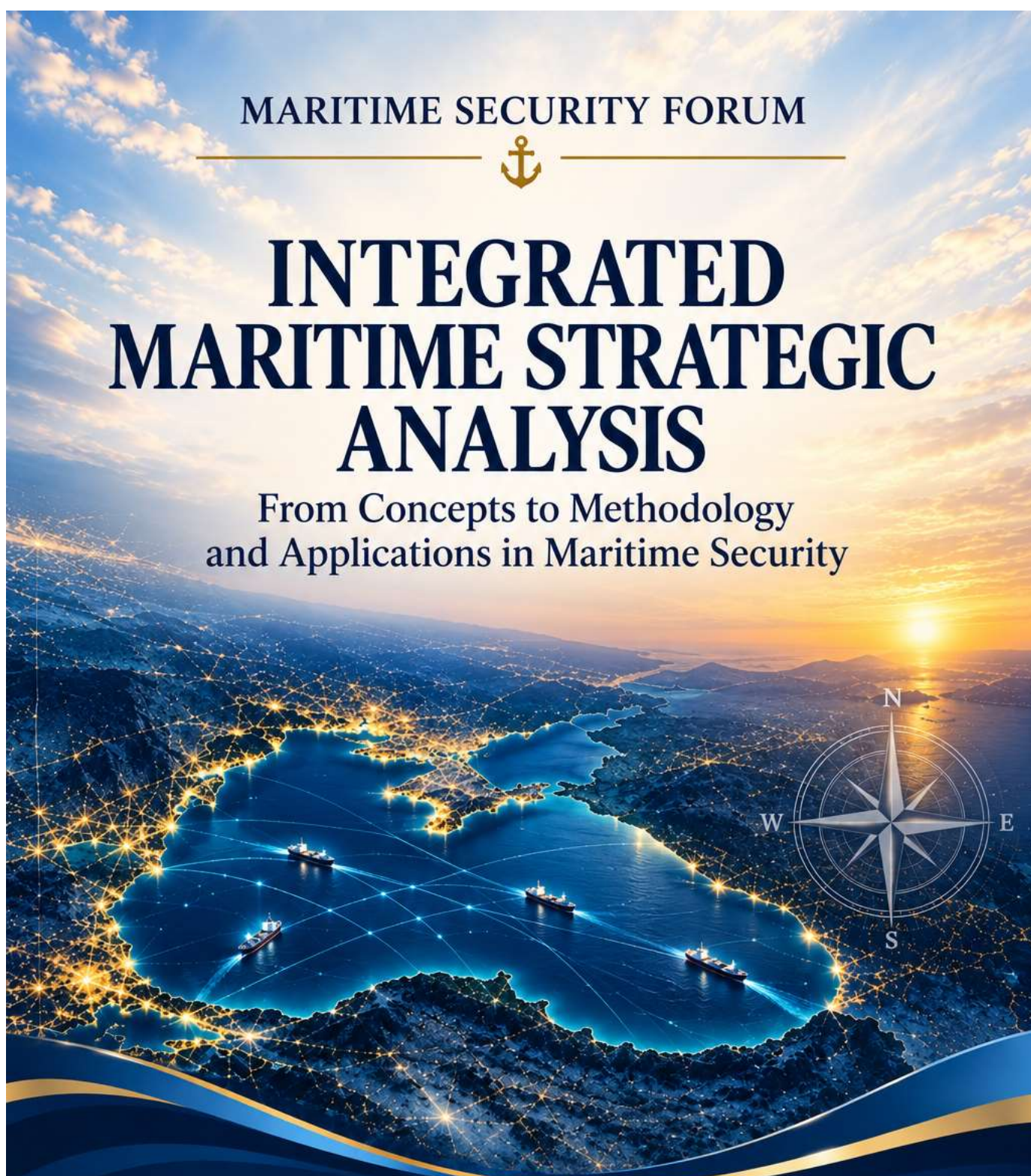


MARITIME SECURITY FORUM



INTEGRATED MARITIME STRATEGIC ANALYSIS

From Concepts to Methodology
and Applications in Maritime Security



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BUCHAREST
OCTOBER 2026

INTEGRATED MARITIME STRATEGIC ANALYSIS – From concepts to methodology and applications in maritime security

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Authors' Note

This study, 'Integrated Maritime Strategic Analysis: From Concepts to Methodology and Applications in Maritime Security', represents the continuation and development of the research initiated by the study 'The Maritime Strategic Ecosystem'. Whilst the first paper sought to establish the conceptual foundations and identify the interdependencies that define the contemporary maritime strategic environment, the second marks the transition from theoretical construction to the operationalisation of concepts and their effective use in strategic analysis. Through the development of the Maritime Strategic Convergence Framework (MSCF) and the Integrated Maritime Security Architecture (IMSA), the authors propose an integrated methodology, illustrated by its application to the Black Sea. The two studies thus constitute complementary stages of the same scientific endeavour, aimed at developing tools for understanding, assessing and anticipating the dynamics of maritime security.

Abstract

The complexity of the contemporary maritime environment calls for the development of strategic analysis tools capable of examining, in an integrated manner, the interdependencies between critical infrastructure, trade and energy flows, military capabilities, emerging technologies, legal regimes and institutional mechanisms. This study aims to operationalise the concept of the Maritime Strategic Ecosystem (MSE) and to develop an integrated methodology for identifying strategic concentrations, explaining convergence mechanisms and assessing capacities for continuity, adaptation and anticipation. The research articulates five complementary concepts: the Maritime Strategic Centre of Gravity (MSCoG), Maritime Strategic Convergence (MSC), Maritime Strategic Resilience (MSR), Maritime Strategic Elasticity (MSEL) and Maritime Cognitive Superiority (MCS). These are integrated through the Maritime Strategic Convergence Framework (MSCF), structured in six analytical stages, and correlated with the Integrated Maritime Security Architecture (IMSA), organised across five interdependent functional levels. The applicability of the methodology is examined through an analysis of the systemic transformations of the Black Sea ecosystem during the period 2022–2026, using documented events: the application of the Montreux Convention in the context of the Russian–Ukrainian war; the operation and cessation of the Black Sea Grain Initiative; the reorientation of trade flows via the Danube and the European Union's Solidarity Corridors; and the development of the Ukrainian maritime corridor after August 2023. The analysis highlights the distinction between maintaining or restoring strategic functions – associated with resilience – and reconfiguring relationships, infrastructures and operational mechanisms – associated with elasticity. The integrated strategic assessment indicates the existence of differentiated adaptive capacities, conditioned by systemic vulnerabilities, infrastructural constraints, and legal and institutional mechanisms. A prospective exercise complements the empirical analysis, illustrating the possibilities for the anticipatory use of the methodology. The scientific contribution of the study lies in articulating the concepts of MSE, MSCoG, MSC, MSR, MSEL and MCS within a coherent methodological framework, in which the MSCF systemic diagnosis is complemented by the IMSA functional and institutional assessment. The methodology provides a basis for formulating transparent and verifiable strategic assessments, with the potential for comparative application across different maritime ecosystems; its extensive empirical validation serves as a guide for further research.

Keywords: Strategic Maritime Ecosystem; Integrated Maritime Strategic Analysis; Maritime Strategic Centre of Gravity; Maritime Strategic Convergence; Maritime Strategic Resilience; Maritime Strategic Elasticity; Maritime Cognitive Superiority; MSCF; IMSA; Black Sea security.

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Introduction. From maritime interdependence to integrated strategic analysis

The contemporary maritime domain is a strategic environment in which naval power, critical infrastructure, commercial transport, energy and digital systems, emerging technologies, international legal norms and institutional mechanisms interact in a dynamic configuration. The strategic importance of these components stems not only from their individual characteristics, but also from the relationships of interdependence, complementarity and vulnerability that form between them. Consequently, maritime strategic analysis must be able to explain both the distribution of resources and capabilities, and the mechanisms through which interactions between components influence the functioning and transformation of the system as a whole.

This necessity becomes evident in situations where a localised disruption produces consequences beyond its initial scope. Restricting access to a maritime corridor can affect the functioning of ports, the capacity of land-based infrastructure, the continuity of supply and institutional response options. Damage to energy or digital infrastructure can simultaneously alter operating conditions, economic security and coordination capacity. In such situations, the strategic significance of an event cannot be determined solely by assessing the affected component, but requires an examination of the interdependencies through which its effects can be transmitted and amplified.

Maritime strategic thinking has developed important tools for interpreting the relationships between the sea, power and the political organisation of space. Alfred Thayer Mahan highlighted the links between naval power, trade and international influence, whilst Julian Corbett explored in greater depth the relationship between maritime communications, naval operations and political objectives. Subsequent contributions by Ken Booth and Geoffrey Till broadened the examination of the functions of naval power, whilst contemporary research on maritime security and governance—including that developed by Christian Bueger—has highlighted the plurality of actors, practices and domains involved in maritime security.

These perspectives provide a relevant foundation for current research. The issue investigated in this study does not concern their individual shortcomings, nor the need to replace established concepts, but rather the possibility of organising the relationships between the various dimensions of the maritime environment within an integrated analytical framework. The existence of specialised tools for assessing naval power, infrastructure, risks, transport or legal regimes does not, in itself, provide an explanation of the mechanisms through which the results of these assessments influence one another.

In this context, a significant methodological challenge lies in moving from identifying the relevant components to explaining their systemic functioning. An inventory of critical infrastructure does not automatically establish which of these harbour decisive strategic dependencies. The identification of interdependencies does not demonstrate the mechanisms through which they produce cumulative effects. Identifying a vulnerability does not, without further assessment, allow for an evaluation of the system's capacity to maintain essential functions or to reorganise itself. Similarly, the availability of information does not guarantee the ability of actors to interpret changes and to make informed decisions.

In light of these difficulties, this research employs the concept of the Maritime Strategic Ecosystem (MSE), developed in previous research, as a relational unit of analysis. The MSE refers to the dynamic ensemble of actors, infrastructures, technologies, legal norms, flows and strategic processes whose interactions influence the functioning, vulnerabilities and transformations of the maritime environment. This definition allows the maritime space to be examined not only as a geographical or operational environment, but also as a system of functions and interdependencies that can extend beyond its physical boundaries.

However, identifying the ecosystem is not sufficient for conducting a strategic analysis. It is necessary to develop tools through which the researcher can determine where strategic importance is concentrated, how transformations occur, which functions can be maintained under conditions of disruption, how the system can be reorganised, and to what extent actors can interpret and anticipate these processes.

To this end, the conceptual framework examined integrates five complementary concepts: the Maritime Strategic Centre of Gravity (MSCoG), Maritime Strategic Convergence (MSC), Maritime Strategic Resilience (MSR), Maritime Strategic Elasticity (MSEL) and Maritime Cognitive Superiority (MCS).

Each concept fulfils a distinct analytical function. MSCoG enables the investigation of the concentration of strategic functions and dependencies. MSC directs the analysis towards the mechanisms

through which interactions between components generate cumulative or emergent effects. MSR focuses on the continuity and restoration of essential functions, whilst MSEL examines the possibilities for structural reconfiguration through which these functions can be sustained. MCS introduces the dimension of information integration, the interpretation of interdependencies and anticipation, with superiority itself presupposing the existence of an explicit comparator.

The relevance of these concepts to strategic research should not be assessed solely on the basis of their definitions, but rather through the analytical operations they enable. A concept becomes useful when it can guide the selection of information, the formulation of questions, the identification of relevant relationships and the construction of well-reasoned conclusions. From this perspective, the central issue of this article is the transformation of the conceptual framework into a methodology that can be applied, critically examined and used comparatively.

The central research question is as follows: *How can the concepts of the Maritime Strategic Ecosystem be operationalised and used in an integrated manner to identify strategic concentrations, explain the mechanisms of convergence, assess functional continuity and reconfiguration, and examine cognitive and institutional response capacity?*

This question is complemented by a distinct methodological issue: under what conditions can the results obtained by applying these concepts be brought together into a coherent, transparent and independently verifiable strategic assessment?

The working hypothesis posits that the coordinated use of these five concepts, within an explicit procedure, may enable the identification and explanation of systemic relationships that risk being insufficiently highlighted by the separate examination of ecosystem components. This hypothesis concerns the explanatory potential of methodological integration and does not imply, in the absence of empirical comparisons, the proven superiority of the model over existing tools.

The main objective of the research is to systematise and operationalise the MSE architecture by developing a strategic analysis procedure and demonstrating how it can be used. The specific objectives aim to define the analytical functions of the concepts, establish the relationships between them, formulate the methodological stages, examine the functional and institutional conditions for application, and illustrate the procedure through an analysis of the Black Sea.

Methodological integration is achieved through the Maritime Strategic Convergence Framework (MSCF), organised into six stages: delineating the ecosystem, identifying centres of gravity, analysing convergence, separately assessing resilience and elasticity, examining the cognitive dimension, and formulating the integrated strategic diagnosis. This structure aims to translate concepts into research operations, with each stage contributing results relevant to the interpretation of the whole.

The methodological framework is complemented by the Integrated Maritime Security Architecture (IMSA), designed as an analytical model of the functional organisation of maritime security. IMSA examines five interdependent levels: the strategic environment, actors, convergence processes, resilience and elasticity, and the cognitive-decision-making dimension. The model does not entail the establishment of a new organisation or the modification of existing legal powers, but rather enables the investigation of the institutional, legal and operational conditions that influence the management of strategic interdependencies.

The relationship between the MSCF and the IMSA is a central element of the research. The MSCF enables the construction of a systemic diagnosis, whilst the IMSA examines the functional conditions under which vulnerabilities can be managed and the identified alternatives activated. The results of the institutional analysis may alter the assessment of the feasibility of certain options and may necessitate a review of the initial diagnosis. Consequently, the two tools are used complementarily, within an iterative analytical process.

