel and, where necessary, of the crew. A distinctive feature is therefore that the presence and content of insurance cover are expressly designated as elements to be examined in connection with MASS trials and operations.

### **(b) Communications and cybersecurity**

In the Netherlands, the communications environment required for continuous control, namely communication range, bandwidth and low latency, together with cybersecurity, is expressly identified

in the regulations as a matter for review [3-4]. Continuity of VHF communications is also required, with reception requirements of at least two channels for larger vessels and one channel for smaller vessels. Among the countries surveyed, this is an example of comparatively concrete codification of communications and cyber requirements.

### **(c) VTS / port regulation and applications for trial areas**

The structure combines a nationwide regime with operational review by regional authorities [3-4]. Applications are reviewed by the competent authority for the relevant waters, and compliance with local conditions and safety requirements is required.

### **(d) Other**

The Netherlands has set out the conditions for trials and operations in relatively concrete administrative regulations, primarily for inland waters. Although the scope remains limited, the Netherlands is among the more advanced European countries in terms of regulatory clarity.

## **(3) Status of Major Projects (see Annex Table 3)**

Several major projects, including Roboat (urban waterways), Novimar and the JIP Autonomous Shipping initiative, have been completed, indicating a high level of maturity. Commercial deployment is already a reality, as exemplified by companies such as Fugro introducing unmanned surface vessels for offshore inspection work. Other projects, such as RAS and FerryGo, are also actively under way.

## **4. Developments in Denmark**

### **(1) Status of Legal Framework**

#### **(a) Basic framework**

In Denmark, the existing vessel regulations are recognised as having been designed on the fundamental assumption that crew members are continuously on board. For this reason, rather than enacting separate national legislation specifically for MASS, Denmark is responding through targeted guidance and the flexible application of existing maritime law. The current framework is built principally around administrative guidelines [4-3] [4-4] involving the Danish Maritime Authority (DMA) [4-1] and the Danish Emergency Management Agency (DEMA) [4-2]. Engagement in the formation of international rules at the IMO proceeds in parallel, while the regulatory framework is being developed incrementally through case-by-case authorisations.

#### **(b) Guidelines forming the basis of the approval process**

At the heart of this approach are guidelines published by the DMA, such as the "Approval process for the remote operation of maritime drones in Danish waters" [4-3] [4-4]. These constitute the practical baseline documents for authorising the operation of remotely operated and autonomous vessels. The guidelines also link to the IMO guidelines for the trial of autonomous-ship activities [4-5], reflecting Denmark's attentiveness to the formation of an international regulatory foundation.

#### **(c) Practical review and authorisation procedures**

Individual MASS projects are evaluated against the existing rules applicable to manned vessels on the basis of an "equivalent level of safety" or an alternative-design approach. That is, the operator must

demonstrate that automation or remote operation will provide a level of safety equivalent to, or higher than, conventional operation. Procedurally, the operator engages with the DMA at an early stage and ordinarily submits a formal application via the DEMA online system at least several weeks before the planned activity. The application focuses on the area of operation, the operating concept, risk assessment, impact on other traffic and the warning plan, and authorisation is granted on a case-by-case basis.

#### **(d) Accumulation of experience and international cooperation**

In Denmark, experience is also being built up on matters such as electronic look-out, redefined safe manning and the role of shore-based operators. Notable outputs include the 2017 analysis of regulatory barriers [4-8] and recent reports [4-7], which examine the intersection of MASS with SOLAS, COLREG, EU law and domestic law, and which address institutional issues such as liability, qualifications, look-out and situational awareness.

In addition, Denmark participates in the regional cooperation on the operation of MASS in the North Sea.

## **(2) Status of Individual Requirements**

### **(a) Insurance and liability**

In Denmark, dedicated rules on insurance and liability for autonomous vessels have not yet been clearly established, and these are recognised as matters requiring further development [4-6].

### **(b) Communications and cybersecurity**

Danish analyses treat autonomous-ship operations from a risk-management perspective and treat cybersecurity as one of the principal topics. However, the publicly available material does not make clear the existence of detailed MASS-specific requirements for communications and cyber matters [4-6].

### **(c) VTS / port regulation and applications for trial areas**

Under the DMA trial guidelines, trials of autonomous and similar vessels require coordination with the relevant authorities and stakeholders and, in some cases, authorisation from other bodies such as port authorities. The system therefore appears to operate not through a unified, MASS-specific regime, but through safety assessments and coordination with the relevant authorities on an individual-trial basis [4-6].

### **(d) Other**

Denmark can be characterised as adopting an approach in which safety management of trials and demonstrations leads the way, rather than comprehensive legislation.

## **(3) Status of Major Projects (see Annex Table 4)**

Many projects are at a demonstration and operational-trial stage, such as RECOTUG, SVITZER HERMOD, remote pilotage trials and the deployment of Saildrone. The Fjordbussen / GreenHopper harbour bus, in particular, is technically ready and has been approved through trials, but currently has no concrete plans for regular operation and is functioning as a trial platform.

## 5. Developments in Spain

### (1) Status of Legal Framework

#### (a) Basic framework

Spain's response to MASS is characterised by the step-by-step development of a regulatory foundation through the application of existing law and demonstration activities, in alignment with international developments. At present, no legislation dedicated specifically to MASS has been enacted. In recent years, however, the Directorate-General for the Merchant Marine (DGMM) [5-1], under the Ministry of Transport, has taken the lead in advancing the administrative and technical foundations. Meetings on autonomous vessels organised by the DGMM [5-2] are also under way, and regulatory discussions among stakeholders are continuing.

#### (b) Development of a national certification framework

In 2025, the DGMM held a significant meeting on autonomous vessels [5-2], at which discussions on the development of the national framework were advanced with the IMO MASS Code schedule in view. However, publicly available material remains limited on matters such as the extension of the concept of master to shore-based operators and the establishment of a systematic national certification framework [5-3].

#### (c) Application of existing law and demonstration operations

In Spain, in the absence of a dedicated legal framework for MASS, the Maritime Navigation Act [5-4] continues to provide the principal legal basis. Article 56 of that Act defines a "vessel" broadly as "a structure capable of navigating at sea and of carrying persons or goods, fitted with a complete deck and exceeding 24 metres in length"; this definition does not expressly require human operation, and may therefore in principle encompass autonomous platforms. By contrast, certain small USVs are being registered and demonstrated through procedures that differ from those applicable to conventional vessels, with the registration of PLOCAN THREE [5-5] being a representative example. For larger autonomous vessels, matters appear to continue to be addressed on an individual basis within the existing ship regulation framework.

#### (d) Demonstration infrastructure and safety requirements

In Spain, the development of supporting infrastructure for demonstrations is also being pursued in parallel with regulatory work. A representative example is the PLOCAN ocean test bed, which manages a maritime test zone and supports the demonstration of unmanned ocean equipment [5-6] [5-7].

### (2) Status of Individual Requirements

#### (a) Insurance and liability

In Spain, a dedicated and independent insurance and liability regime for MASS cannot be confirmed. However, under Royal Decree 1616/2011 [5-9], which implemented EU Directive 2009/20/EC [5-8] in national law, an insurance regime addressing shipowners' maritime claims is in place. At the current stage, MASS appears to be treated within the framework of the existing general maritime law and the shipowner insurance regime.

### **(b) Communications and cybersecurity**

For Spain, no public basis demonstrating a nationwide MASS-specific cyber regime, or a dedicated cyber certification regime applicable to autonomous vessels in general, could be identified.

### **(c) VTS / port regulation and applications for trial areas**

For Spain, no nationwide VTS or port regulation dedicated to MASS could be confirmed.