The research methodology combines conceptual and doctrinal analysis, the comparative delineation of analytical categories, the modelling of systemic relationships, and the demonstrative application of the MSCF–IMSA protocol. The operationalisation of concepts aims to link them to research questions, identification criteria, categories of information, and explicit analytical results. Particular attention is paid to distinguishing between documented findings, analytical inferences and hypothetical scenarios, in order to avoid confusing potential developments with empirically demonstrated results.

The Black Sea is used as a case study due to the interactions between maritime and continental functions, logistical and energy infrastructures, security conditions, legal regimes and institutional mechanisms. The analysis aims to delineate the regional ecosystem, identify candidate centres of gravity, examine convergence mechanisms and assess the possibilities for continuity and reconfiguration. A

hypothetical scenario involving the prolonged disruption of a maritime trade corridor is used to demonstrate the sequence of analytical operations and the relationship between the MSCF diagnosis and the IMSA functional assessment.

The application does not aim to provide an exhaustive assessment of Black Sea security, nor does it seek definitive empirical validation of the proposed architecture. Its purpose is to demonstrate the use of these concepts within a structured investigation, highlighting the results that each operation can yield, the informational limitations, and the conditions necessary for the development of subsequent comparative assessments.

The research's contribution manifests itself on three complementary levels. At the conceptual level, the study systematises the relationships between the dimensions of the strategic maritime ecosystem and delineates the analytical functions of the derived concepts. At the methodological level, it develops the MSCF as a protocol for investigating interdependencies and systemic transformations. At the functional level, it integrates IMSA to examine the conditions of coordination, continuity, adaptation and decision-making. The originality sought lies in the articulation of these dimensions within a common analytical procedure, the additional explanatory value of which remains open to empirical verification.

The paper is structured progressively, moving from conceptual foundations to operationalisation and application. Following an examination of the origins of the MSE and the relationships between the derived concepts, the paper analyses terminological delimitations and criteria for use, presents the MSCF protocol and develops the IMSA functional model. Its application to the Black Sea highlights the integrated use of the tools, whilst the final analysis examines the reproducibility, limitations and transferability of the methodology.

Through this approach, the research aims to contribute to the development of a strategic maritime analysis in which the identification of components is complemented by an explanation of the relationships between them, an assessment of systemic behaviour under conditions of disruption, and an examination of anticipation and response capabilities. The aim is not to multiply strategic terminology, but to construct a research tool through which the complexity of the maritime environment can be investigated in a coherent, well-reasoned and applicable manner.

The Origins of the Maritime Strategic Ecosystem and the Foundations of a New Conceptual Architecture

The evolution of the subject of maritime strategic analysis: from naval power to systemic interdependence

The development of maritime strategic concepts has traditionally been driven by shifts in the relationships between power, geography, the economy and the political organisation of the maritime domain. From classical theories of maritime power to contemporary approaches to maritime security and governance, the scope of analysis has progressively expanded, reflecting the growing complexity of the relationships between the use of the sea, the interests of states and the functioning of the international system.

In Alfred Thayer Mahan's strategic thinking, maritime power constitutes a fundamental component of international influence, being associated with the development of trade, naval capability, port infrastructure and geographical position. Julian Corbett explored the political-strategic dimension of maritime operations in greater depth, highlighting the importance of maritime communications and the instrumental nature of naval power in relation to political objectives.

Subsequently, the development of maritime studies led to the expansion of analysis beyond the military dimension. Ken Booth highlighted the multiple functions performed by naval forces, whilst Geoffrey Till integrated economic, technological, political and institutional dimensions into the analysis of maritime power. Research on maritime security, including that carried out by Christian Bueger, has contributed to an understanding of the relationships between maritime threats, economic security, navigational safety, environmental protection and governance.

These developments have significantly expanded the discipline's explanatory power. However, the diversification of research topics does not automatically lead to a unified methodology for analysing the relationships between them. Naval power, infrastructure security, legal regimes, commercial transport and

emerging technologies can be investigated using specialised tools, but the effects generated by their interaction require an additional perspective.

The issue becomes particularly important when transformations in one field alter the functioning of other fields. The digitalisation of port infrastructure can boost economic efficiency, but may simultaneously create cyber dependencies. The development of offshore energy infrastructure can alter the strategic relevance of certain areas, generating new requirements for protection, surveillance and institutional cooperation. Restrictions on navigation can have logistical, economic, legal and security consequences that extend beyond the geographical area in which they were imposed.

Consequently, strategic maritime analysis must be able to explain not only the characteristics of individual components, but also the mechanisms through which their interaction alters the functioning of the system as a whole.

This necessity forms the starting point for the conceptual framework developed in previous research and further explored in this study.

The limitations of sectoral analysis and the need for a systemic research framework

Sectoral analysis is an indispensable component of strategic research. It allows for an in-depth investigation of military capabilities, infrastructure, trade flows, legal regulations or technological risks. Its limitations, however, become apparent when conclusions drawn at the level of a single component are used to explain a system whose properties result from the interaction of multiple components.

A port infrastructure can be assessed in terms of its operational capacity, physical vulnerabilities or economic importance. However, its strategic significance may also depend on its connectivity with land transport, access to energy resources, integration into digital networks, the applicable legal framework and the possibility of substitution by other infrastructure.

Similarly, a maritime corridor may be of high economic importance, without this characteristic fully reflecting its strategic relevance. This may increase or change when the corridor simultaneously becomes the subject of military competition, legal constraints, energy dependencies and information vulnerabilities.

In such situations, strategic value can no longer be determined solely by the sum of sectoral characteristics. It must also be assessed in terms of the intensity of interdependencies, the degree of concentration of critical functions, the potential for the spread of disruptions, and the system's capacity to respond to changes.

This highlights the need for a framework for analysis that simultaneously integrates three dimensions:

The structural dimension, represented by actors, infrastructure, resources, legal norms and networks;

The functional dimension, represented by flows, interactions, dependencies and strategic processes;

The adaptive dimension, represented by continuity, reorganisation, anticipation and transformation.

The Maritime Strategic Ecosystem is proposed as a unit of analysis capable of bringing these dimensions together within a common explanatory model.

The Maritime Strategic Ecosystem: from systemic analogy to a distinct strategic concept

The concept of an ecosystem is used in several fields to describe systems characterised by interdependence, interaction and transformation. However, applying such a perspective to maritime strategic analysis requires more than simply using a terminological analogy.

As defined in previous research, **the Maritime Strategic Ecosystem (MSE)** refers to a dynamic system of relationships between actors, infrastructure, technologies, legal norms, resources, flows and strategic processes, whose operational properties, vulnerability and adaptability stem from the interdependence of its components.

The specificity of the concept does not lie in the mere bringing together of different fields, but in identifying the relationships that transform the individual components into an interdependent strategic whole.

This perspective entails four fundamental characteristics.

The first characteristic is relationality. The importance of a component cannot be determined solely by its individual properties, but must be examined in relation to the functions and dependencies it generates within the system.

The second characteristic is multidimensionality. The ecosystem simultaneously integrates the military, legal, economic, energy, technological, informational and institutional dimensions, without implying that these are always of equal importance.

The third characteristic is emergence. Interactions between components can produce effects that cannot be adequately explained by analysing each component in isolation. A relatively minor change can generate significant systemic consequences when it affects a node on which multiple functions depend.

The fourth characteristic is adaptability. The ecosystem is not a static structure, but a system whose relationships and operating mechanisms can change under the influence of disruptions, technological innovations, regulatory changes and strategic decisions.

These characteristics distinguish the Maritime Strategic Ecosystem from a mere geographical description of a maritime area or a list of the actors and infrastructure present within it.

A strategic ecosystem may be geographically delimited, but its functioning is not determined exclusively by spatial boundaries. Economic, technological, energy and legal relationships can link a maritime basin with infrastructure and actors located at considerable distances. Consequently, the analytical delimitation must be carried out in accordance with the research question and the relationships relevant to it.

This observation has direct methodological implications. The analysis of the Black Sea, for example, cannot automatically be reduced to its geographical area. Depending on the research focus, defining the ecosystem may require examining connections with the Turkish Straits, with continental port and logistics infrastructure, with energy markets, and with institutions involved in regional governance and security.

The MSE thus becomes a unit of analysis that is flexible in terms of its boundaries, yet rigorous in identifying the relevant components and relationships.

The need for derived concepts: from describing the system to explaining how it works

The introduction of the Maritime Strategic Ecosystem allows for the identification of the general subject of the analysis, but does not, in itself, explain all the processes that determine the system's behaviour.

A fundamental systemic concept must be supplemented by tools capable of answering distinct analytical questions: where strategic importance is concentrated, how systemic transformations occur, under what conditions essential functions are maintained, how the system reorganises itself, and through what mechanisms information is transformed into strategic knowledge.

This necessity has led to the development of the five derived concepts.

The Maritime Strategic Centre of Gravity: identifying systemic concentrations

The classical concept of the centre of gravity, associated with the Clausewitzian tradition and subsequently developed in military doctrine, is used to identify sources of power or capability that are decisive in relation to the objectives of a conflict.

Within the Maritime Strategic Ecosystem, this research proposes a distinct conceptual application.

The Maritime Strategic Centre of Gravity (MSCoG) designates a node or functional cluster within the ecosystem where critical, interdependent interests, dependencies and functions are concentrated, the functioning or disruption of which can produce systemic consequences for the maritime strategic environment.

This definition shifts the focus from an actor's source of power to the concentration of functions and interdependencies at the ecosystem level.

An MSCoG should not be identified exclusively with a geographical point. It may be spatial, infrastructural or functional in nature, and its delineation depends on the relationships that confer strategic importance upon it.

Identifying such a centre requires an examination of the concentration of flows, dependencies, the importance of the functions performed, and the possibilities for substitution. A highly visible piece of

infrastructure does not automatically constitute a maritime strategic centre of gravity; its relevance must be demonstrated by the effects that its operation or disruption may have on the ecosystem.

In the model's terminology, *maritime strategic gravity* can be used to describe the property of concentrating and attracting strategic interests and dependencies, whilst MSCoG designates the node or functional entity in which this property manifests itself. This terminological distinction helps to avoid overlap between the mechanism and the object of analysis.

Maritime Strategic Convergence: explaining the transformations brought about by interdependence

Identifying strategic concentrations is not sufficient to explain the behaviour of the ecosystem. It is necessary to examine the processes through which its components interact and produce cumulative effects.

Maritime Strategic Convergence (MSC) refers to the dynamic process whereby the interaction between actors, infrastructure, technologies, legal norms and strategic processes generates cumulative or emergent effects capable of altering the functioning and configuration of the Maritime Strategic Ecosystem.

Strategic convergence should not be confused with mere institutional cooperation or the operational integration of capabilities.

Cooperation presupposes the existence of relationships between actors. Operational integration aims to coordinate resources and actions. Strategic Maritime Convergence, however, examines how the interaction between different domains produces effects on the system, even in the absence of a common intention to cooperate.

Convergence can generate favourable effects, such as increased coordination capacity, but also additional vulnerabilities, by amplifying interdependencies and the potential for the propagation of disruptions.

Consequently, the MSC analysis involves identifying the relationships between domains, the direction of influences, the mechanisms of propagation and the resulting effects.

Maritime Strategic Resilience: maintaining the functionality of the ecosystem

Systemic interdependence creates both opportunities and vulnerabilities. In an ecosystem characterised by multiple connections, a disruption to one component can affect functions in other domains.

Maritime Strategic Resilience (MSR) refers to the capacity of the Maritime Strategic Ecosystem to absorb disruptions, limit the spread of their effects, and maintain or restore essential strategic functions.

Unlike a sector-specific assessment of infrastructure resilience, MSR examines functional continuity at the ecosystem level.

This distinction is important because a piece of infrastructure may be technically resilient, whilst the system of which it forms part remains vulnerable due to external dependencies, a lack of logistical alternatives or insufficient institutional coordination.

Maritime Strategic Resilience must therefore be analysed in relation to critical functions, existing redundancies, response capacity, recovery mechanisms and knock-on effects.

Maritime Strategic Elasticity: structural adaptation and system reorganisation

Resilience does not fully explain the behaviour of a transforming ecosystem. In certain situations, maintaining essential functions requires modifying the structure and operating mechanisms, rather than reverting to the previous configuration.

Maritime Strategic Elasticity (MSEL) refers to the capacity of the Maritime Strategic Ecosystem to reconfigure its structure, relationships and operating mechanisms in response to changes in the strategic environment, whilst retaining its ability to fulfil its fundamental functions and objectives.

Elasticity complements resilience, without replacing it.

Whilst resilience addresses the question of the continuity of functions under conditions of disruption, elasticity explains how these functions can be maintained through the reorganisation of the system.

The reconfiguration of logistics routes, the diversification of links between infrastructure networks, changes to cooperation mechanisms, or the integration of new technologies may all be manifestations of elasticity when they bring about a relevant functional transformation at the ecosystem level.

Consequently, resilience and elasticity must be assessed together, but using distinct criteria.

Maritime Cognitive Superiority: the integration of knowledge and strategic foresight

Identifying strategic focal points, examining convergence and assessing resilience and elasticity require the ability to interpret information from different domains.

The established concepts of *Maritime Domain Awareness* and *Information Superiority* provide important benchmarks for understanding the maritime situation and gaining an information advantage. However, the proposed model aims to further highlight the role of systemic interpretation, anticipation and the transformation of knowledge into strategic decision-making.

Maritime Cognitive Superiority (MCS) refers to the relative capacity of an actor or an institutional framework to integrate and interpret multidimensional information about the Maritime Strategic Ecosystem, to anticipate relevant changes and to underpin strategic decisions that are better adapted to the system's evolution.

The relative nature of this superiority is essential. Possessing large volumes of data or advanced technologies does not, in itself, demonstrate the existence of cognitive superiority.

This must be assessed through the quality of interpretation, the ability to identify interdependencies, the anticipation of systemic effects and the relevance of the resulting decisions.

In the proposed architecture, the cognitive dimension is not merely a final stage of the analysis. It contributes continuously to the identification of centres of gravity, the interpretation of convergence, the assessment of vulnerabilities and the adaptation of strategic responses.

Correlating concepts: from individual notions to an explanatory architecture

The five derived concepts describe different dimensions of the same ecosystem, and their scientific value must be assessed both individually and in terms of their ability to produce an integrated explanation.

The relationships between them are not exclusively linear.

A centre of gravity may concentrate interdependencies that favour convergence processes, but convergence may, in turn, alter the distribution of centres of gravity. Resilience can limit the propagation of the effects of disturbances, whilst elasticity can alter the structure of dependencies and, by extension, the future configuration of the ecosystem. Cognitive superiority influences the identification and interpretation of all these processes, whilst being itself dependent on the quality of information and the functioning of institutional networks.

The result is an architecture characterised by interdependence and feedback, rather than by a rigid sequence of stages.

From this perspective, the relationship between concepts can be summarised by five fundamental questions:

Where does strategic importance lie? – The Maritime Strategic Centre of Gravity.

How do the components interact and what effects do they produce? – Maritime Strategic Convergence.

Which functions can be maintained in the face of disruption? – Maritime Strategic Resilience.

How can the ecosystem be reorganised without losing fundamental functions? – Maritime Strategic Elasticity.

How can these transformations be understood and anticipated to inform decision-making? – Maritime Cognitive Superiority.

The Maritime Strategic Ecosystem constitutes the framework within which these questions acquire shared significance.

Their methodological integration is achieved through the Maritime Strategic Convergence Framework (MSCF), whilst their application to the analysis of functional organisation, coordination and governance processes is achieved through the Integrated Maritime Security Architecture (IMSA).

The epistemological and methodological significance of the proposed architecture

The development of a new conceptual vocabulary in a scientific field involves more than simply formulating definitions. Concepts must identify distinct analytical objects or relationships, be distinguished from existing terminology, and allow for the formulation of explanations that are open to critical examination.

From this perspective, the architecture of the Maritime Strategic Ecosystem proposes a shift in the level of observation: from individual components to the relationships between components, and from the description of strategic configurations to the explanation of systemic transformations.

This shift does not entail abandoning classical theories or sectoral tools. On the contrary, the model aims to integrate their findings into an analysis capable of identifying dependencies, cumulative effects, adaptive mechanisms and decision-making implications.

For this contribution to go beyond the level of a theoretical construct, additional conditions are required: terminological consistency, the definition of observable indicators, the clarification of analytical procedures, and the possibility of comparative application across different maritime areas.

In this regard, the present study is not limited to a mere reiteration of the conceptual framework previously established. It aims to translate the proposed architecture into an operational analytical language, in which each concept can be linked to research questions, data categories, evaluation criteria and interpretative findings.

The Black Sea will be used to demonstrate this possibility, without its geographical and geopolitical characteristics being confused with the general limits of the model's applicability.

Consequently, the intended contribution does not lie in multiplying the terms in the maritime security vocabulary, but in formulating a coherent conceptual architecture capable of supporting a distinct mode of strategic analysis.

Conceptual standardisation and functional correlation of the Maritime Strategic Ecosystem architecture

This section moves from the theoretical foundation to the practical application of the terminology. The aim is for each concept to be definable, identifiable, distinguishable and applicable by an analyst who did not participate in the drafting of the initial study.

The analysis retains the five derived concepts and the two integrative tools, MSCF and IMSA. We shall also introduce an important methodological distinction: a concept may be proposed as original, but its scientific utility must be demonstrated through observable criteria, explanatory results and the possibility of application in different contexts.

Terminological standardisation as a condition for scientific transferability

The introduction of a new conceptual framework into maritime strategic analysis requires a language that is sufficiently precise to enable its use by researchers and analysts who did not participate in the development of the original model. In the absence of standardised terminology, concepts risk being interpreted differently, overlapping with established notions, or being used merely as descriptive expressions without any distinct methodological value.

Consequently, the operationalisation of the Maritime Strategic Ecosystem must begin with the establishment of reference definitions, standardised abbreviations and criteria that enable the empirical identification of the phenomena described.

This requirement is of particular importance in the context of the objective of disseminating the model internationally. The translation of terms into English must preserve the conceptual identity of the original formulations, avoiding the emergence of multiple equivalents that could affect their recognition and use in the specialist literature.

The proposed standardisation does not aim to establish a closed or unamendable vocabulary. On the contrary, the definitions are formulated in such a way as to allow for the application, critical evaluation and further development of the model, without losing its fundamental coherence.

From this perspective, each concept must fulfil four conditions: it must denote an identifiable phenomenon or property; it must answer a distinct analytical question; it must be distinguishable from related concepts; and it must allow for association with relevant data and indicators.

Conceptual Glossary of the Maritime Strategic Ecosystem

Table 1 presents the proposed reference terminology for use in maritime strategic research and analysis.

Table 1. Terminological glossary of the proposed conceptual architecture

Romanian term	English equivalent	Abbreviation
Ecosistem Strategic Maritim	Maritime Strategic Ecosystem	MSE
Centru de Greutate Strategic Maritim	Maritime Strategic Centre of Gravity	MSCoG
Convergență Strategică Maritimă	Maritime Strategic Convergence	MSC
Reziliență Strategică Maritimă	Maritime Strategic Resilience	MSR
Elasticitate Strategică Maritimă	Maritime Strategic Elasticity	MSEL
Superioritate Cognitivă Maritimă	Maritime Cognitive Superiority	MCS
Cadrul Convergenței Strategice Maritime	Maritime Strategic Convergence Framework	MSCF
Arhitectura Integrată a Securității Maritime	Integrated Maritime Security Architecture	IMSA

The eight elements do not belong to the same theoretical level. MSE represents the fundamental unit of analysis; MSCoG, MSC, MSR, MSEL and MCS constitute the five derived concepts; MSCF represents the methodological tool for integration; and IMSA denotes the functional model for organising the relationships between the components of the ecosystem.

This distinction is essential. It prevents MSCF and IMSA from being used merely as synonyms for the Maritime Strategic Ecosystem and allows a clear relationship to be established between the subject of the research, the explanatory tools and the implementation mechanisms.

Operational definitions and identification criteria

Conceptual definitions establish the meaning of terms, but their analytical use also requires specifying the conditions under which the respective phenomena can be identified.

An operational definition should not be confused with a single indicator or a numerical score. It represents the link between the theoretical meaning of the concept and the observations that enable it to be examined within a specific strategic context.

The Maritime Strategic Ecosystem (MSE)

Reference definition: The Maritime Strategic Ecosystem is the dynamic ensemble of actors, infrastructure, resources, legal norms, technologies, flows and strategic processes whose interdependencies determine the functioning, vulnerabilities and transformations of a maritime environment.

Analytical object: the maritime relational system as a whole.

Identification criteria: the existence of interdependent components, common or interconnected functions, mechanisms of mutual influence, and the possibility of effects propagating across domains.

Analytical question: what are the components and relationships that determine the functioning of the maritime system under analysis?

The application of MSE begins by defining the scope of the ecosystem in relation to the research problem. This definition may be geographical, functional or a combination of both, and must be explicitly justified.

Maritime Strategic Centre of Gravity (MSCoG)

Reference definition: The Maritime Strategic Centre of Gravity represents a spatial, infrastructural or functional node of the Maritime Strategic Ecosystem, characterised by a concentration of interdependent strategic interests, flows, dependencies and functions, the functioning or disruption of which can have significant effects on the ecosystem.

Analytical object: the concentration of strategic importance and systemic dependencies.

Identification criteria: the concentration of critical functions, connectivity, dependence on other components, difficulty of substitution and the scale of potential knock-on effects.

Analytical question: where are the functions and dependencies concentrated whose alteration could influence the entire ecosystem?

In this sense, a MSCoG is not necessarily a military target and does not automatically represent a vulnerability that must be neutralised. The concept serves an explanatory and diagnostic function, being designed to identify strategic concentrations and their implications.

The Maritime Strategic Centre of Gravity can be used to describe the intensity of concentration and the capacity to attract strategic interests, without being treated, in this framework, as a sixth independent derived concept.

Maritime Strategic Convergence (MSC)

Reference definition: Maritime Strategic Convergence represents the dynamic process through which interactions between the legal, military, economic, energy, technological, informational and institutional components of the Maritime Strategic Ecosystem generate cumulative or emergent effects on the functioning and transformation of the system.

Analytical focus: interdependencies and mechanisms of systemic transformation.

Identification criteria: the existence of cross-domain influences, the propagation of effects, feedback loops, the transformation of dependencies and the emergence of consequences that extend beyond the initial domain.

Analytical question: through what mechanisms do interactions between components alter the functioning of the ecosystem?

Convergence does not necessarily imply cooperation or the harmonisation of interests. It can also be generated through competition, conflict, asymmetric dependence or disruption.

Maritime Strategic Resilience (MSR)

Reference definition: Maritime Strategic Resilience is the capacity of the Maritime Strategic Ecosystem to absorb disturbances, limit the spread of their effects and maintain or restore essential strategic functions to an acceptable level of performance.

Analytical focus: the functional continuity of the ecosystem under conditions of disruption.

Identification criteria: the existence of redundancies, the continuity of critical functions, the capacity to respond, recovery time, the availability of alternative resources and the limitation of cascading effects.

Analytical question: Which strategic functions can be maintained or restored when the ecosystem is affected?

Resilience must be examined at the level of system functions, not merely in terms of the survival of individual infrastructure.

Maritime Strategic Elasticity (MSEL)

Reference definition: Maritime Strategic Elasticity represents the capacity of the Maritime Strategic Ecosystem to reconfigure its structure, relationships and operating mechanisms in response to changes in the strategic environment, whilst retaining its fundamental functions and objectives.

Analytical focus: structural adaptation and functional reorganisation.

Identification criteria: diversification of functional configurations, reorganisation of routes and networks, modification of institutional relationships, integration of alternative technologies, and the ability to maintain functions through a different configuration.

Analytical question: how can the ecosystem continue to function through reorganisation when the previous configuration is no longer adequate?

Elasticity should not be confused with the ad hoc flexibility of an organisation. It describes the transformation of the ecosystem's relationships and functional configuration.

Maritime Cognitive Superiority (MCS)

Reference definition: Maritime Cognitive Superiority represents the relative capacity of an actor or an institutional framework to integrate and interpret multidimensional information about the Maritime Strategic Ecosystem, to anticipate relevant developments and to transform the resulting knowledge into a strategic decision-making advantage.

Analytical focus: the capacity for systemic interpretation, anticipation and decision-making.

Identification criteria: the quality of information integration, the identification of interdependencies, the anticipation of consequences, the updating of assessments, the capacity for institutional learning and the relevance of decisions.

Analytical question: to what extent does the capacity for knowledge and anticipation enable the adoption of better-informed strategic decisions?

Cognitive superiority does not automatically result from the volume of information collected or from the use of artificial intelligence. It must be assessed through the quality of interpretation and by reference to an explicit benchmark.

The matrix for operationalising concepts

To facilitate the use of the model, each concept must be associated with categories of observations and data sources.

Table 2. Preliminary matrix for the operationalisation of the conceptual architecture

Concept	Dimension assessed	Indicative indicators	Data categories
MSE	Ecosystem configuration	Actors, infrastructure, flows, regulations, relationships	Strategic documents, maps, economic and institutional data
MSCoG	Strategic concentration	Dependencies, connectivity, substitutability, critical functions	Port, logistics, energy and infrastructure data
MSC	Systemic interdependence	Cross-sectoral influences, cascading effects, feedback	Timelines of events, multi-sectoral analyses, legal documents
MSR	Operational continuity	Redundancy, recovery, service maintenance	Business continuity plans, operational data, risk assessments
MSEL	Adaptive reconfiguration	Alternative routes, reorganisation, functional substitution	Logistical, technological and institutional changes
MCS	Anticipation and decision-making	Data integration, alerts, updating of assessments	Information systems, exercises, assessment and decision reports

The proposed indicators are indicative and do not, at this stage, constitute a statistically validated measurement tool. Their selection must be tailored to the research objective, data availability and level of analysis.

A rigorous assessment must distinguish between observed data, the analyst's estimates and explanatory hypotheses. Furthermore, the absence of information should not automatically be interpreted as the absence of a capability or a phenomenon.

Functional relationships between concepts

The proposed conceptual architecture cannot be reduced to a sequence in which each concept automatically gives rise to the next. The relationships between them are dynamic, multidirectional and context-dependent.

The Maritime Strategic Centre of Gravity may concentrate functions that amplify interdependencies, but convergence processes may alter the distribution of strategic importance and generate new centres of gravity.

Resilience can mitigate the negative effects of convergence when interdependencies amplify the spread of disruptions. Elasticity can alter the structure of these interdependencies, including through the development of functional alternatives.

Maritime Cognitive Superiority influences the ability of actors to identify these relationships and anticipate their transformations, but depends, in turn, on access to information, the quality of institutional processes and the functioning of digital infrastructures.

Table 3. Matrix of functional relationships between derived concepts

Relationship	Explanatory mechanism	Analytical utility
MSCoG – MSC	Concentration of functions and interaction of dependencies	Identification of nodes and systemic effects
MSC – MSR	Propagation of disruptions and continuity capacity	Assessment of interdependent vulnerabilities
MSC – MSEL	Transformation of relationships between components	Analysis of strategic reconfigurations
MSR – MSEL	Functional continuity and structural reorganisation	Distinguishing between recovery and adaptation
MCS – MSCoG	Interpreting the strategic importance of nodes	Prioritising analysis and monitoring
MCS – MSC	Identifying interdependencies and anticipating effects	Developing systemic scenarios
MCS – MSR	Early warning and response preparedness	Justifying continuity measures
MCS – MSEL	Anticipating change and institutional learning	Underpinning reorganisation options

The matrix highlights the fact that each concept helps to explain a distinct aspect, but a complete interpretation of the ecosystem requires the results to be correlated.