### **(d) Other**

Spain can be characterised as taking the basic approach of applying existing maritime law to MASS, rather than enacting dedicated MASS legislation. Its distinctive feature is that demonstrations and regulatory discussions are being pursued in parallel through PLOCAN, DGMM meetings and related initiatives.

## **(3) Status of Major Projects (see Annex Table 5)**

Spain shows a high level of operational maturity, particularly in port and security operations. The USV "VENDAVAL" was delivered in 2019 and is fully operational, conducting continuous surveillance activities in Ceuta, and has also been successfully integrated with Spanish Navy vessels in NATO exercises.

## **6. Developments in France**

### **(1) Status of Legal Framework**

#### **(a) Basic framework**

Unlike many other European countries, France has not addressed MASS merely by interpreting existing law; rather, it has incorporated MASS directly into the Transport Code [6-1]. France has therefore clearly positioned the legal regime for autonomous vessels within dedicated domestic legislation, and is one of the few countries to have established a comprehensive national framework while uniform international standards at the IMO and EU levels remain incomplete.

#### **(b) Development of the regulatory framework**

France modernised its legal framework for autonomous vessels by introducing and amending provisions of the Transport Code through Decree No. 2021-1330 on the conditions of navigation of autonomous ships and maritime drones [6-2]. This regime was established to resolve legal uncertainties concerning unmanned and remotely controlled vessels, and to provide an institutional foundation for their navigation and use while ensuring safety and environmental sustainability. In addition, specific provisions for experiments with autonomous or remotely controlled floating maritime devices have been established, including the "Guidelines for autonomous vessels (NI641)" and the "Specific Rules for Unmanned Surface Vessels (USVs) (NR681)" [6-3].

#### **(c) International cooperation**

France's activity is not limited to the development of national legislation; it is also engaged in regional international cooperation as one of the parties to the North Sea MASS MoU. Accordingly, France is distinctive in having put in place a clearly defined dedicated legal regime while also participating in

international institutional harmonisation.

## **(2) Status of Individual Requirements**

### **(a) Insurance and liability**

Although France is among the leading countries in giving autonomous vessels and maritime drones a clear legal status in domestic law, no comprehensive MASS-specific insurance regime has been confirmed. The existing regimes on shipowner liability, pollution damage and financial security appear to apply to MASS according to the type of claim concerned.

### **(b) Communications and cybersecurity**

In France, it is difficult to say that an independent communications and cyber regime dedicated to MASS has been fully completed. However, in addition to general maritime-communications obligations, cybersecurity measures in the maritime sector are proceeding under the horizontal cyber-law regime of the NIS / NIS2 series [6-4]. MASS therefore appears to be addressed, in the first instance, within the existing general maritime and cyber rules.

### **(c) VTS / port regulation and applications for trial areas**

In France, while autonomous vessels have a legal status and trial operations are covered by a legal framework, the existence of a complete nationwide set of detailed VTS or port rules dedicated to MASS has not been identified in publicly available sources. At present, MASS appears to be incorporated within the existing general framework of port, VTS and navigational-safety rules.

### **(d) Other**

France is distinctive in clearly defining autonomous vessels and maritime drones in domestic law and in developing a legal framework that includes trial operations. Within Europe, France is relatively advanced in the conceptual organisation and institutionalisation of MASS.

## **(3) Status of Major Projects (see Annex Table 6)**

France has a very advanced development pipeline, with many projects moving from a proof-of-concept (PoC) phase into industrial scale-up and series production (for example, the ROSS commercial fleet, the MMCM mine-countermeasures vessel and the CHOF oceanographic vessel). Other major defence and commercial projects (including DANAE, ARROW, CEMAS and SEMNA II) are currently engaged in active sea trials or are targeting full operational capability between 2026 and 2028.

## **7. Developments in Italy**

### **(1) Status of Legal Framework**

#### **(a) Basic framework**

At present, no legal framework dedicated specifically to MASS exists in Italy. The current law nonetheless retains a degree of flexibility, and autonomous vessels may, to a certain extent, be brought within the concept of a "ship" as a matter of law. In other words, although dedicated legislation has not been put in place, Italy is at a stage where the partial accommodation of MASS is

being explored on the basis of the existing Code of Navigation.

### **(b) Application of the Code of Navigation and institutional limits**

The principal legislation is the Code of Navigation of 1942 [7-1]. While the Code can be read as defining the concept of vessel comparatively broadly, the regime as a whole presupposes the physical presence of a human crew and master on board [7-2]. As a result, the Code contains insufficiently specific provisions for unmanned or remotely controlled operation, and limitations have been noted in applying it to MASS as a matter of interpretation.

### **(c) Liability regime and challenges in safety regulation**

In Italy, while an existing legal regime based on shipowner liability exists, the system as a whole is built on the premise of a master and crew physically present on board. Accordingly, it is noted that issues such as autonomous decision-making based on sensor inputs and AI malfunctions cannot be fully addressed by the existing liability and safety regimes alone.

### **(d) Future regulatory development and the role of RINA**

Accordingly, a review of Italy's national legal framework, taking into account the forthcoming IMO MASS Code and the EU's AI and product-liability rules, is expected to become an important task. In the meantime, RINA, the Italian classification society, has already introduced specific class notations dedicated to MASS [7-3] and is providing a de facto technical framework for safety certification and technical evaluation. RINA plays a particularly important role in domestic projects in terms of cyber resilience and system reliability.

## **(2) Status of Individual Requirements**

### **(a) Insurance and liability**

In Italy, a general framework for shipowner liability exists under the existing Code of Navigation. However, the establishment of a liability and insurance regime dedicated specifically to MASS could not be confirmed.

### **(b) Communications and cybersecurity**

For Italy, the fact that RINA provides cyber-resilience services for autonomous vessels [7-4] confirms that communications and cybersecurity are treated as important issues from a technical and certification perspective.

### **(c) VTS / port regulation and applications for trial areas**

In Italy, demonstrations of assisted and autonomous shipping in waters close to ports [7-5] can be confirmed, but the existence of a nationwide VTS or port regime dedicated to MASS could not be confirmed.

### **(d) Other**

In Italy, the formation of the regulatory framework is being supported through the work of classification societies and technical demonstrations, rather than through the completion of a national regulatory system.

### **(3) Status of Major Projects (see Annex Table 7)**

Several projects, including 5GMASS, GSAB 1 and AUTOSHIP, which reached the TRL 7 prototype-demonstration phase, have successfully completed their initial demonstration stages. The focus has now shifted to ongoing next-generation projects, such as GSAB 2 and I-MASTER, that are preparing for at-sea trials and operational testing planned for around 2026–2027.

## **8. Developments in Greece**

### **(1) Status of Legal Framework**

#### **(a) Basic framework**

The situation surrounding MASS in Greece is characterised by an emphasis on alignment with IMO and EU standards, rather than by the development of an independent comprehensive national regime. Greece is one of the world's foremost ship-owning nations and has traditionally placed emphasis on its perspective as a flag State; it therefore prioritises the international consistency of the regulatory regime so that Greek-owned vessels can operate consistently around the world. As of the time of writing, no special legislation dedicated to autonomous navigation has been identified in Greek shipping or maritime law.

#### **(b) Concept of master and crew regulation**

Under Greek law [8-1], the master's exercise of command and legal authority is premised on the master's physical presence on board. The CMI Questionnaire [8-2] likewise sets out that remote controllers do not constitute crew. For this reason, the transfer of the master's role to a remote operation centre lies at the heart of the legal issues concerning the allocation of liability.

The CMI Questionnaire is the questionnaire and accompanying national responses [8-3] prepared by the Comité Maritime International (CMI) with the aim of establishing the treatment of unmanned and autonomous vessels under the domestic law of each country.

### **(2) Status of Individual Requirements**

#### **(a) Insurance and liability**

No public material directly setting out a MASS-specific insurance or liability regime could be identified.