A node characterised by high strategic concentration may be relatively resilient, but insufficiently elastic. An ecosystem may possess adaptation mechanisms, without the actors having the cognitive capacity required to anticipate their consequences. Similarly, a high level of interdependencies may generate functional efficiency, but also systemic vulnerabilities.

Therefore, it should not be assumed that strengthening one concept automatically leads to improvements in the others. Relationships must be demonstrated through the analysis of data and specific mechanisms.

Distinguishing from established terminology

To integrate the model into specialist vocabulary, it is necessary to avoid conceptual overlaps.

The Maritime Strategic Ecosystem is not synonymous with the maritime domain, the naval system or the institutional security architecture. It refers to the relational framework that can integrate them all.

The Maritime Strategic Centre of Gravity is not equivalent to a *chokepoint*, as a chokepoint may represent only one of the possible forms of strategic concentration. Furthermore, the MSCoG must not be confused with an adversary's operational centre of gravity.

Maritime Strategic Convergence is not synonymous with interoperability, cooperation or multi-domain operations, as it can also describe unintended, competitive or vulnerability-inducing interdependencies.

Maritime Strategic Resilience must not be reduced to the physical resilience of infrastructure, and Maritime Strategic Elasticity does not simply mean recovery following a disruption. The former concerns functional continuity, whilst the latter concerns the reorganisation of the system.

Maritime Cognitive Superiority is not equivalent to maritime surveillance or to holding an information advantage. It involves interpreting systemic relationships and transforming knowledge into the capacity for anticipation and decision-making.

These distinctions do not imply that the established literature ignores interdependencies, adaptation or anticipation. The proposed contribution lies in integrating these concepts into a specialised terminological framework, built around the Maritime Strategic Ecosystem.

Distinguishing the Maritime Strategic Centre of Gravity and Maritime Strategic Convergence from established approaches

The specificity of the Maritime Strategic Centre of Gravity (MSCoG) must be examined in relation to two distinct analytical traditions: the strategic theory of the centre of gravity and the analysis of centrality in complex networks.

In military doctrine, the centre of gravity is associated with identifying sources of power relevant to the achievement of strategic or operational objectives, and its analysis includes critical capabilities, requirements and vulnerabilities. In network analysis, centrality enables the identification of important nodes through their position and structural relationships.

The MSCoG concept proposed within the Maritime Strategic Ecosystem does not replace these approaches and does not imply that the identification of dependencies or critical nodes constitutes, in itself, a new theoretical contribution. Its distinctive feature lies in integrating these dimensions into an assessment of the concentration of interdependent strategic functions, beyond the boundaries of a single network, infrastructure or category of actors.

In this sense, identifying an MSCoG requires demonstrating its functional relevance to the ecosystem, the dependencies it concentrates, the possibilities for substitution, and the systemic consequences associated with its disruption or reconfiguration. Structural centrality is a possible indicator, but not a sufficient criterion.

Maritime Strategic Convergence (MSC) must, in turn, be distinguished from interdependence, cooperation and operational integration. Interdependence expresses the existence of relationships between components, whilst convergence, in the proposed sense, denotes the process by which interactions between different domains generate cumulative or emergent effects relevant to the transformation of the ecosystem's functioning.

This distinction allows convergence to be examined even in situations characterised by competition, conflict, power asymmetries or unintended disruptions. Convergence is therefore not necessarily associated with the harmonisation of interests, nor with the achievement of favourable outcomes.

From a methodological perspective, identifying a process of convergence involves explaining the mechanisms through which influences are transmitted between domains, any cumulative or emergent effects, and the consequences for the strategic functions of the ecosystem.

Correlating MSCoG and MSC thus allows for the examination of two complementary dimensions: the distribution of strategic concentrations and the transformation of relationships between components. A centre of gravity can amplify the effects of convergence, whilst convergence processes can, in turn, alter the configuration of centres of gravity.

The explanatory value of this correlation must be assessed through documented applications and by comparison with results obtained using established methods of strategic and network analysis.

The Operational Delimitation of Maritime Strategic Resilience and Maritime Strategic Elasticity

The relationship between Maritime Strategic Resilience (MSR) and Maritime Strategic Elasticity (MSEL) requires careful conceptual delineation, given the evolution of research on the resilience of complex systems. The specialist literature does not reduce resilience to the capacity to recover from disruption, but includes mechanisms for adaptation, reorganisation and transformation of functional architectures.

In this context, the proposed distinction between MSR and MSEL does not aim to artificially separate phenomena that may form part of the same adaptive process, but rather to identify two complementary analytical dimensions of the behaviour of the Maritime Strategic Ecosystem.

Maritime Strategic Resilience expresses the ecosystem's capacity to absorb disturbances, limit the spread of their effects and maintain or restore essential strategic functions. Its assessment focuses on functional continuity, the extent of performance degradation, response mechanisms and the conditions for recovery.

Maritime Strategic Elasticity refers to the ecosystem's capacity to modify its relational and functional configuration by redistributing flows, substituting components, reorganising connections and adapting institutional or technological mechanisms, with a view to maintaining fundamental functions and objectives.

The two dimensions are interdependent, but should not be considered equivalent. Functional continuity can be achieved temporarily through robustness, redundancy or recovery, without significant structural reconfiguration. Similarly, the availability of reconfiguration options does not guarantee the maintenance of strategic functions when their activation is delayed, insufficiently coordinated or constrained by legal, technological or economic factors.

Consequently, the distinction between MSR and MSEL is justified within the proposed methodological framework by the possibility of separately assessing functional performance and reconfiguration capability.

This distinction does not imply that structural adaptability is absent from established theories of resilience. The aim of this contribution is to specialise and operationalise this concept for the analysis of strategic maritime ecosystems, in which the interdependencies between infrastructures, actors, flows and legal regimes can give rise to adaptive configurations with different strategic effects.

In applying the Maritime Strategic Convergence Framework (MSCF), the assessment of these two dimensions must employ distinct yet interrelated criteria. MSR can be examined in terms of the continuity of critical functions, the extent of degradation, the duration of recovery and the mitigation of cascading effects. MSEL can be assessed in terms of the availability and activation of functional alternatives, the capacity to redistribute flows, the modification of connections between components and the effectiveness of the new configuration.

The results must be interpreted in context, without assuming an automatic correlation between the levels of the two capabilities. Validating this distinction requires empirical research and comparisons between maritime ecosystems exposed to different disturbances.

The Specificity and Operationalisation of Maritime Cognitive Superiority

Maritime Cognitive Superiority (MCS) falls within a field of research in which the relationship between information, knowledge, anticipation and strategic decision-making already benefits from a significant theoretical and doctrinal foundation. The concepts of Maritime Domain Awareness, Maritime Situational Awareness, Information Superiority and Cognitive Superiority highlight the importance of collecting and integrating information, understanding the operational environment and transforming knowledge into decision-making advantages.

Consequently, MCS is not proposed as a substitute for these categories, nor as a claim to priority over the general concept of cognitive superiority. Its specificity stems from the relationship between cognitive processes and the relational structure, interdependencies and transformations of the Maritime Strategic Ecosystem.

Within the proposed architecture, strategic knowledge is not limited to identifying the actors, activities or threats present in a maritime space. It also entails the ability to explain how changes occurring

at the level of one component can influence the functioning of other components, alter the distribution of strategic importance and generate systemic vulnerabilities or opportunities.

This perspective gives the cognitive dimension a cross-cutting role in relation to the other derived concepts of the Maritime Strategic Ecosystem.

In relation to the Maritime Strategic Centre of Gravity (MSCoG), cognitive capability contributes to the identification and reassessment of concentrations of strategic functions and dependencies. In relation to Maritime Strategic Convergence (MSC), it enables the interpretation of mechanisms through which influences propagate and the anticipation of cumulative or emergent effects. In the analysis of Maritime Strategic Resilience (MSR), the cognitive dimension supports the identification of vulnerabilities and the substantiation of options for functional continuity. In the assessment of Maritime Strategic Elasticity (MSEL), it contributes to the examination of reconfiguration alternatives and the consequences associated with changes to the ecosystem's structure.

Consequently, MCS is not an isolated or exclusively final stage of the analysis, but a dimension that continuously influences the delineation of the ecosystem, the interpretation of information, the construction of scenarios and the review of the strategic diagnosis.

A fundamental condition for operationalising the concept is the distinction between cognitive capacity and cognitive superiority proper. The former can be examined through indicators relating to the quality of information, data integration, the identification of interdependencies, the anticipation of consequences, institutional learning and the substantiation of decisions. The latter requires a comparative assessment, carried out in relation to an actor, an institutional configuration, past performance or an explicit and methodologically justified benchmark.

The mere existence of advanced surveillance systems, large volumes of data or artificial intelligence-based tools does not demonstrate cognitive superiority. This must be underpinned by evidence of relevant comparative performance in interpreting the situation, anticipating changes and underpinning strategic decisions.

Within the Maritime Strategic Convergence Framework (MSCF), the assessment of the cognitive dimension must include identifying information sources, assessing their reliability and limitations, examining cross-sectoral integration capacity, analysing anticipation mechanisms, and evaluating how cognitive outputs are utilised in decision-making processes.

This assessment must distinguish between available information, knowledge actually produced, analytical interpretation and observable decision-making performance. It must also take into account uncertainty, errors of interpretation, information asymmetries and legal and institutional constraints regarding access to and use of data.

Maritime Cognitive Superiority can thus be treated as a specialised analytical dimension of the capacity to understand and anticipate the maritime strategic ecosystem. The intended contribution does not lie in introducing a cognitive category unknown to the existing literature, but in explicitly correlating cognitive assessment with strategic focus, systemic convergence, functional continuity and adaptive reconfiguration.

Validating its explanatory utility involves comparing the results obtained through the proposed methodology with those provided by established tools for situational awareness, strategic analysis and anticipation

From conceptual standardisation to reproducible analysis

The use of a concept by the scientific community presupposes the possibility of its application under explicit methodological conditions.

For the proposed architecture, reproducibility does not mean that different analysts will necessarily reach identical conclusions. It implies that they can use the same definitions, identify comparable data and transparently explain the steps through which they arrive at their own interpretations.

Consequently, an analysis carried out using this framework must specify the boundaries of the ecosystem, the units of observation, the criteria for identifying centres of gravity, the convergence relationships examined, the relevant critical functions, the forms of adaptation observed, and the criteria for assessing the cognitive dimension.

The results must allow for a distinction to be made between empirical findings, analytical interpretations and prospective scenarios.

This requirement represents the link between terminological standardisation and the development of the MSCF methodology.

Consequently, the five derived concepts do not merely constitute a vocabulary intended to describe maritime transformations, but rather a set of analytical categories that can be linked to observations, indicators and interpretative procedures.

In this way, the architecture of the Maritime Strategic Ecosystem can become a transferable research tool, capable of being applied comparatively to maritime regions characterised by different geographical, legal, economic and strategic configurations.

The Maritime Strategic Convergence Framework (MSCF): the integrated methodology for maritime strategic analysis

From conceptual architecture to analytical methodology

The development of a new conceptual architecture constitutes a theoretical contribution only to the extent that the proposed concepts allow for the formulation of distinct and coherent explanations of the phenomena under investigation. To transform this contribution into a strategic analysis tool, it is necessary to develop a methodology that establishes the relationship between concepts, data, examination procedures and results.

This necessity forms the basis of the Maritime Strategic Convergence Framework (MSCF), introduced in previous research as an integrative tool for the Maritime Strategic Ecosystem.

In the proposed sense, **the MSCF represents a methodological framework for the systemic analysis of the maritime strategic environment, through which the concentration of strategic functions, multidimensional convergence, ‘ ’ resilience, elasticity and cognitive superiority are examined in their interdependence, in order to identify vulnerabilities, explain transformations and underpin strategic anticipation.**

The MSCF is neither a theory separate from the Maritime Strategic Ecosystem nor a mere method for aggregating sectoral indicators. It is the tool through which the conceptual architecture is transformed into a procedure for strategic research and interpretation.

This distinction is important because integrated analysis cannot be achieved simply by juxtaposing legal, military, economic, energy or technological assessments. Such an approach would merely replicate the sectoral fragmentation that the model seeks to overcome.

The specificity of the MSCF lies in examining the relationships between these dimensions, the mechanisms through which changes propagate, and the way in which the ecosystem maintains or transforms its functioning.

Consequently, the unit of observation may be an infrastructure, an actor, a maritime corridor or a strategic process, but the unit of interpretation remains the ecosystem and the set of relevant interdependencies.

The methodological principles of the MSCF

The application of the MSCF must adhere to a set of principles that ensure the consistency of interpretation and the model's applicability in different contexts.

The principle of systemic delimitation involves explicitly defining the ecosystem under analysis, its components and the relevant relationships. Geographical boundaries are not sufficient when the functioning of the system depends on flows, infrastructure or decisions located outside those boundaries.

The principle of multidimensional interdependence requires an examination of the relationships between the legal, military, economic, energy, technological, information and institutional spheres, without assuming the existence of a dominant dimension in all situations.

The principle of strategic concentration involves identifying the nodes and functions whose importance stems from the density of interdependencies, their systemic relevance and the potential for far-reaching consequences should they be disrupted.

The principle of dynamics and feedback recognises that the relationships between components change over time, and that decisions taken to manage a disruption may subsequently alter the configuration of the ecosystem.

The principle of functional differentiation requires the separate assessment of resilience and elasticity, even though the two capacities may act complementarily.

The principle of cognitive anticipation involves using the results of the analysis to identify possible developments, without confusing prospective scenarios with certain predictions.

The principle of analytical traceability requires the documentation of sources, assumptions and stages of interpretation, so that conclusions can be critically examined and, under comparable conditions, reproduced.

These principles transform the MSCF from a conceptual framework into a structured methodological protocol.

Protocol for applying the MSCF

For the practical application of the proposed framework, this study develops a protocol comprising six analytical stages. These represent a further operationalisation of the model introduced in the initial study.

The sequence of stages serves a methodological purpose, without implying the existence of a rigid hierarchy between concepts. The analyst may revisit previous stages when new information emerges or when the assessment identifies previously unobserved relationships.

Stage I. Defining the Maritime Strategic Ecosystem

The first stage consists of establishing the subject matter, purpose and scope of the analysis.

The analyst must identify the maritime area under examination, the relevant actors, infrastructure, resources, economic and energy flows, applicable legal norms, technologies and institutional mechanisms that influence the functioning of the system.

The definition must be based on a specific strategic question. For example, an analysis of commercial transport security may require a different ecosystem configuration from that used to assess the protection of offshore energy infrastructure.

This stage must answer the following questions: what are the essential strategic functions, what components support them, what interdependencies exist between them, and what external factors influence the functioning of the ecosystem?

The result is a preliminary map of the ecosystem, highlighting its components and key functional relationships.

Stage II. Identification of Strategic Maritime Centres of Gravity

The second stage aims to identify the nodes where relevant strategic functions and interdependencies are concentrated.

The analyst examines the infrastructure, spaces, corridors and functional clusters that exhibit high connectivity, support critical functions or generate significant dependencies.

Identifying a MSCoG involves more than simply noting its geographical or economic importance. It must be demonstrated that the component in question concentrates strategic relationships and that any change in its functioning could have consequences for other components of the ecosystem.

The main criteria are the concentration of functions, systemic dependence, substitutability, connectivity and the potential for the propagation of disturbances.

The outcome of this stage is a map of strategic concentrations, accompanied by a justification for the identification of each centre of gravity.

Stage III. Analysis of Strategic Maritime Convergence

The third stage examines the processes through which the components of the ecosystem interact and generate systemic effects.

The analyst identifies the relationships between domains, the mechanisms of mutual influence, direct and indirect dependencies, and the possibility of cumulative effects arising.

A change in the legal framework governing shipping may affect commercial transport, logistics costs, energy security and the strategic options available to actors. Similarly, a cyber attack on port infrastructure may have consequences for transport, supply chains and institutional response capacity.

These relationships should not be assumed automatically. They must be identified by examining specific mechanisms and, where data permit, by reconstructing the sequence of events.

The MSC analysis must distinguish between structural interdependencies, situational interactions and emergent effects.

The result is a matrix of strategic convergences, which highlights the relationships between sectors and the possible mechanisms through which effects propagate.

Stage IV. Assessment of Maritime Strategic Resilience and Elasticity

The fourth stage examines the ecosystem's capacity to function under conditions of disruption and its potential for reorganisation.

The resilience assessment aims to identify critical functions, continuity mechanisms, redundancies and recovery capacity.

The assessment of elasticity aims to identify structural alternatives, opportunities for reconfiguring routes and networks, institutional adaptability and the integration of new technological or organisational solutions.

The distinction between these two dimensions must be maintained when interpreting the results.

An ecosystem may temporarily maintain essential functions without having sufficient alternatives to adapt to a prolonged disruption. Conversely, the existence of reorganisation options does not guarantee the immediate continuity of critical functions.

Therefore, resilience and elasticity must be analysed in a complementary manner, but an automatic relationship between their levels should not be assumed.

The result is a profile of the ecosystem's continuity and adaptability, which identifies both existing capabilities and their dependencies and limitations.

Stage V. Assessment of Maritime Cognitive Superiority

The fifth stage examines the ability of relevant actors to transform available data into strategic knowledge and informed decisions.

The analysis focuses on access to information, the integration of multidimensional sources, the ability to identify interdependencies, the development of scenarios and the use of the results in the decision-making process.

Maritime Cognitive Superiority must be assessed against an explicit benchmark, which may be another actor, a different institutional configuration, or the performance of the same system in a previous period.

In the absence of comparable data, the analysis may examine cognitive capability without asserting the existence of demonstrated superiority.

This clarification is important to avoid confusing technological potential with actual strategic advantage.

The outcome of this stage is an assessment of the capacity for information integration, anticipation and decision-making, including the limitations imposed by uncertainty and incomplete access to data.

Stage VI. Integration of results and formulation of the strategic assessment

The final stage brings together the findings obtained by applying the five derived concepts.

The analyst examines how centres of gravity, convergence processes, capacities for resilience and elasticity, and the cognitive dimension collectively influence the functioning of the ecosystem.

Integration must highlight systemic vulnerabilities, opportunities for adaptation, critical interdependencies and possible developments in the strategic environment.

The final result is not necessarily an aggregate score. It may consist of a reasoned strategic assessment, a dependency map, a set of scenarios or a comparative evaluation.

At this stage, the MSCF can provide the results required for the application of the IMSA, by identifying the functional relationships and coordination requirements between the ecosystem's actors.

Methodological and functional complementarity between the MSCF and IMSA

The relationship between the Maritime Strategic Convergence Framework (MSCF) and the Integrated Maritime Security Architecture (IMSA) is a fundamental component of the proposed model. The two tools examine the same Maritime Strategic Ecosystem, but fulfil different and complementary analytical functions.

The MSCF establishes the procedure by which the ecosystem is delineated, strategic focal points are identified, convergence processes are analysed, and functional continuity, adaptive reconfiguration and cognitive-decision-making capacity are assessed. Its main output is the integrated strategic diagnosis.

IMSA examines the functional configuration in which actors, infrastructure, norms, coordination mechanisms and decision-making processes interact to support maritime security. Its main output consists of identifying operating conditions, incompatibilities, coordination gaps and options for institutional or operational improvement.

This distinction does not imply a rigid separation of the two tools. The MSCF assessment may highlight vulnerabilities that require an examination of functional relationships through the IMSA. In turn, the IMSA analysis may identify institutional dysfunctions, legal constraints or information asymmetries that necessitate a review of the ecosystem's boundaries, a reassessment of centres of gravity or a reformulation of the MSCF scenarios.

The relationship between the two tools is therefore bidirectional and iterative. MSCF helps to explain the configuration and transformations of the ecosystem, whilst IMSA enables an examination of how these transformations are managed through existing functional mechanisms.

The integrated nature of IMSA does not entail the standardisation of institutional mandates, the elimination of differences between legal regimes, or the establishment of a supranational authority. It refers to the possibility of a coordinated examination of components that retain their legal and organisational autonomy, but whose functioning is influenced by mutual dependencies.

To apply the model, the IMSA analysis must identify, at each functional level, the responsible actors, the relevant competences, the cooperation mechanisms, the information flows, the legal constraints and any coordination failures.

Thus, the complementarity of the MSCF–IMSA approach allows the systemic diagnosis to be correlated with an examination of the functional organisation of maritime security, without confusing the research methodology with the institutional architecture of the object under analysis.

The explanatory and practical value of this correlation remains subject to verification through empirical applications and comparisons with existing tools for strategic analysis and maritime governance

The MSCF operational matrix

To facilitate the independent application of the methodology, the six stages can be summarised in a single matrix.

Table 4. Operational protocol of the Maritime Strategic Convergence Framework

Stage	Subject of analysis	Main tool	Desired outcome
I	Ecosystem delineation	Mapping of actors, functions and relationships	MSE map
II	Strategic focus	Analysis of nodes and dependencies	Identification of MSCoG
III	Interdependencies and transformations	Multidimensional relationship matrix	MSC profile
IV	Continuity and Adaptation	Assessment of Functions, Redundancies and Reconfiguration	The MSR–MSEL Profile
V	Knowledge and anticipation	Analysis of information and decision-making integration	MCS assessment
VI	Systemic integration	Synthesis, scenarios and comparative analysis	Integrated strategic diagnosis

The matrix allows the model to be applied to different marine areas, provided that the data and indicators are adapted to the characteristics of each ecosystem.

Identifying systemic vulnerabilities using the MSCF

One of the main uses of the MSCF is to identify vulnerabilities that do not become apparent through the isolated analysis of ecosystem components.

Systemic vulnerability can be understood, within the model, as the possibility that a disruption to one component or relationship may affect the functioning of several interdependent areas.

This vulnerability is not determined solely by the probability of an incident occurring or by the physical fragility of an infrastructure. It may result from an excessive concentration of functions, a lack of alternatives, institutional dependencies, insufficient information sharing, or the ecosystem's inability to adapt.

The MSCF framework enables the assessment of vulnerability by linking four questions:

What functions and dependencies are concentrated in a particular strategic node?

Through what mechanisms might the effects of a disruption to this node propagate?

To what extent can the ecosystem maintain or reorganise the affected functions?

What capacity exists for the early identification and interpretation of consequences?

This approach allows a distinction to be made between the vulnerability of a component and the vulnerability of the ecosystem.

A piece of infrastructure may have a high level of physical protection, but may still form part of a vulnerable systemic configuration if other components on which it depends lack adequate continuity or adaptation mechanisms.

Similarly, the existence of alternative infrastructures does not guarantee a reduction in vulnerability if they depend on the same digital networks, energy resources or institutional mechanisms.

Therefore, systemic analysis must examine both visible dependencies and shared dependencies that may lead to simultaneous disruptions.

The anticipatory dimension of the MSCF: from diagnosis to strategic scenarios

The MSCF can be used not only to interpret an existing strategic configuration, but also to examine possible transformations of the ecosystem.

The anticipatory dimension does not involve the certain identification of future events. It consists of examining the conditions under which changes to certain components or relationships may generate different strategic configurations.

Prospective analysis can be structured around three categories of scenarios.

The continuity scenario examines the evolution of the ecosystem under conditions where the main relationships and operating mechanisms are maintained.

The disruption scenario examines the possible consequences of damage to a centre of gravity, the disruption of certain flows, or changes to legal, economic or technological conditions.

The reconfiguration scenario examines how the ecosystem can develop new relationships, infrastructure, institutional mechanisms or technological solutions to maintain strategic functions.

These scenarios must be constructed on the basis of explicit assumptions and must distinguish between documented developments, plausible possibilities and major uncertainties.

The advantage of the MSCF lies in the fact that each scenario can be examined through the same conceptual categories, facilitating comparison between different strategic configurations.

For example, a disruption to a maritime corridor may alter the relative importance of other nodes, generate new convergence processes, require resilience mechanisms and lead to logistical reconfigurations. The ability of actors to identify these transformations and react proactively is the subject of cognitive assessment.

From this perspective, strategic anticipation is not an activity separate from ecosystem analysis, but rather the result of the dynamic integration of its concepts.

A demonstrative application of the MSCF to a maritime disruption

To illustrate how the methodology works, a hypothetical scenario can be used involving a cyber disruption at a seaport playing a key role in commercial transport and regional connectivity.

The scenario does not describe a real incident and does not constitute an assessment of the vulnerability of any specific port. It serves a purely methodological purpose.

In the first stage, the analyst defines the relevant ecosystem, identifying the port, logistics operators, transport links, energy suppliers, digital systems and relevant institutions.

In the second stage, they examine whether the port constitutes a Strategic Maritime Centre of Gravity by assessing critical functions, dependencies and substitution possibilities.

In the third stage, they analyse Maritime Strategic Convergence, examining how digital disruption may affect logistics operations, transport, economic activities and institutional mechanisms.

In the fourth stage, it assesses Maritime Strategic Resilience by identifying functions that can continue to operate and recovery mechanisms. In parallel, it examines Maritime Strategic Elasticity through the possibility of redirecting flows to other infrastructure or reorganising logistics processes.

In the fifth stage, it analyses the capacity of the relevant institutions to integrate information, identify indirect effects and inform response decisions.

In the final stage, the results are integrated into a systemic assessment, which highlights not only the consequences of the initial disruption but also the relationships through which it may affect the ecosystem.

The example shows that the MSCF enables the formulation of questions and interpretations that go beyond the technical assessment of the incident, without replacing the specialist expertise required in each field.

Conditions for reproducibility and limitations of the methodology

For the MSCF to be used in academic research and applied strategic analysis, the procedure must allow for the documentation and verification of the interpretation stages.

An analysis carried out using the MSCF must specify the research question, the scope of the ecosystem, the period under consideration, the sources used, the criteria for identifying centres of gravity, and the assumptions regarding the relationships between components.

Furthermore, the criteria used to assess resilience, elasticity and cognitive dimension must be explained.

Applying the model does not necessarily require assigning numerical values to each concept. In the absence of validated indicators and explicit aggregation rules, the use of a composite index could create an appearance of unjustified precision.

At this stage of its development, the MSCF can be used as a structured tool for qualitative analysis, supplemented, where the data allow, by specific quantitative indicators.

The model also has limitations that must be acknowledged.

The first concerns access to data. Some strategic relationships, institutional dependencies or cognitive capacities cannot be fully assessed using publicly available information.

The second limitation concerns the delineation of the ecosystem. A definition that is too narrow may exclude relevant dependencies, whilst one that is excessively broad may reduce the clarity of the analysis.

The third limitation concerns the identification of causal relationships. The simultaneous occurrence of transformations in different areas does not automatically prove that they are generated by the same convergence process.

The fourth limitation concerns comparative assessment. Applying the MSCF to different regions requires adapting the indicators to the legal, economic, technological and strategic characteristics of each area.

These limitations do not negate the model's usefulness, but rather define the conditions under which its results can be interpreted rigorously.

Further validation can be pursued through comparative applications, the examination of a series of events, assessments carried out by independent analysts, and the comparison of the MSCF's conclusions with the results of other methodologies.

The added value of the MSCF for maritime strategic analysis

The methodological contribution of the MSCF lies in its ability to organise, within a coherent procedure, the analysis of phenomena that are frequently investigated using distinct sectoral tools.