#### **(b) Communications and cybersecurity**

No public material setting out a MASS-specific communications or cyber regime could be identified.

#### **(c) VTS / port regulation and applications for trial areas**

No public material on VTS or port regulation specifically dedicated to MASS could be identified.

#### **(d) Other**

In Greece, the legal, insurance-related and cyber-related issues that accompany MASS are recognised, but primary sources actively documenting the development of the regulatory regime are scarce.

### **(3) Status of Major Projects (see Annex Table 8)**

Project maturity is currently at a research-and-development stage led by academic institutions and digital platforms, such as SmartMove and WARRANT. Owing to regulatory uncertainty, the commercial shipping sector remains cautious. According to publicly available information, however, the Hellenic Navy appears to be actively testing unmanned systems for military applications.

## Conclusion

A review of European responses to MASS shows that countries are not proceeding uniformly towards the development of dedicated legislation. Rather, while taking existing maritime law as the basis, they are advancing institutionalisation incrementally through a combination of administrative guidance, case-by-case authorisations, trial operation regimes and industry standards. In particular, the United Kingdom, Germany, Denmark, Spain, Italy and Greece share a common stance: they are developing practical responses through the flexible interpretation and application of existing law and through individual exemptions, rather than immediately enacting comprehensive MASS-specific legislation.

By contrast, France has developed a comprehensive framework that incorporates autonomous vessels directly into national law, and the Netherlands has also moved forward, through its 2025 legislative amendments, to put in place a regime expressly accommodating highly automated navigation. Accordingly, the European MASS landscape may be characterised as divided between countries that are developing dedicated legislation in advance and countries that are responding incrementally through the application of existing law.

Common challenges across countries include reorganising the concepts of master and crew, demonstrating equivalent safety, defining the legal status of the remote operator and managing demonstration operations through individual approvals. In many countries, legal systems still presuppose the physical presence of a master or crew; accordingly, the question of the extent to which a remote operator can substitute for the master's legal duties stands at the heart of regulatory design.

Operationally, regulatory practice has a strongly demonstration-led character. In Germany, Denmark and the Netherlands, experience is being accumulated through case-by-case authorisation or exemption regimes, with safety, COLREG compliance, cybersecurity and communications arrangements assessed individually. In Spain too, trial operations are being conducted while ensuring consistency with existing regulation; in Italy, although the legal regime remains incomplete, the technical standards of the classification society RINA provide important practical support.

Taken together, the development of MASS regulation in Europe may broadly be classified into four models: (i) dedicated legislation (France); (ii) express acceptance through legislative amendment (the Netherlands); (iii) flexible application of existing law and case-by-case authorisation (the United Kingdom, Germany, Denmark and Spain); and (iv) technical and practice-led development in the absence of an established regulatory regime (Italy and Greece). Although a broad common policy direction towards MASS can be observed across Europe, the means of institutionalisation differ markedly from country to country. These differences reflect each country's legal system, administrative practice, maritime industrial base and environment for demonstrations.

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## Annex Tables

### Annex Table 1 — United Kingdom: Major Development Projects

Project Name	Participants (Role)	Period	Project Overview / MASS Specifications	ROC / Remote Operation Status	Current Status	References
(1) Mayflower Autonomous Ship Project (MAS 400)	<p><b>ProMare:</b> Non-profit organisation leading the research; project owner</p> <p><b>IBM:</b> Principal technology and scientific partner</p> <p><b>Msubs Ltd. and Marine AI Ltd.:</b> Design, construction and development of the "Guardian" AI software</p> <p><b>Other partners:</b> University of Plymouth, the UK Hydrographic Office, Iridium / Thales, Nvidia, and various sensor and power-supply sponsors.</p>	<p><b>2016:</b> Concept</p> <p><b>Spring 2019:</b> Construction began</p> <p><b>March 2020:</b> Construction completed</p> <p><b>September 2020:</b> Launch of the autonomous vessel "Mayflower"</p> <p><b>April 2022:</b> Second transatlantic attempt</p> <p><b>June 2022:</b> Arrival in Plymouth, Massachusetts (USA)</p>	<p><b>Vessel type and size / tonnage</b> Weight: 5 tonnes Length: 15 m Speed: up to 10 knots Materials: aluminium and composites Form: trimaran</p> <p><b>Level of autonomy</b> Fully autonomous. No master or crew on board.</p> <p><b>Propulsion:</b> hybrid (wind / solar, with diesel-generator back-up)</p> <p><b>Navigation and communications:</b> state-of-the-art inertial navigation system and high-precision GNSS positioning; oceanographic and meteorological observation equipment, SATCOM, radar, LiDAR.</p> <p><b>Advanced technologies:</b> data processed by IBM Power AI Vision ashore and by edge devices on board; IBM Deep Learning supports hazard avoidance at sea.</p> <p><b>Sensors:</b> acoustic sensor, nutrient sensor, water-temperature sensor, water and air sampling equipment.</p> <p><b>Security:</b> advanced IBM Cloud and edge security systems.</p> <p><b>Operating area:</b> a wide range of domestic and international waters.</p> <p><b>Demonstration scenarios:</b> June 2021 – first transatlantic attempt (unsuccessful); December 2021 – new series of trials.</p>	Command centre: a "virtual crew" based in Plymouth, UK, with global operating capability.	Currently located in Plymouth. Preparing at HMNB Devonport for a long-duration mission, based out of Plymouth, beginning in spring/summer 2026.	<p><a href="#">Annex 1(1)-1</a> MAS400</p> <p><a href="#">Annex 1(1)-2</a> MAS400</p> <p><a href="#">Annex 1(1)-3</a> Plymouth</p> <p><a href="#">Annex 1(1)-4</a> IBM</p> <p><a href="#">Annex 1(1)-5</a> Marine AI</p> <p><a href="#">Annex 1(1)-6</a> MARS</p> <p><a href="#">Annex 1(1)-7</a> News</p>