The framework does not seek to replace military analysis, legal assessment, economic research or technological risk analysis. It enables the integration of their results into an interpretation focused on the relationships and transformations within the ecosystem.

In this way, the MSCF can support the identification of strategic focal points, the examination of multidimensional interdependencies, the assessment of functional continuity and adaptation, and the formulation of prospective scenarios.

Its usefulness must be demonstrated through empirical applications, by comparison with existing methods, and by assessing its ability to generate additional relevant findings.

From this perspective, the development of the MSCF represents a shift from formulating a conceptual framework to proposing a systemic methodology for maritime strategic analysis.

However, identifying relationships and vulnerabilities is not sufficient to examine how actors and institutions can organise the necessary responses. This dimension requires the use of a complementary functional model.

The Integrated Maritime Security Architecture (IMSA) meets this need, providing the framework through which the results of the MSCF analysis can be linked to the organisation of actors, responsibilities, coordination mechanisms and decision-making processes.

Consequently, **the MSCF explains how the ecosystem can be analysed, whilst the IMSA enables an examination of how its operation and coordination can be organised from an integrated perspective.**

Integrated Maritime Security Architecture (IMSA): the functional model for integrating stakeholders, infrastructure and decision-making processes

From ecosystem analysis to the functional organisation of maritime security

The development of the Maritime Strategic Convergence Framework (MSCF) enables a systemic examination of the maritime strategic environment by identifying centres of gravity, convergence processes, capacities for resilience and elasticity, and the cognitive mechanisms that influence strategic anticipation and decision-making. However, an understanding of the relationships between the components of the ecosystem is not sufficient to explain how they can be coordinated to ensure maritime security.

This distinction between analysing the system and organising its operation forms the basis for the development of the Integrated Maritime Security Architecture (IMSA).

In previous research, IMSA was introduced as an operational model of the Maritime Strategic Ecosystem, designed to integrate the relationships between the actors, infrastructures and processes that determine the functioning of contemporary maritime security. This study builds on this framework by clarifying the functional levels, interaction mechanisms and methods of analytical application.

The Integrated Maritime Security Architecture (IMSA) can be defined as a functional and systemic model for analysing and coordinating the relationships between the strategic environment, the actors, the convergence processes, the adaptation mechanisms, and the cognitive and decision-making capabilities of the Maritime Strategic Ecosystem, geared towards the continuity, adaptability and anticipation of maritime security.

The concept of architecture is used in a functional, rather than an institutional, sense. IMSA does not entail the establishment of a new international organisation, any change to the legal powers of existing institutions, or the creation of a supranational maritime security authority.

It represents a model through which the relationships between institutions, infrastructure, rules and decision-making mechanisms can be examined, including the limits of coordination between them.

This clarification is important because contemporary maritime security involves actors operating on the basis of different legal mandates, responsibilities and interests. Functional integration does not entail the

elimination of these differences, but rather the identification of the relationships through which they can be managed in a coherent manner.

The systemic foundation of IMSA

The need for an integrated architecture stems from the interdependent nature of maritime functions.

The security of a trade route may depend simultaneously on navigational conditions, the functioning of port infrastructure, the protection of digital systems, energy stability, compliance with legal regimes and the capacity of institutions to coordinate responses in crisis situations.

In such an environment, the efficiency of any single actor does not, in itself, guarantee the efficiency of the entire ecosystem. An authority may fulfil its own responsibilities adequately, whilst systemic vulnerabilities persist due to insufficiently understood interdependencies, incomplete information-sharing or a lack of appropriate coordination mechanisms.

IMSA is based on the premise that the functioning of maritime security must be examined both at the level of individual components and at the level of the relationships between them.

From this perspective, the model focuses on three complementary dimensions.

The first is **functional coherence**, which concerns the compatibility between the functions and responsibilities of the actors involved.

The second is **systemic continuity**, which concerns the maintenance of essential functions in the event of disruption.

The third is **anticipatory capacity**, which concerns the integration of information and its use to identify changes and inform strategic responses.

These dimensions should not be confused with guaranteed outcomes of integration. They represent analytical objectives and criteria through which the functioning of an existing or proposed maritime architecture can be examined.

The IMSA structure: the five functional levels

In accordance with the model developed in the initial study, IMSA is organised into five interdependent functional levels.

These levels do not constitute hierarchical tiers and do not necessarily correspond to distinct institutions. They represent analytical categories through which the functioning of the strategic maritime ecosystem can be described.

Level I – The maritime strategic environment

The first level comprises the physical, geographical, infrastructural and legal foundations of the ecosystem.

This includes the maritime space, shipping routes, ports, critical infrastructure, energy resources, communications systems, logistical connections and the relevant legal regimes.

The analytical function of this level is to identify the structural conditions that influence the functioning of the ecosystem.

Geographical and infrastructural characteristics can determine the concentration of certain flows and dependencies. Legal regimes can influence access, the exercise of powers, freedom of navigation and the scope for intervention by actors.

At the same time, digital and energy infrastructures can connect distinct geographical areas, extending the ecosystem's functional scope beyond its immediate physical boundaries.

Consequently, the analysis at this level must identify not only the existing elements, but also the relationships between them, the functions they fulfil and the conditions under which they may become strategically relevant.

Desired outcome: to identify the physical, geographical and legal structure of the ecosystem and its main functional interdependencies.

Level II – Actors in the Maritime Strategic Ecosystem

The second level comprises the actors who influence the functioning of the ecosystem through the exercise of powers, the use of resources, the management of infrastructure or the adoption of strategic decisions.

This category includes states, maritime authorities, naval forces, international organisations, political-military alliances, port operators, energy companies, logistics and digital service providers, and other relevant non-state actors.

Integrating these actors into a common analytical framework does not presuppose that they share identical objectives.

On the contrary, IMSA allows for the examination of relationships characterised by cooperation, competition, interdependence, shared responsibilities or divergent interests.

From a legal perspective, this level is of particular importance. Actors cannot be analysed solely on the basis of their material capabilities, but also in terms of the powers, obligations and limits on action established by international law and applicable domestic law.

Consequently, the analysis must distinguish between the actual capacity to act and the legal authority to adopt or implement certain measures.

A functional architecture cannot be considered coherent if it involves coordination mechanisms that are incompatible with institutional mandates or applicable legal norms.

Desired outcome: mapping of actors, interests, competences, responsibilities and relationships of cooperation or interdependence.

Level III – Maritime Strategic Convergence Processes

The third level represents the relational core of IMSA.

It examines the processes through which the legal, military, economic, energy, technological, informational and institutional dimensions interact, producing effects on the functioning of the ecosystem.

Strategic Maritime Convergence should not be interpreted exclusively as a process of harmonisation or positive coordination. It may include conflicting interdependencies, asymmetric influences and mechanisms for the propagation of disruptions.

Within the IMSA framework, the analysis of convergence aims to identify the functional relationships between the ecosystem's actors and infrastructures, as well as the conditions under which these relationships produce cumulative effects.

For example, a change in the accessibility of a maritime route may simultaneously influence commercial decisions, logistical planning, the use of alternative infrastructure and security priorities.

Similarly, the development of offshore energy infrastructure can generate new relationships between economic operators, maritime authorities, security institutions and the applicable regulations.

These interactions cannot be fully explained by examining each actor in isolation.

Consequently, the level of convergence represents the analytical framework within which the relationships identified through the MSCF are correlated with the actual functioning of the security architecture.

Desired outcome: to identify the mechanisms of interaction, the multidimensional dependencies and the systemic effects generated by them.

Level IV – Mechanisms of resilience and strategic elasticity

The fourth level concerns the ecosystem's capacity to maintain essential functions and to reorganise itself in the face of disruption.

Within the IMSA framework, Maritime Strategic Resilience and Maritime Strategic Elasticity constitute two distinct dimensions of systemic adaptation.

Resilience concerns functional continuity, the absorption of disturbances and the recovery of affected functions.

Elasticity concerns the reorganisation of relationships and functional configuration when maintaining the previous structure becomes insufficient or inappropriate.

This distinction makes it possible to identify situations in which the system can withstand a short-term disruption but lacks structural alternatives for managing a prolonged transformation.

It also allows us to examine situations in which reconfiguring the system creates new dependencies or transfers vulnerabilities to other components.

Consequently, IMSA should not treat adaptation as an automatically beneficial process. Reorganisation may enhance the ecosystem's capacity to function, but it may also generate additional costs, vulnerabilities or institutional tensions.

The assessment at this level must examine both the outcomes of adaptation and its indirect consequences.

Desired outcome: to identify mechanisms of continuity, capacities for reorganisation and the limits of systemic adaptation.

Level V – The cognitive and decision-making dimension

The fifth level integrates the processes of collecting, interpreting and strategically utilising information.

Maritime Cognitive Superiority is the concept through which the model examines the relative capacity of actors to understand the interdependencies of the ecosystem, to anticipate transformations and to underpin appropriate decisions.

Within the IMSA, the cognitive dimension is cross-cutting in nature.

It does not come into play exclusively after a disruption has occurred, but contributes to the ongoing identification of changes in the strategic environment, the interpretation of relationships between components and the assessment of response options.

This dimension involves integrating information from different sources, assessing its credibility, carrying out a systemic interpretation and transforming the conclusions into analytical outputs relevant to decision-making.

The use of advanced technologies, including artificial intelligence systems, can support these processes, but does not guarantee cognitive superiority.

The quality of a decision also depends on human expertise, the ability of institutions to interpret uncertainty, the compatibility of coordination mechanisms, and the possibility of updating assessments.

Desired outcome: to examine the capacity for information integration, anticipation, institutional learning and the underpinning of strategic decisions.

Relationships between IMSA levels: network architecture and systemic feedback

The five functional levels of IMSA do not operate independently.

The strategic environment influences the choices of actors, and their decisions can alter the infrastructure, flows and operating conditions of the ecosystem.

Convergence processes can amplify dependencies between components, whilst mechanisms of resilience and elasticity can alter the intensity and configuration of these relationships.

The cognitive dimension helps to identify transformations and inform responses, but it, in turn, depends on information infrastructures, access to data and the capacity for cooperation amongst actors.

Consequently, IMSA should be interpreted as a network architecture characterised by multidirectional relationships and continuous feedback.

This characteristic distinguishes the model from an exclusively hierarchical representation of maritime security.

In a hierarchical architecture, information and decision-making flows are predominantly interpreted in relation to successive levels of authority. In IMSA, the analysis also examines the cross-cutting relationships between components belonging to different institutional and functional domains.

This perspective does not eliminate existing legal and organisational hierarchies, but allows for an examination of the interdependencies that cut across them.

Table 5. The functional levels of IMSA and the associated analytical results

Functional level	Main subject	Analytical outcome
I. Strategic environment	Space, infrastructure, flows and norms	Structural configuration of the ecosystem
II. Actors	Competences, interests, responsibilities and relationships	Map of stakeholders and institutional mechanisms
III. Convergence	Interdependencies and multidimensional processes	Matrix of systemic relationships and effects
IV. Adaptation	Resilience, elasticity and continuity	Functional and adaptive profile
V. Cognitive and decision-making	Information, anticipation and decision-making	Assessment of interpretative and coordination capacity

The table highlights the fact that each level contributes a distinct category of information, but interpreting the architecture requires correlating the results.

The relationship between MSCF and IMSA: two complementary tools

One of the essential conditions for the correct use of the proposed architecture is the delineation of the functions of the MSCF and the IMSA.

The two tools are complementary, but not equivalent.

The MSCF represents the methodological framework through which the systemic relationships of the Maritime Strategic Ecosystem are identified and analysed.

IMSA is the functional model through which the organisation, coordination and response capabilities of the ecosystem's components are examined.

Using the MSCF, the analyst can identify a centre of gravity, examine the dependencies associated with it and assess systemic vulnerabilities.

Through IMSA, the same analysis can be extended to examine the responsible actors, cooperation mechanisms, legal constraints and institutional capacities required to manage those vulnerabilities.

This relationship does not imply a mandatory sequence in which MSCF is used only once and IMSA is applied exclusively afterwards.

In practice, the analysis may be iterative. The functional assessment carried out through IMSA may highlight institutional dependencies or limitations that require a review of the MSCF diagnosis.

Table 6. Methodological differences between MSCF and IMSA

Criterion	MSCF	IMSA
Nature of the tool	Methodological framework for analysis	Functional and systemic model
Main question	How does the ecosystem function and change?	How are its components organised and coordinated?
Priority focus	Strategic focus, convergence, resilience, elasticity and the cognitive dimension	The environment, actors, processes, adaptation and decision-making
Main outcome	Integrated strategic diagnosis	Assessment of the functional architecture
Usefulness	Explanation, comparison and anticipation	Analysis of coordination, responsibilities and response options
The relationship between tools	Provides systemic findings	Puts the findings into a functional and institutional context

From this perspective, MSCF and IMSA can be used together to construct an analysis that links strategic diagnosis with an examination of coordination and response capacities.

Application of IMSA in maritime security analysis: the functional procedure

To utilise IMSA in a specific analysis, we propose a functional procedure comprising five steps, corresponding to the levels of the model.

The first step consists of identifying the infrastructure, routes, flows and legal regimes relevant to the issue under consideration.

The second step aims to identify the actors involved, their competences and the existing institutional relationships.

The third step involves examining the convergence processes that link the actors and components of the ecosystem.

The fourth step aims to assess continuity and adaptation mechanisms, including the possibilities for reorganising strategic functions.

The fifth step examines the capacity for information integration, anticipation and decision-making coordination.

The results are subsequently consolidated into a functional assessment of the architecture.

This assessment must highlight not only existing mechanisms but also any discontinuities between levels.

For example, an infrastructure may be identified as a relevant strategic element, whilst there is insufficient public information regarding the coordination mechanisms between the responsible actors. In such a situation, the methodological conclusion should not be the automatic assertion of an institutional deficiency, but rather the identification of an information gap requiring further investigation.

This distinction helps to maintain the rigour of the analysis.

IMSA and the legal dimension of maritime governance

The functional integration of maritime security cannot be examined in isolation from the legal norms governing the competences and responsibilities of the relevant actors.

International law of the sea, rules on navigation, infrastructure protection, state jurisdiction, international liability and institutional cooperation constitute components of the normative environment within which the ecosystem operates.

In this context, IMSA can help to identify the relationships between the functional organisation and the applicable legal framework.

A particular measure may be strategically relevant, but its implementation must be examined in relation to the competences of the actors and existing legal obligations.

Furthermore, cooperation between institutions may be necessary to manage a systemic vulnerability, without this allowing the limits of each institution's mandate to be exceeded.

Consequently, IMSA must not be interpreted as a justification for the implicit extension of powers or for the replacement of existing legal mechanisms.

Its value lies in identifying the relationships between strategic functions and institutional responsibilities, including situations where regulatory or organisational fragmentation may affect the capacity to respond.

From this perspective, the legal dimension is not merely an external constraint on the architecture, but one of the fundamental conditions for its functioning.

IMSA as a tool for anticipatory and adaptive analysis

The dynamic nature of the Maritime Strategic Ecosystem necessitates the ongoing examination of transformations that may alter the functioning of the security architecture.

IMSA enables the analysis of these transformations by reference to the five functional levels.

A change in the strategic environment may lead to shifts in the distribution of actors' interests. These may give rise to new processes of convergence, which, in turn, may require the adaptation of mechanisms for resilience and elasticity.

The cognitive dimension contributes to the early identification of these developments and to the assessment of their possible consequences for institutional coordination.

Consequently, IMSA can be used to examine future configurations of maritime security, not merely to describe existing architectures.

However, this use requires a clear distinction to be drawn between empirical observation, prospective assessment and normative proposals.

An analysis can demonstrate the existence of functional dependencies. It can identify scenarios in which these dependencies change. It can also make recommendations on improving coordination.

These three operations are distinct and must be presented as such.

Through this differentiation, IMSA can contribute to the development of a forward-looking strategic analysis, without turning prospective assumptions into factual findings.

The transferability of IMSA and the conditions for comparative application

IMSA is designed as a transferable functional model, not as an exclusive representation of a specific maritime region.

The five levels can be used to examine different ecosystems, provided that the components and relationships analysed are adapted to the specific characteristics of each area.

In the Black Sea, the configuration of the architecture is influenced by geographical characteristics, the applicable legal regimes, relations between the littoral states, energy and logistics infrastructure, and the regional security environment.

In other maritime regions, the same functional levels may reveal different configurations of actors, infrastructure and convergence mechanisms.

The transferability of the model does not imply uniformity of results.

On the contrary, the comparative value of IMSA stems from the possibility of using the same analytical categories to identify differences between ecosystems.

In this regard, comparative application must adhere to common criteria for delimitation, documentation and interpretation, whilst not disregarding the legal and strategic particularities of each region.

IMSA's contribution to the development of the new conceptual architecture

IMSA complements the Maritime Strategic Ecosystem architecture by introducing a functional level of interpretation of maritime security.

Whilst the MSE establishes the systemic unit of analysis, the derived concepts explain the ecosystem's main processes and capabilities, and the MSCF organises their methodological examination, the IMSA enables these results to be correlated with the organisation of actors, infrastructure and decision-making mechanisms.

Its contribution does not lie in proposing a new universal institutional structure, but in formulating a model through which maritime security can be examined as the result of the interaction between interdependent functional levels.

This approach can support academic research, the evaluation of maritime policies, institutional analysis and the development of strategic coordination options.

However, its explanatory power and practical utility must be assessed through concrete applications and by comparing the results with empirical data.

From this perspective, the Black Sea constitutes a relevant case study for demonstrating the integrated functioning of the MSCF and IMSA.

The complexity of the relationships between maritime infrastructure, legal regimes, economic and energy flows, regional actors and security mechanisms allows for an examination of the entire conceptual framework within a specific strategic context.

Applying the model to the Black Sea thus aims to demonstrate how the proposed concepts can be utilised in a coherent analysis, without limiting the theoretical contribution to the specific characteristics of a single geographical area.

The Black Sea as a Strategic Maritime Ecosystem: an analysis of systemic transformations and the application of the MSE–MSCF–IMSA methodology (2022–2026)

Objective and methodological rationale of the case study

The Black Sea represents a particularly relevant area for the application of the integrated maritime strategic analysis methodology developed in this research. The transformations that have taken place since February 2022 have highlighted the profoundly interdependent nature of maritime security, port infrastructure, trade flows, legal regimes and institutional cooperation mechanisms.

The aim of this chapter is to examine the ability of the MSE–MSCF–IMSA methodology to explain the systemic transformations of the Black Sea’s strategic ecosystem, by applying the concepts of Maritime Strategic Centre of Gravity (MSCoG), Maritime Strategic Convergence (MSC), Maritime Strategic Resilience (MSR), Maritime Strategic Elasticity (MSEL) and Maritime Cognitive Superiority (MCS).

Unlike an analysis based exclusively on a hypothetical scenario, this research utilises documented events that took place between 2022 and 2026, which allow for the observation of successive transformations within the same ecosystem.

Four major developments are examined:

1. The application of Article 19 of the Montreux Convention, in the context of the Russian-Ukrainian war, from 2022 onwards.
2. The establishment, operation and termination of the Black Sea Grain Initiative during the period 2022–2023.
3. The re-routing of trade flows via the ports of Izmail and Reni, the Danube, the Port of Constanța and the European Union’s Solidarity Corridors.
4. The development and operation of the Ukrainian maritime corridor after August 2023.

These developments are not treated as independent episodes, but as manifestations of a complex process of disruption, adaptation and strategic reconfiguration.

The research aims to answer three fundamental questions: which strategic functions were able to be maintained or restored; through which transformations of the ecosystem was this continuity made possible; and to what extent did the legal, institutional and operational conditions facilitate or limit adaptation.

From a methodological perspective, the analysis is structured as a case study of the evolution of a strategic maritime ecosystem. It combines an examination of documented events with an analysis of functional relationships and the mechanisms through which effects propagate.

It does not seek to demonstrate an exclusive causal relationship between a specific event and a specific transformation. The changes observed resulted from the interaction of several military, political, economic, legal and technological factors.

The central hypothesis is that the MSE–MSCF–IMSA methodology allows these dimensions to be integrated into a coherent analytical framework, capable of distinguishing between the continuity of strategic functions, the structural reconfiguration of the ecosystem and the institutional conditions for adaptation.

Defining the Black Sea’s strategic ecosystem

The Black Sea Strategic Maritime Ecosystem cannot be reduced to the surface area of the maritime basin or to the infrastructure located on the coastlines of the riparian states. It comprises a set of strategic, economic, legal, logistical, informational and institutional relationships that connect the maritime space with continental networks and the international system.

From a geographical perspective, the ecosystem includes the six riparian states: Romania, Bulgaria, Turkey, Georgia, the Russian Federation and Ukraine.

From a functional perspective, the analysis incorporates the Turkish Straits, sea and river ports, Danube infrastructure, rail and road links, European transport networks and international coordination mechanisms.

This broad scope stems from the interdependent nature of maritime functions. Disruption to access to a port can lead to the re-routing of trade flows to other infrastructure, whilst a change in navigation regulations at a strategic point can influence the regional security landscape.

To assess systemic transformations, four main functions are identified:

- maintaining maritime and multimodal connectivity;
- the continuity of commercial transport and essential freight flows;
- the functioning of port infrastructure and logistical connections;
- legal, institutional and operational coordination of responses to disruptions.

These functions form the subject of the MSR and MSEL assessments. Their continuity must be examined separately from the physical existence of the infrastructure, as infrastructure may remain available without being able to fulfil the necessary strategic function.

Implementation of the first stage of the MSCF: identification of functions and interdependencies

The first stage of the Maritime Strategic Convergence Framework (MSCF) aims to identify the relevant components of the ecosystem and the functional relationships between them.

In the case of the Black Sea, the disruptions that occurred after February 2022 highlighted the fact that commercial transport depends simultaneously on maritime access, port infrastructure, the safety of navigation, inland transport capacity and the functioning of institutional mechanisms.

The Black Sea Grain Initiative has demonstrated that the resumption of certain maritime exports may require not only operational infrastructure, but also international agreements, inspection mechanisms and coordination procedures.

Subsequently, the expanded use of Danube routes highlighted the interdependence between maritime and inland waterway infrastructure, as well as the importance of rail and road connections.

The Ukrainian maritime corridor developed after August 2023 demonstrated the possibility of operating a different maritime transport configuration, under distinct security and coordination conditions.

The outcome of the first stage of the MSCF is the identification of the Black Sea ecosystem as an open strategic system, whose functions are underpinned by interdependencies that extend beyond the geographical boundaries of the maritime basin.

Application of the second stage of the MSCF: identification of Maritime Centres of Strategic Gravity

The concept of the Maritime Strategic Centre of Gravity (MSCoG) is used to identify the nodes and configurations where relevant strategic functions and dependencies are concentrated.

In this study, an MSCoG is not automatically equivalent to the military centre of gravity defined in classical operational doctrine. It denotes a functional concentration of interdependencies, the disruption of which can have effects on the entire ecosystem.

The Turkish Straits

The Bosphorus and Dardanelles Straits represent a strategic hub of connectivity between the Black Sea and the Mediterranean Sea.

The application of Article 19 of the Montreux Convention in the context of the Russian-Ukrainian conflict highlights the influence of the legal regime on naval mobility options.

Article 19 regulates the passage of warships belonging to belligerent states, subject to the exceptions provided for in the Convention. This regime should not be confused with a general closure of the straits to commercial shipping.

The strategic importance of the straits thus stems from the convergence of their geographical position, the legal regime and the operational consequences of naval access.

The Ukrainian port complex

The ports of Odessa, Chornomorsk and Pivdennyi are key hubs for the continuity of maritime exports and international trade connectivity.

The disruption of access to these facilities has necessitated the identification of alternative transport mechanisms.

The operation of the Grain Initiative and the subsequent development of the Ukrainian maritime corridor highlight the fact that the importance of a strategic hub does not depend solely on its physical capacity, but also on the security and coordination conditions that enable its use.

The Izmail–Reni–Danube–Constanța system

This system represents an interdependent logistical configuration, in which port, river, maritime and inland functions support one another.

The redistribution of trade flows towards these infrastructures has highlighted their capacity to take over certain functions previously carried out by other components of the ecosystem.

At the same time, this redistribution has placed additional pressure on operational capacity, navigation and administrative procedures.

Coordination and information networks

Traffic monitoring systems, information exchanges and institutional coordination mechanisms are important functional components of the ecosystem.

The unavailability or poor functioning of these mechanisms may limit the use of physical infrastructure, even when it remains operational.

Table 7. Candidate Strategic Maritime Centres of Gravity in the Black Sea ecosystem (2022–2026)

Candidate MSCoG	Strategic functions and dependencies	Relevant episode	Verification criteria
The Turkish Straits	Naval access, legal regime, connectivity	Application of the Montreux Convention	Regime of passage, exceptions, operational effects
Ukrainian ports	Maritime exports, infrastructure, trade connectivity	The Grain Initiative and the Ukrainian Corridor	Volumes, continuity, capacity, substitutability
The Danube–Constanța system	Multimodal transport and trade transit	Solidarity Corridors	Capacity, congestion, transit times, costs
Continental networks	Rail and road transport, cross-border control	Adaptation of alternative routes	Interoperability, delays, modal shift
Coordination systems	Traffic monitoring and operational decision-making	Corridor management	Availability, quality of information, coordination

The identification of these configurations does not amount to definitive validation of their status as MSCoGs. This requires a comparative assessment of functional dependencies, the degree of substitutability and the consequences of disruption.

Application of the third MSCF stage: analysis of Maritime Strategic Convergence

Maritime Strategic Convergence (MSC) describes the processes through which transformations in one strategic domain influence the functioning of other domains, generating cumulative or emergent effects.

Events in the Black Sea provide an opportunity to examine several mechanisms of convergence.

Legal-military convergence

The application of the Montreux Convention demonstrates that international legal regimes can directly influence the operational configuration of maritime security.

In this case, the mechanism of convergence arises from the interaction between armed conflict, the application of conventional norms and changes in naval mobility options.

Political, institutional and commercial convergence

The Grain Initiative, established in July 2022, enabled the resumption of maritime exports through a multilateral coordination mechanism.

According to UN data, approximately 32.8 million tonnes of cereals and foodstuffs were exported through this initiative by July 2023.

The functioning of the mechanism depended on the interplay between diplomatic agreements, inspections, maritime safety, port infrastructure and commercial operators.

The end of the Initiative in July 2023 highlighted the vulnerability of a functional framework that relies on sustained institutional cooperation.

Logistical and institutional convergence

The development of alternative routes via the Danube and the Solidarity Corridors led to a redistribution of trade flows across different transport infrastructures and modes.

This transformation has necessitated adjustments to traffic management, the coordination of port operations and cross-border procedures.

Convergence between security and commercial transport

The Ukrainian maritime corridor developed after August 2023 highlights the interdependence between security conditions, commercial operators' decisions, port infrastructure and risk management.

Table 8. Matrix of systemic transformations and mechanisms of Strategic Maritime Convergence

Episode	Disruption or change	MSC Mechanism	Systemic effect
Montreux, 2022	Application of conventional restrictions	International law – security – naval mobility	Changes to access options
The Grain Initiative, 2022–2023	Resumption of exports	Diplomacy – security – trade	Partial restoration of flows
End of the Initiative, 2023	Loss of the multilateral mechanism	Security – institutions – logistics	The need for alternatives
Danube routes, 2022–2026	Redistribution of transport	Ports – navigation – inland infrastructure	New dependencies and bottlenecks
The Ukrainian Corridor, 2023–2026	Resumption of maritime transport	Security – infrastructure – risk management	Reconfiguring connectivity

The outcome of this stage is the identification of the mechanisms through which disruptions and adaptations propagate between the components of the ecosystem.