<p>(2) UKHO – MARINE AI Autonomous Navigation Research Programme</p>	<p><b>UK Hydrographic Office (UKHO):</b> Principal data provider and research partner. Supplies the "ADMIRALTY Sailing Directions" and "Radio Navigation Warnings". <b>Marine AI:</b> Software-development company. Provides the GuardianAI autonomous-control software and large-language-model (LLM) processing. <b>ZeroUSV:</b> Vessel supplier. Provides the "Oceanus12" unmanned surface vessel for the demonstration.</p>	<p>October 2025 – Spring 2026 Launched in October 2025 as an 8-month research programme.</p>	<p><b>Vessel:</b> ZeroUSV Oceanus12 (a 12-metre unmanned surface vessel) <b>Autonomy:</b> A high level of autonomy with a focus on natural-language processing (NLP). The system uses a custom LLM to convert unstructured text into machine-readable structured data, enabling real-time navigation.</p>	<p>Operating location: waters off Plymouth, UK. Serves as a nationwide test bed for MASS. <b>Functionality:</b> Aims to eliminate the "human-in-the-loop" requirement and to enable vessels to respond instantly to warnings without human intervention.</p>	<p>A live-vessel demonstration is scheduled to take place in Plymouth in spring 2026.</p>	<p><a href="#">Annex 1(2)-1</a> News <a href="#">Annex 1(2)-2</a> Smart Maritime Network <a href="#">Annex 1(2)-3</a> News</p>
<p>(3) FUGRO VAQUITA</p>	<p><b>Fugro:</b> Owner and operator of the USV and the global remote-operation centre (ROC). <b>SEA-KIT International:</b> Designer and builder of the X-Class USV platform. <b>Petrobras:</b> Client under a long-term contract for inspection of shallow-water infrastructure. <b>Eni Energy Netherlands:</b> Client for pioneering pipeline-survey work.</p>		<p><b>Vessel type and size / tonnage</b> Survey vessel Length: 12 metres Beam: 2 metres</p> <p><b>Level of autonomy</b> Fully unmanned, remotely operated</p> <p><b>Propulsion:</b> Hybrid <b>Equipment:</b> Includes a Blue Volta® eROV and a multibeam echo sounder (MBES) for seabed surveys to a depth of 450 m. <b>Autonomy:</b> MCA Category 0 (unrestricted navigation in UK waters), the highest level for fully remote / autonomous operation. <b>Efficiency:</b> Up to 95% reduction in fuel consumption compared with manned vessels.</p>	<p><b>Operating bases:</b> Controlled via satellite from Fugro centres in Macaé (Brazil), Aberdeen (UK) and Dubai (UAE).</p>	<p>Fully operational. Currently undertaking inspections of infrastructure and pipelines in shallow waters off Brazil for Petrobras. Has successfully completed non-destructive survey campaigns at the Beatrice offshore wind farm in Scotland and at various pipeline facilities in the North Sea.</p>	<p><a href="#">Annex 1(3)-1</a> News <a href="#">Annex 1(3)-2</a> News <a href="#">Annex 1(3)-3</a> MASS World News</p>
<p>(4) Maritime Mine Counter-Measures (MMCM) – RNMB ARIADNE</p>	<p><b>Thales:</b> Prime contractor and principal systems integrator <b>OCCAR:</b> International management organisation for the joint UK–France programme <b>Royal Navy and French Navy:</b> End users and evaluators <b>Partners:</b> BAE Systems (C2), Saab (ROV), ECA (AUV), Wood &amp; Douglas (communications)</p>	<p>2012 – present 2015: Production contract (Phase 2) concluded March 2025: RNMB Ariadne delivered to the Royal Navy</p>	<p><b>Vessel type and size / tonnage</b> Length: 12 metres</p> <p><b>On-board sensors and communications systems:</b> Thales TSAM system for high-resolution seabed scanning. Navigation sensors: include radar, LIDAR, and electro-optical / infrared cameras for situational awareness. Integrated AI Automatic Target Recognition (ATR) to accelerate the filtering of sonar data and the classification of threats. Underwater tooling: deployable MUMMS ROV (Saab) for the identification and neutralisation</p>	<p><b>Operations centre:</b> Command and control is exercised through a portable e-POC (lightweight operations command centre) deployed ashore or on a mother ship.</p>	<p>RNMB Ariadne is currently undergoing rigorous evaluation by Royal Navy personnel in Plymouth. The Royal Navy is scheduled to receive a total of four major systems in the 2025–2026 timeframe.</p>	<p><a href="#">Annex 1(4)-1</a> Royal Navy News <a href="#">Annex 1(4)-2</a> OCCAR</p>



			<p>of mines.</p> <p><b>Demonstration scenarios:</b>  <b>Clyde trials (September 2024):</b> The prototype RNMB Apollo successfully demonstrated flexible and rapid deployment in a complex maritime environment.  <b>Swarming demonstration (October 2025):</b> Five unmanned craft were remotely controlled from 500 miles away and conducted a swarming circuit around HMS Tyne, demonstrating long-range control of an autonomous mine-countermeasures fleet.  <b>Live ordnance event (April 2025):</b> As part of the system-qualification phase, the programme achieved its first successful live launch from an ROV, neutralising a simulated threat.</p>		
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## Annex Table 2 — Germany: Major Development Projects

Project Name	Participants (Role)	Period	Project Overview / MASS Specifications	ROC / Remote Operation Status	Current Status	References
(1) iPortus	<p>Principal consortium partners:  Hamburg Port Authority: coordination and regulatory expertise  Fraunhofer Center for Maritime Logistics and Services (CML): autonomous navigation and navigational safety  Kongsberg Maritime Germany GmbH: integration of navigational safety and maritime technology  Associated partners:  Federal Maritime and Hydrographic Agency (BSH); the Free Hanseatic City of Bremen (represented by bremenports and Niedersachsen Ports);  HafenCity University Hamburg (HCU);  NVL B.V. &amp; Co. KG (Naval Vessels Lürssen).</p>	From 2026	The project aims to safely integrate semi-autonomous, remote-monitorable low-emission surface craft (Autonomous Surface Vehicles: ASVs) into complex port environments. As part of the project, five different ASVs are to be deployed in real-world ports and in a simulation environment that replicates these complex settings.	The project also aims to develop the remote operation centre (ROC) and, with particular emphasis on cybersecurity, to establish the regulatory foundations for the routine autonomous operation of vessels in German ports.	Ongoing	<a href="#">Annex 2(1)-1</a> News <a href="#">Annex 2(1)-2</a> Fraunhofer



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(2) CAPTN Initiative	A range of partners from industry, academia and government. The full list is published on the project website.	Launched in 2018	The foundation of the project is the development of a passenger ferry linking the eastern and western shores of the Kiel Fjord.	Includes the CAPTN Fjord 5G sub-project, which provides the high-bandwidth, low-latency network required for remote monitoring and "shore-to-ship" control.  A significant milestone in the CAPTN Initiative was the establishment of a remote operations centre at Anschütz, Kiel.	Ongoing	<a href="#">Annex 2(2)-1</a> Anschütz <a href="#">Annex 2(2)-2</a> CAPTN
(3) Digitales Testfeld Elbe (Digitest Elbe)	Fraunhofer IFF, Fraunhofer CML, Galileo-Testfeld Sachsen-Anhalt, Otto von Guericke University Magdeburg, Thorsis Technologies GmbH. Funded by the German Federal Ministry of Transport and Digital Infrastructure.	2022 – 2025	The project aims to prepare inland navigation for future autonomous transport, with a particular focus on the use of unmanned vessels (drone ships).	Principal objectives of the project include technological integration through the development of equipment using ITS-G5 to improve communication between vessels and infrastructure.	Completed	<a href="#">Annex 2(3)-1</a> NDR <a href="#">Annex 2(3)-2</a> Fraunhofer <a href="#">Annex 2(3)-3</a> Thorsis
(4) DigitalSOW2	Technical University of Berlin University of Rostock Supported by the German Federal Ministry of Transport and Digital Infrastructure.	2025 – 2027	The project aims to develop and operate a digital test field for automated and networked navigation on the Spree–Oder Waterway. Its purpose is to investigate the dynamic behaviour of variable, highly automated pushed-convoy configurations.		Ongoing	<a href="#">Annex 2(4)-1</a> DigitalSOW2
(5) AutoGnom	Flensburg University of Applied Sciences Flensburger Schiffbau-Gesellschaft (shipbuilder): construction of the vessel.	From 2022	The project aims to develop an electrically powered passenger ferry that will ultimately operate fully autonomously across the Flensburg Fjord.		Ongoing	<a href="#">Annex 2(5)-1</a> Flensburger <a href="#">Annex 2(5)-2</a> AutoGnom
(6) Schuppi	Marinom GmbH (project lead; aspects of autonomous navigation and steering) Green Fuels GmbH (research into alternative propulsion systems) Lloyd Werft / Rönner Group (construction and technical support) Port of Bremen	From 2025	The demonstrator "Schuppi" was developed under a commission from the State of Bremen to demonstrate the feasibility of introducing an autonomous harbour ferry in the new-shipyard district of Bremerhaven.	The system is controlled by the open-source software "ArduPilot" and is capable of autonomous navigation along defined waypoints.	Ongoing	<a href="#">Annex 2(6)-1</a> Schuppi News <a href="#">Annex 2(6)-2</a> Schuppi News
(7) AISchiff	Marinom GmbH Topas Industriemathematik Innovation gGmbH Sloman Neptun and Boluda	From 2024	The project aims to develop technologies and methodologies enabling automated and autonomous shipping operations.	Vessels are equipped with appropriate environment-sensing sensors and the	Ongoing	<a href="#">Annex 2(7)-1</a> University of Bremen

	Towage University of Bremen North German Maritime Cluster			hardware required for autonomous control.		
(8) MS WVELAB	Kiel University Anschütz GmbH (navigation- system supplier) Addix GmbH (5G communications-infrastructure supplier) Wissenschaftszentrum (WiZe) Kiel GmbH	2023 – 2027	MS WVELAB is an autonomous research catamaran used for data collection and analysis in ocean research. The project aims to develop autonomous- navigation technology on the Kiel Fjord.		Ongoing	<a href="#">Annex 2(8)-1</a> WVELAB News <a href="#">Annex 2(8)-2</a> WVELAB News <a href="#">Annex 2(8)-3</a> WVELAB News <a href="#">Annex 2(8)-4</a> WVELAB News
(9) MUM	TKMS GmbH (project coordinator) Atlas Elektronik Fraunhofer Institute EvoLogics GmbH German Aerospace Centre (DLR) Institute for Maritime Infrastructure Protection University of Rostock Technical University of Berlin	From 2019	The project aims to develop a modular autonomous underwater robot for use in a variety of applications, including offshore inspection and deep-sea exploration.		Ongoing	<a href="#">Annex 2(9)-1</a> MUM Project <a href="#">Annex 2(9)-2</a> TU Berlin <a href="#">Annex 2(9)-3</a> Naval News
(10) Galileo Nautic	RWTH Aachen University University of Rostock	2023 – 2024	The project aims to develop a state-of-the-art interconnected transport system using three autonomous vessels in safety-critical waters.		Completed	<a href="#">Annex 2(10)-1</a> RWTH Aachen

### Annex Table 3 — Netherlands: Major Development Projects

Project Name	Participants (Role)	Period	Project Overview / MASS Specifications	ROC / Remote Operation Status	Current Status	References
(1) Novimar	22 partners, including logistics operators, industry, public authorities and research institutions <a href="#">Member list</a>	2017 – 2021	The project aims to develop and operate so- called "vessel trains" for waterborne transport on short-sea, sea–river and inland routes.	Although not autonomous navigation (and not an ROC) in the strict sense, the following vessels are remotely operated from a lead vessel.	Completed	<a href="#">Annex 3(1)-1</a> Novimar Project
(2) Roboat	Massachusetts Institute of Technology (MIT) and Amsterdam Institute for Advanced Metropolitan	2015 – 2022	The project aims to develop autonomous, electric, zero-emission vessels for urban waterways.	Roboat uses Light Detection and Ranging (LiDAR) data for localisation and mapping.	Completed	<a href="#">Annex 3(2)-1</a> Roboat News <a href="#">Annex 3(2)-2</a>



	Solutions (AMS Institute) Supported by the City of Amsterdam, the Amsterdam water-utility Waternet and the City of Boston.					Roboat Project <a href="#">Annex 3(2)-3</a> TU Delft <a href="#">Annex 3(2)-4</a> EU News
(3) FerryGo	MARIKO GmbH, Vereniging FME, Doeksen, AG Reederei Norden-Frisia, DLR research institute, Kroes Marine Projects, YP Your Partner BV, Abeking & Rasmussen, Schiffs- und Yachtwerft SE, and Kaiko Systems GmbH	2024 – 2027	The project aims to operate an autonomous-ferry service across the Wadden Sea spanning Germany and the Netherlands.		Ongoing	<a href="#">Annex 3(3)-1</a> News <a href="#">Annex 3(3)-2</a> ICD
(4) Joint Industry Project (JIP)	Multiple partners; an outline is given on slide 16 of the project presentation.	2017 – 2019	The project brought together industry, government and research institutions to develop, test and integrate unmanned-vessel technologies.		Completed	<a href="#">Annex 3(4)-1</a> Joint Project <a href="#">Annex 3(4)-2</a> Final Report
(5) Researchlab Autonomous Shipping (RAS)	Project lead: Delft University of Technology (TU Delft) Participation from a diverse range of stakeholders across science, policy and industry <a href="#">Member list</a>	From 2019	The focus is on autonomous navigation when passing through bridges and locks, autonomous mooring and unmooring, and navigation among autonomous and non-autonomous vessel traffic.	Each vessel has different sensor and hardware configurations, making the platform suitable for experiments in a wide range of scenarios — from dynamic positioning under environmental disturbances to complex multi-vessel navigation and obstacle-avoidance manoeuvres.	Ongoing	<a href="#">Annex 3(5)-1</a> RAS <a href="#">Annex 3(5)-2</a> TU Delft
(6) Fugro	Company		Fugro has introduced advanced unmanned surface vessels (USVs) in the Netherlands to carry out sustainable remotely operated maritime inspection and survey work.	Fugro is controlled from its ROC and is engaged in tasks such as inspecting offshore wind farms and conducting geophysical surveys.		<a href="#">Annex 3(6)-1</a> Fugro

#### Annex Table 4 — Denmark: Major Development Projects

Project Name	Participants (Role)	Period	Project Overview / MASS Specifications	ROC / Remote Operation Status	Current Status	References
(1) RECOTUG™ Project	Svitzer A/S, Kongsberg Maritime and the American	Launched in 2021	The project aims to deliver the world's first commercial tugboat to be fully operated from a	Provides a remotely operated tugboat	This is an ongoing development and	<a href="#">Annex 4(1)-1</a> Svitzer



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	Bureau of Shipping		shore-based remote operation centre. A harbour tug of 25 metres in length, fitted with two 2,000 kW engines, equipped with Kongsberg's K-Chief 700 vessel automation, monitoring and control system and the SeaAware system.	capable of performing the full towage cycle — from leaving the berth, transiting to the assisted vessel, making fast, completing towage operations, returning to its mooring and making fast — from the ROC.	demonstration project targeting future commercial remote-tug operation. At present, the tug does not yet appear to be operating in Copenhagen as a fully authorised, routine commercial remote-controlled tugboat.	<a href="#">Annex 4(1)-2</a> Kongsberg
(2) SVITZER HERMOD	Danish Maritime Authority, Port of Copenhagen (trial area)	Developed in 2017	2016: Tugboat designed by Robert Allan Ltd. and built by Sanmar (Türkiye) Rolls-Royce DP system with a remote link; two MTU 16V4000 M63 engines (2,000 kW each); bollard pull of 70 tonnes 28 / 12 m	The master operates the vessel from the ROC during continuing test voyages. During test activities a crew remains aboard the vessel.	The vessel remains in service.	<a href="#">Annex 4(2)-1</a> DMA <a href="#">Annex 4(2)-2</a> Sanmar
(3) Trial of a remotely operated workboat in waters south of Funen	TUCO Yards (Faaborg) and Sea Machines	Trials of a remotely operated workboat manufactured by TUCO Yards are currently under way in waters south of Funen. The technologies being tested have been developed by the US company Sea Machines (SM300).	TUCO designs autonomous vessels including tugs, patrol craft, ice-capable workboats and ROV support vessels. Sea Machines systems have been installed on the ProZero 11 m towing drone, the ProZero DCW 9 m Arctic workboat, the ProZero DCW 15 m ROV support vessel and the ProZero 11 m patrol craft.	To enable unmanned operation of the ProZero series, Tuco has worked together with Sea Machines to develop the remote-pilotage navigation system.	No information later than 2019 has been identified in available sources. While the ongoing TUCO remotely operated workboat trials with Sea Machines technology south of Funen are listed as an active project, no detailed progress reports, completion timelines or 2025–2026 deployment plans have been published.	<a href="#">Annex 4(3)-1</a> DMA <a href="#">Annex 4(3)-2</a> News <a href="#">Annex 4(3)-3</a> News <a href="#">Annex 4(3)-4</a> Tuco
(4) Remote and data-driven pilotage trial programme	DanPilot and Danelec have been authorised by the Danish Emergency Management Agency to carry out trials of remote pilotage that guide vessels from ashore using only advanced data transmitted directly from the vessels. The trials use vessels operating in the trial area. Conducted jointly with several shipping companies, including Maersk.	28 months (including approximately 50 pilotages); commenced May 2025	Targets vessels with a draft of less than 13 metres in the Kattegat and the western Baltic Sea.	Pilotage is conducted from the control centre in Randers, and is carried out only on transits where pilotage is not compulsory.	Ongoing	<a href="#">Annex 4(4)-1</a> DanPilot <a href="#">Annex 4(4)-2</a> News <a href="#">Annex 4(4)-3</a> DMA



(5) Saildrone Denmark	Close cooperation between Saildrone, the Danish Defence Command, the Danish Defence Acquisition and Logistics Organisation (DALO), the Royal Danish Naval Command and the Danish Defence Innovation Unit	Four Saildrones were deployed for a three-month mission in summer 2025	Saildrone: Length 10 m, wing height 6 m; unmanned surface vessel (USV) Designed for coastal surveillance and coastal-zone survey missions Endurance between resupplies: 100 days		Completed	<a href="#">Annex 4(5)-1</a> Saildrone <a href="#">Annex 4(5)-2</a> Saildrone <a href="#">Annex 4(5)-3</a> Saildrone <a href="#">Annex 4(5)-4</a> Saildrone
(6) Fjordbussen / GreenHopper	Through ShippingLab, the partners — the Port of Aalborg, Logimatic, Danelec, Tuco Marine ApS – ProZero Workboats, Wärtsilä and DTU Electro — have developed an autonomous system enabling unmanned operation of the harbour bus.	Around 2017 – 2022	The small electric catamaran built by Tuco (Faaborg) is fitted with an autonomous control system developed by DTU. It has carried 24 passengers, including bicycles and prams, across the Limfjord between Utzon Center (Aalborg) and Stigsborg Brygge (Nørresundby).	However, the City of Aalborg decided not to take on the operation; at present there are no concrete plans for regular operation across the Limfjord, and the vessel is instead being considered for use as a future trial and educational platform.	The vessel has successfully completed sea-acceptance tests, has demonstrated that it can operate without crew, and is technically ready and certified for use as a passenger vessel.	<a href="#">Annex 4(6)-1</a> ShippingLab <a href="#">Annex 4(6)-2</a> News <a href="#">Annex 4(6)-3</a> News
(7) SLGREEN	More than 20 partners from industry, academia and the public sector Supported by the Innovation Fund Denmark, the Danish Maritime Fund and the Lauritzen Foundation	A three-year cross-sector innovation project on the ShippingLab platform	N/A	Not applicable	Launched in May 2024. SLGREEN focuses on three interrelated pillars: digitalisation, decarbonisation and safety. Through digital tools, data-driven operations and autonomous technologies, the project aims to enable smarter and more efficient vessel operations.	<a href="#">Annex 4(7)-1</a> ShippingLab <a href="#">Annex 4(7)-2</a> SDU

## Annex Table 5 — Spain: Major Development Projects

Project Name	Participants (Role)	Period	Project Overview / MASS Specifications	ROC / Remote Operation Status	Current Status	References
(1) USV VENDAVAL	<b>Ceuta Port Authority:</b> Project owner and principal operator <b>Navantia Sistemas:</b> Software development, system integration and supply of	<b>2019:</b> Construction and trials began <b>December 2019:</b> Delivered	<b>Hull:</b> 10.23 m monohull in naval aluminium, fitted with a 350 hp outboard engine and an auxiliary electric motor for emergencies <b>Speed:</b> Up to 25 knots <b>Endurance and operating modes:</b> Fully	"Vendaval" is managed through a dedicated ROC installed at the Ceuta Port Authority's facilities.	Fully operational. Carries out continuous surveillance, maritime-traffic control	<a href="#">Annex 5(1)-1</a> Navantia <a href="#">Annex 5(1)-2</a> Aister <a href="#">Annex 5(1)-3</a> Naval

	remote-control equipment <b>AISTER Shipyards:</b> Builder, responsible for the naval aluminium structure and the integration of mechanical and logical systems	to the Port of Ceuta and entered service <b>2022:</b> Successfully integrated with Spanish Navy vessels for NATO exercises	autonomous, remotely operated and optional manned operating modes. In autonomous mode, the vessel follows automatic routes plotted from a pre-mapped chart and "geographic coordinates". <b>Sensors:</b> LIDAR, RADAR, AIS, FLS sonar, 360° video cameras, thermal cameras, a fluorometer and a meteorological station. <b>Communications:</b> Navantia's NAIAD system is used for secure transmission of data and video, supporting real-time monitoring and mission tasking from ashore or from a mother ship.	The ROC fully replicates the bridge, enabling operators to monitor navigation systems such as GPS and radar in real time. The system can also be integrated with external command centres, thereby extending the area of operations.	and environmental-protection missions in Ceuta. Functions as a key asset for Manned-Unmanned Teaming (MUM-T) in Spanish Navy naval-tactical operations.	News
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## Annex Table 6 — France: Major Development Projects

Project Name	Participants (Role)	Period	Project Overview / MASS Specifications	ROC / Remote Operation Status	Current Status	References
(1) DANAE Programme (autonomous surface drone with on-board weapons capability)	<b>Defence Innovation Agency (AID):</b> Funding <b>French Navy:</b> Joint lead <b>Defence Procurement Agency (DGA):</b> Naval-technology expertise and support from its test centres <b>Industry partners:</b> Exail, Sirehna, Thales, SeaOwl Group, Marine Tech, Keys4sea and SEAir	<b>2025:</b> Project call for proposals <b>January 2026:</b> Phase 1 begins <b>2027/2028:</b> Target for operational capability	<b>Autonomy:</b> Advanced decision-making AI for threat classification and navigation in adverse environments. Fitted with surface radar, sonar and electro-optics. <b>Theatre of operations:</b> Coastal and open-sea operations.		<b>Phase 1:</b> 19–23 January 2026 — evaluation of seven surface drones and selection of the top three <b>Phase 2:</b> 12–18 months — design and development of prototypes by the three short-listed candidates, followed by selection of the system to be adopted <b>Phase 3:</b> Full production and deployment by the French Navy by 2027	<a href="#">Annex 6(1)-1</a> AID News <a href="#">Annex 6(1)-2</a> AID News <a href="#">Annex 6(1)-3</a> News <a href="#">Annex 6(1)-4</a> News <a href="#">Annex 6(1)-5</a> Marine Tech News <a href="#">Annex 6(1)-6</a> News
(2) ARROW Project (Autonomous high-speed Reconnaissance and Operational Watercraft)	<b>SEAir</b> – project leader and coordinator <b>European Defence Agency</b> – indirect management European Defence Fund – funding (€7.5 million) A <b>European consortium</b> of 10 participating organisations from 8 EU Member States: C&V Defence, D3 Applied	2025 – 2028 July 2025: Official launch <b>End of 2028:</b> Prototype delivery planned	<b>Vessel type and size / tonnage</b> 12 m "flying" USV Speed: 35–45 knots 50% fuel-consumption reduction  <b>Level of autonomy</b> Fully autonomous or manned operation		<b>Ongoing:</b> The design phase is scheduled for completion by the end of 2025. Sea trials are to commence in 2026, with a fully operational prototype scheduled to be completed in 2028.	<a href="#">Annex 6(2)-1</a> Naval News <a href="#">Annex 6(2)-2</a> Naval News <a href="#">Annex 6(2)-3</a> ARROW <a href="#">Annex 6(2)-4</a> OpexNews <a href="#">Annex 6(2)-5</a> CNV

	Technologies, Knierim Yachtbau GmbH, Maritime Robotics AS, Rīgas Tehniskā universitāte, TalTech, Sierra Tango, Maxwell Applied Tech, EU3STAR B.V.					Defence <a href="#">Annex 6(2)-6</a> The Defense Post
(3) CEMAS Project	<b>RTsys</b> – project leader <b>IM Solutions</b> – industry partner <b>IES</b> (joint CNRS-UM research unit 5214) – research partner <b>France 2030 – AMI CORIMER 2021</b> – co-funder	2022 – 2026 Full prototype trials and environmental-evaluation phase to be completed in early 2026	Autonomous surface station powered by solar and wind energy. <b>Autonomy:</b> Designed for "full energy self-sufficiency," enabling it to remain at sea for several months. Acts as a docking station for autonomous underwater vehicles (AUVs).	Remote operation centre functions via satellite (Starlink / Kymeta) enable "over-the-horizon" control.	Following successful sea trials in 2024–2025, the technology is now being integrated into broader French Navy programmes such as SLAMF (the next-generation mine-countermeasures system).	<a href="#">Annex 6(3)-1</a> CEMAS Project <a href="#">Annex 6(3)-2</a> IM Solutions <a href="#">Annex 6(3)-3</a> CEMAS Project
(4) SEMNA II Project (Expert Multi-Platform System for Autonomous Navigation)	<b>iXblue (EXAIL)</b> – project leader <b>Other consortium members:</b> Forssea Robotics, DONECLE, ENSM, IFREMER, The Bees, CS – industry partners <b>ENSM</b> – research partner	<b>Start date:</b> 1 June 2021 <b>2021 – 2026:</b> The initial three-year period has been extended to 2026 through a project amendment to complete the certification of multi-drone operations.	Rather than a single vessel, a next-generation bridge system. Integrates AI-based obstacle detection and data fusion from radar / LiDAR, enabling "State 4" (unmanned) autonomous navigation. A "smart-ship" architecture resilient to GPS spoofing and jamming.	Development of a standardised remote operations centre (ROC) interface designed on ergonomic principles to reduce operator cognitive load.	Final validation of "multi-platform" command capability is currently under way. Endorsed by Pôle Mer Méditerranée and funded through the France 2030 (CORIMER) programme.	<a href="#">Annex 6(4)-1</a> ENSM <a href="#">Annex 6(4)-2</a> SEMNA II
(5) ROSS Project (Remotely Operated Service at Sea)	<b>Project leader:</b> SeaOwl <b>Partners:</b> Bureau Veritas (certification), Marlink (satellite communications), Safran Electronics & Defense (cyber-secure PNT / navigation), Storm Studio (design / ergonomics) <b>Support:</b> Funding from ADEME (Investissements d'Avenir)	2019 – 2028 <b>2020:</b> Proof of concept <b>2023–2028:</b> Establishment of series-production arrangements and construction of the fleet	<b>Vessel type and size / tonnage</b> Commercial vessel Length: 80 metres 3,000 tonnes  <b>Level of autonomy</b> Unmanned  <b>Demonstration scenarios</b> Demonstrated response to multiple scenarios, including weather events that interrupt communications connectivity and cybersecurity attacks detected through tampering with GPS signals.	Full remote control of a vessel (Paris–Toulon). A remote operation centre installed on a shore-based site. Navigators have full 360° all-round situational awareness, radar and VHF control, as if on board.	SeaOwl's next steps are to validate the ROSS concept on newly built vessels designed for the provision of services to offshore platforms. The "Proof of Concept" (PoC) was successfully completed (2020). The project is now being scaled up to a fleet of around 20 electric-propulsion remotely controlled vessels for the global offshore market.	<a href="#">Annex 6(5)-1</a> SeaOwl <a href="#">Annex 6(5)-2</a> Naval News <a href="#">Annex 6(5)-3</a> News <a href="#">Annex 6(5)-4</a> Bureau Veritas
(6) ROBOAT Ferry	<b>Technology lead:</b> Roboat	2022 – 2026	<b>Vessel type and size / tonnage</b>	Controlled from a shore-	Following the	<a href="#">Annex 6(6)-1</a>

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	<p>(MIT spin-off / AMS Institute) <b>Shipbuilder:</b> Holland Shipyards Group <b>French operator:</b> Sequana Développement <b>Sponsors:</b> Voies Navigables de France and the Agency for the Promotion of Innovation in Transport</p>	<p>December 2022: Won the tender September 2022: Construction began 2024 – 2026: Trial operation in Paris</p>	<p>Length – 9 m Beam – 3.9 m Draught – 0.9 m</p> <p><b>Level of autonomy</b> Fully autonomous</p> <p><b>Sensors:</b> Automatic docking, automatic charging and collision avoidance via LiDAR, radar and cameras <b>Operating waters:</b> High-traffic waterways (river transport, ferry routes)</p>	<p>based control centre for fleet management.</p>	<p>conclusion of the 2024 Olympic Games period, the vessel will continue to operate in Paris as an innovation platform (2025–2026), demonstrating a regular autonomous public-transport route.</p>	<p>MASS World News <a href="#">Annex 6(6)-2</a> VNF News <a href="#">Annex 6(6)-3</a> Roboat <a href="#">Annex 6(6)-4</a> Uncrewed Systems</p>
<p>(7) MCMC Programme — Canopus / Rigel (Maritime Mine Counter-Measures); SLAM-F (France)</p>	<p><b>Management:</b> OCCAR (Organisation Conjointe de Coopération en matière d'Armement) <b>Prime contractor:</b> Thales (system integration and sonar) <b>Principal partners:</b> Exail, BAE Systems, Saab, and L3Harris / Couach (USV hull) Funding: French Defence Procurement Agency (DGA)</p>	<p><b>2015 – 2030</b> and beyond <b>2015:</b> Contract concluded <b>2021:</b> Prototype delivered <b>2024 – 2025:</b> Series-production deliveries <b>2027 – 2028:</b> Full operational capability expected</p>	<p><b>Vessel type and size / tonnage</b> 12 metres</p> <p><b>Level of autonomy</b> Unmanned surface vessel — AI-driven obstacle avoidance and Automatic Target Recognition (ATR) using Mi-Map software</p> <p><b>Sensors and communications systems</b> Towed Synthetic-Aperture Multi-view (TSAM) sonar</p>	<p>Portable Operations Centre (e-POC), or shore-based Operations Centres (SOC) in Brest and Toulon. Future operation from a "mother ship" will also be possible.</p>	<p>The French Navy received its first series-production USV (Canopus) in December 2024 and its second USV (Rigel) in October 2025. The Royal Navy received its first system in March 2025. Operational evaluation is currently under way (2026).</p>	<p><a href="#">Annex 6(7)-1</a> Thales <a href="#">Annex 6(7)-2</a> OCCAR <a href="#">Annex 6(7)-3</a> Thales <a href="#">Annex 6(7)-4</a> Joint Forces</p>
<p>(8) CHOF</p>	<p><b>Lead:</b> SHOM and the French Defence Procurement Agency (DGA) <b>Industry partners:</b> Exail (USV), RTsys (micro AUV), Kongsberg Discovery (deep-sea AUV)</p>	<p>2024 – 2030 March 2024: Investment plan launched 2025 / 2026: First drone deliveries</p>	<p><b>Vessel type and size / tonnage</b> Length 7.71 metres 1.6 tonnes Marlin (DriX H-8) and the new DriX H-9; 24/7 operation <b>Speed:</b> 12 knots</p> <p><b>Sensors and communications systems</b> A range of sensors, including cameras, laser profilers, sub-bottom profilers, magnetometer, methane, CO<sub>2</sub> and oxygen sensors. <b>Autonomy:</b> AI-driven obstacle avoidance and decision-making autonomy (adjusting the mission path on the basis of real-time seabed data).</p>	<p>Controlled via satellite / UHF from the GHOA (Groupe Hydrographique et Océanographique de l'Atlantique) in Brest.</p>	<p>Marlin (DriX H-8) is in service Delivery of Hugin Superior is scheduled for the first quarter of 2026 NemoSens is scheduled for delivery in the first half of 2026 DriX H-9 is scheduled for delivery in the first quarter of 2027</p>	<p><a href="#">Annex 6(8)-1</a> SHOM <a href="#">Annex 6(8)-2</a> Baird Maritime <a href="#">Annex 6(8)-3</a> Hydro International <a href="#">Annex 6(8)-4</a> SHOM</p>
<p>(9) XLUUV</p>	<p><b>Naval Group:</b> System integrator <b>Thales:</b> Sonar / sensors <b>Sirehna:</b> Autonomy / dynamics <b>DGA:</b> Customer</p>	<p><b>2010:</b> Launched <b>2022 – 2023:</b> Major upgrade to autonomous-navigation</p>	<p><b>Vessel type and size / tonnage</b> Length 17 metres Beam 7.5 metres Catamaran with an aluminium hull 25 tonnes</p>	<p>Operated through ROCs based in Brest or Lorient.</p>	<p>An operational test platform. After a decade of mine-clearance duties, the vessel has been</p>	<p><a href="#">Annex 6(9)-1</a> Naval News <a href="#">Annex 6(9)-2</a> PECH Alu</p>



		functions <b>2025 – 2026:</b> Sea trials	<b>Level of autonomy</b> "Level 3" autonomy (remote monitoring and management)		converted in recent years into an "experimental ship" that tests technologies for future medium-sized and large unmanned surface vessels (MUSVs and LUSVs).	<a href="#">Annex 6(9)-3</a> Naval Drones
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## Annex Table 7 — Italy: Major Development Projects

Project Name	Participants (Role)	Period	Project Overview / MASS Specifications	ROC / Remote Operation Status	Current Status	References
(1) 5GMASS	TIM (project leader), CNIT (the National Inter-University Consortium for Telecommunications), CETENA, FlySight, Grimaldi Group; with the support of the Italian Coast Guard and the Livorno Port Authority	Approximately 2022–2024	A demonstration using a Grimaldi Group Ro-Ro vessel (Eco Savona). The system integrates sensors, HD cameras, LIDAR and ECDIS data to support assisted and semi-autonomous navigation, particularly for manoeuvring and berthing within ports.	The ROC installed at the CNIT research facility in Livorno enables shore-based monitoring during entry and departure operations, supports situational awareness, and assists the bridge team.	The demonstration phase has been completed, with the potential to be rolled out to other vessels and ports.	<a href="#">Annex 7(1)-1</a> European Space Agency
(2) I-MASTER Project	CNR-INM (prime contractor), Spaceexe Srl, YetItMoves Srl, Engineering S.p.A.; supported by ESA, ASI and the Italian Coast Guard	2024 – 2027 (Phase 1: 2024–2025; Phase 2 scheduled for 2025–2027)	Development of a national test range for MASS using approximately 10-metre autonomous-surface-vessel models to validate AI navigation, sensor fusion and operational procedures. Target capability: experimental trials at MASS Level 3+.	The infrastructure includes a control centre, a data centre and an ROC connected via VDES and communications systems to enable remote and autonomous-operation testing.	Research project ongoing. Phase 1 design has been completed; operational trials are expected by 2027.	<a href="#">Annex 7(2)-1</a> NAVISP News <a href="#">Annex 7(2)-2</a> CNR News
(3) "Quirinale" (N.I.O.M.) hydro-oceanographic vessel	Italian Navy, Fincantieri, the defence research ecosystem	Delivery planned: around 2026	Hydro-oceanographic vessel replacing the "Ammiraglio Magnaghi". It is expected to support the operation of unmanned and autonomous maritime systems for seabed surveys and oceanographic missions.	Rather than vessel-level autonomy, the design envisages integration with remote and autonomous survey systems (USVs / UUVs) operated from the vessel.	Under development as part of the modernisation programme of the Italian Navy.	<a href="#">Annex 7(3)-1</a> Fincantieri
(4) GSAB 1	Grimaldi Group, Kongsberg Maritime, Radiolabs; ESA NAVISP programme	2022 – 2024	Development of the first satellite-guided berthing-assistance system for large PCTC (pure car / truck carriers) Focus on decision-supporting navigation during berthing manoeuvres.	The system integrates satellite navigation, situational awareness and manoeuvring-prediction tools to assist bridge crews during port	Initial phase completed; the berthing-assistance concept has been validated.	<a href="#">Annex 7(4)-1</a> GSAB



				entries.		
(5) GSAB 2	Grimaldi Deep Sea S.p.A. (lead), Kongsberg Maritime, the Radiolabs Consortium, RINA Services	2024 – 2027 (36 months)	Evolution of the GSAB system for large Ro-Ro and PCTC vessels. Demonstrates autonomy Level 2 (operator on board, supporting decision-making) and studies the requirements for Level 3 autonomy (autonomous action under supervision).	Uses satellite-based multi-sensor positioning, AI algorithms and integration with vessel-automation systems to achieve partly autonomous berthing manoeuvres.	Ongoing. Equipment design, laboratory tests and shipboard tests are planned.	<a href="#">Annex 7(5)-1</a> Grimaldi
(6) AUTOSHIP (Initiative for Autonomous Navigation in European Waters)	PNO Innovation, Kongsberg Maritime, Sintef Ocean AS, University of Strathclyde, Eidsvaag AS, ZULU Associates, Bureau Veritas, DE VLAAMSE WATERWEG NV	Approx. 2019 – 2023	Development of two autonomous demonstrator vessels for short-sea shipping and inland waterways. Technologies include autonomous navigation, self-diagnosis and automated operations scheduling.	Includes a shore-based control network and remote-operation infrastructure enabling monitoring and control of the autonomous vessels.	The demonstration phase has been completed; the technologies have reached TRL 7 (prototype demonstration in an operational environment).	<a href="#">Annex 7(6)-1</a> AUTOSHIP Project <a href="#">Annex 7(6)-2</a> CORDIS

## Annex Table 8 — Greece: Major Development Projects

Project Name	Participants (Role)	Period	Project Overview / MASS Specifications	ROC / Remote Operation Status	Current Status	References
(1) SmartMove	University of the Aegean, Intelligent Transport Systems Laboratory	Not specified	The Laboratory advances intelligent maritime-transport systems through interdisciplinary research and practical applications. Its work includes the autonomous surface vessel "AeroSEA 1", designed for long-duration ocean-data-collection missions in the Aegean; "C.U.A.K.", the Laboratory's first autonomous surface vessel; and a swarm of eight identical small autonomous surface vessels designed for cooperative multi-agent operations.	AeroSEA 1 uses a high-performance autopilot that provides reliable GPS-waypoint navigation, autonomous mission execution and real-time telemetry. The C.U.A.K. vessels employ GPS-waypoint navigation and autonomous control.	Ongoing	<a href="#">Annex 8(1)-1</a> SmartMove
(2) WARRANT (Greece participates as a partner in this international project)	Greek participants are Danaos Shipping and the National Technical University of Athens	2025 – 2028	The project develops a unified methodology and digital platform to enhance the safety, resilience and cybersecurity of Waterborne Digital Systems (WDS).	Information on ROC arrangements is not specified, but the project develops tools for hazard analysis, fault simulation and real-time risk management.	Ongoing	<a href="#">Annex 8(2)-1</a> WARRANT Project