Application of the fourth MSCF stage: assessment of Maritime Strategic Resilience and Elasticity

The distinction between Maritime Strategic Resilience (MSR) and Maritime Strategic Elasticity (MSEL) is one of the central elements of the proposed methodology.

MSR expresses the ecosystem's capacity to maintain or restore essential strategic functions under conditions of disturbance.

MSEL refers to the ecosystem's capacity to modify its structure, relationships and functional mechanisms in order to sustain the continuity of these functions.

The two concepts are complementary but not equivalent.

Strategic Maritime Resilience

The Grain Initiative has contributed to the partial restoration of Ukrainian maritime exports.

The Danube routes and the Solidarity Corridors have made it possible to maintain trade flows via alternative routes. The Ukrainian maritime corridor subsequently helped to restore transport via Ukrainian seaports.

These developments are observable manifestations of the continuity or recovery of certain strategic functions. However, assessing resilience requires distinguishing between the mere resumption of activity and the recovery of previous performance levels. Relevant indicators include the volume of goods transported, the duration of disruptions, operational capacity, transit times and additional costs.

Strategic Maritime Elasticity

Resilience is demonstrated through the transformation of logistical and institutional configurations.

The re-routing of flows via the Danube and Constanța involved greater use of alternative infrastructure and the adaptation of multimodal connections.

The development of the Solidarity Corridors involved the coordination of several modes of transport and administrative mechanisms.

The operation of the Ukrainian maritime corridor after August 2023 represented a further reconfiguration of maritime transport conditions.

However, these changes should not be confused with an automatic increase in the system's efficiency.

An alternative may sustain operational continuity, but at higher costs or with capacity constraints.

Table 9. Comparative Assessment of Maritime Strategic Resilience and Elasticity

Function under review	MSR – continuity of function	MSEL – system reconfiguration	Assessment indicators
Exports via the Grain Initiative	Partial resumption of exports	Multilateral transport and inspection mechanism	Volumes, vessels, transit times
Exports via the Danube	Maintaining alternative routes	Redistribution via Izmail, Reni and Constanța	Capacity, costs, duration
Solidarity Corridors	Continuity of exports and imports	Multimodal integration	Volumes by mode, border crossing times
The Ukrainian Corridor	Restoration of maritime transport	Different transport configurations and risk management	Volumes, availability, costs
Operational coordination	Maintaining traffic management capacity	Adaptation of procedures and cooperation	Decision-making times, delays

The analysis shows that MSR and MSEL must be assessed separately, even if they occur simultaneously.

The continuity of a function can be achieved through reconfiguration, but this is not a mandatory requirement in all situations. Furthermore, reconfiguration may take place without producing the intended functional results.

Application of the fifth MSCF stage: the cognitive dimension and strategic anticipation

The cognitive dimension of the strategic ecosystem concerns the capacity of actors to collect, integrate and interpret information relevant to identifying interdependencies, anticipating risks and underpinning decisions. In the case of the Black Sea, this dimension can be examined through navigation monitoring systems, traffic coordination mechanisms and information-sharing procedures.

The adaptation of mechanisms for managing Danube river flows highlights the importance of information coordination for the efficient use of infrastructure. However, the existence of monitoring systems does not automatically demonstrate Maritime Cognitive Superiority (MCS).

Assessing MCS involves identifying a benchmark and indicators relating to the quality of information, foresight, speed of decision-making and effectiveness of response. Consequently, the application enables the identification of relevant cognitive capabilities, without asserting the existence of empirically demonstrated superiority.

Application of the sixth MSCF stage: integrated strategic diagnosis

Integrating the results of the previous stages enables the formulation of a strategic diagnosis of the transformations taking place within the Black Sea ecosystem.

The first finding concerns the interdependent nature of maritime functions. The continuity of transport does not depend solely on the availability of port infrastructure, but also on the safety of navigation, legal frameworks and institutional coordination.

The second finding concerns the propagation of effects. Disruptions occurring in one component of the ecosystem can lead to changes in flows and place pressure on other infrastructure.

The third finding concerns the difference between resilience and elasticity. Maintaining functions and reconfiguring the system are distinct processes, which must be assessed using their own indicators.

The fourth finding concerns the conditional nature of adaptation. The availability of an alternative route does not guarantee its effective use.

The fifth finding concerns the importance of the cognitive and institutional dimensions in anticipating disruptions and coordinating responses.

The analysis highlights an ecosystem characterised by successive adaptations, differentiated functional continuity and the redistribution of strategic dependencies.

Application of the Integrated Maritime Security Architecture (IMSA)

IMSA complements the MSCF analysis by examining the conditions under which the identified adaptations can be achieved and sustained.

The five levels of the architecture allow for the correlation of the strategic environment, the actors, the convergence processes, the capacities for resilience and elasticity, and the cognitive dimension.

Table 10. Application of IMSA to transformations in the Black Sea ecosystem

IMSA level	Subject of assessment	Relevant evidence	Constraints
I. Strategic, legal and infrastructural environment	Legal frameworks, access and infrastructure	Montreux, ports, the Danube	Restrictions, capacity, security
II. Stakeholders	States, organisations and operators	Turkey, Ukraine, Romania, the EU, the UN	Powers, interests, responsibilities
III. Convergence processes	Interactions between sectors	The Grain Initiative, Solidarity Corridors	Bottlenecks, dependencies, cumulative effects
IV. Resilience and elasticity	Continuity and reconfiguration	Adaptation of transport	Costs, timescales, substitutability
V. Cognitive dimension	Information, anticipation and decision-making	Traffic monitoring and coordination	Data quality and speed of decision-making

The application of IMSA highlights the fact that an alternative identified through MSCF analysis must be assessed in terms of operational and institutional feasibility.

A waterway route may constitute a reconfiguration option, but its use depends on infrastructure capacity, navigation conditions, control procedures and the coordination of the stakeholders involved.

This relationship gives the methodology an iterative nature: the results of the IMSA may lead to a revision of the MSCF diagnosis.

Summary of the integrated application of MSCF–IMSA

Table 11. Methodological summary of the MSCF–IMSA application in the Black Sea ecosystem

MSCF stage	Analytical operation	Main result	IMSA contribution
I. Delimitation of the MSE	Identification of functions and relationships	Extended strategic ecosystem	Verification of legal and infrastructural conditions
II. Identification of MSCoG	Locating critical dependencies	Candidate strategic nodes	Assessment of capacity and substitutability
III. Analysis of MSCs	Examination of the propagation of effects	Interdependencies between security, trade and logistics	Identification of institutional bottlenecks
IV. Assessment of MSR–MSEL	Continuity and reconfiguration	Successive adjustments to flows	Assessment of costs and feasibility
V. Assessment of MCS	Information and anticipation	Relevant cognitive abilities	Quality assurance of decision-making processes
VI. Integrated diagnosis	Correlation of results	Differentiated systemic adaptation	Review of strategic options

The summary highlights the complementarity of the two methodological components. MSCF organises the strategic analysis process, whilst IMSA enables the assessment of the functional and institutional conditions of the responses.

Final strategic assessment and implications of the results

The integrated application of the MSCF–IMSA methodology leads to a diagnosis of the continuity of functions, the reconfiguration of dependencies and the institutional conditions that enabled the adaptation of

the Black Sea ecosystem during the period 2022–2026. The diagnosis results from correlating the MSCF stages with the IMSA functional verification and does not represent a statistically validated composite score.

The key finding points to a partial and differentiated functional continuity, underpinned by successive transport and coordination arrangements. The Grain Initiative, the Danube routes and the Ukrainian maritime corridor have supported trade functions under distinct conditions; however, these developments do not indicate a uniform return to previous levels of performance or the elimination of vulnerabilities.

The centres of gravity identified remain candidates until their functional dependence, the consequences of disruption and their substitutability have been verified. Strategic convergence is underpinned by the documented mechanisms through which security, law, trade and infrastructure have influenced one another. MSR indicates the maintenance or restoration of certain functions; MSEL indicates the reconfiguration of relationships and routes that has contributed to this continuity. For MCS, the available evidence allows for an examination of coordination capabilities, not an assertion of comparative superiority.

Table 12. Integrated strategic assessment of the Black Sea ecosystem (2022–2026)

Dimension	Finding arising from the analysis	Significance and limitations
MSCoG	Straits, ports and multimodal networks are candidate nodes.	Dependencies and substitutability require comparative verification.
MSC	Interactions between security, law, trade and logistics are identified.	The mechanisms can be documented, without attributing causality exclusively to any one factor.
MSR	Some trade flows have been maintained or re-established.	Partial continuity; full recovery has not been demonstrated.
MSEL	Routes and institutional mechanisms have been reconfigured.	Efficiency, costs and sustainability remain to be quantified.
MCS	Monitoring and coordination capacities exist.	Cognitive superiority cannot be demonstrated without a comparator.
IMSA	The feasibility of alternatives depends on regulations, capabilities and coordination.	The options identified through MSCF are operationally conditioned.

The final strategic diagnosis is that of an ecosystem which has demonstrated capabilities for functional continuity and reorganisation, but in which adaptation remains uneven and conditioned by infrastructure, legal frameworks, resources and institutional coordination. The reorientation of flows has alleviated certain constraints whilst simultaneously shifting pressures to other nodes, without automatically eliminating systemic risks.

This gives rise to three implications for strategic analysis: (i) assessing infrastructure in relation to concentrated functions and dependencies, not merely its individual importance; (ii) evaluating alternatives in terms of capacity, activation time, costs and sustainability; (iii) integrating information and inter-institutional coordination to identify bottlenecks at an early stage and limit the spread of their effects.

From a methodological perspective, the results illustrate the MSCF's ability to organise a systemic diagnosis and the role of IMSA in verifying the functional feasibility of the options. They do not constitute a demonstration of superiority over other methods, in the absence of a comparative exercise and uniform indicators. The following prospective exercise uses this diagnosis as a basis for examining possible future disruptions, without turning past experience into a forecast.

Prospective exercise on the disruption of a trade corridor

Based on the documented changes, the methodology can also be used to examine a forward-looking scenario concerning the prolonged unavailability of a maritime trade corridor.

The scenario aims to test the analytical framework's ability to identify strategic dependencies, mechanisms for the propagation of effects, and adaptation options.

In the first stage, the affected functions and the ecosystem components on which they depend are identified.

In the second stage, candidate centres of gravity and associated vulnerabilities are examined.

The third stage examines the propagation of effects across security, transport, infrastructure and institutions.

The fourth stage assesses separately the capacity to maintain functions and the possibilities for reconfiguration.

The fifth stage examines the availability of information and the capacity for anticipation.

The final stage integrates the results into a strategic assessment, supplemented by the IMSA verification.

This exercise is not a forecast, but a structured prospective analysis, based on the relationships and constraints identified in the empirical analysis.

Limitations of the application and requirements for empirical validation

Applying the methodology to the Black Sea allows for the examination of documented transformations, but does not eliminate the limitations of the research.

The events analysed are interdependent and influenced by multiple factors. Consequently, the results cannot be attributed exclusively to a single causal mechanism.

Data on trade volumes, logistics capacities, transit times and costs are not always available for comparable periods and categories.

Furthermore, the continuity of a function should not be confused with a full recovery of previous performance, and the reconfiguration of a system does not automatically demonstrate the effectiveness of the adaptation.

Further empirical validation requires the use of comparable indicators and data series on transport volumes, port capacities, the duration of disruptions, additional costs and changes to institutional mechanisms.

At this stage, the application demonstrates the usefulness of the framework for organising and interpreting systemic transformations, without constituting a definitive validation of its superiority over other methodologies.

Conclusions of the case study

The transformations occurring in the Black Sea's strategic ecosystem between 2022 and 2026 highlight the interdependent and adaptive nature of contemporary maritime security.

The application of the Montreux Convention demonstrates the influence of legal regimes on the regional strategic configuration. The Grain Initiative highlights the role of multilateral coordination in restoring certain commercial functions, as well as the vulnerability of mechanisms dependent on the continuity of institutional cooperation.

The development of the Danube routes and the Solidarity Corridors demonstrates the possibility of redistributing trade functions between maritime and land-based infrastructure. The Ukrainian maritime corridor developed after August 2023 highlights the emergence of a new configuration for transport and risk management.

These developments underpin the relevance of the distinction between Strategic Maritime Resilience and Strategic Maritime Elasticity.

Resilience concerns the continuity or restoration of strategic functions, whilst elasticity concerns the transformation of the relationships and configurations through which these functions are fulfilled.

The analysis also demonstrates that the adaptation of the ecosystem is not automatic. It depends on infrastructural capacities, legal frameworks, the availability of resources and the effectiveness of institutional coordination.

The methodological contribution of this application lies in the integration of the concepts MSE, MSCoG, MSC, MSR, MSEL and MCS into a coherent analytical process, organised through MSCF and complemented by IMSA.

Through this approach, maritime security is examined not merely as a matter of protecting specific infrastructure or routes, but as an expression of the continuity, transformation and governance of a complex strategic ecosystem.

The main finding of the chapter is that maintaining strategic functions and reconfiguring the system represent distinct yet interdependent dimensions of maritime adaptation. The MSE–MSCF–IMSA methodology provides a framework for the integrated examination of these dimensions, with potential for further development through comparative applications and additional empirical validation.

Methodological rigour and the conditions for the scientific validation of the MSE–MSCF–IMSA architecture

This chapter examines the conditions under which the proposed conceptual and methodological architecture can be applied independently, critically evaluated and transferred between maritime ecosystems. Its application to the Black Sea (2022–2026) provides a documented analytical demonstration, but does not amount to an exhaustive validation of the model or a demonstration of its superiority over established tools.

From demonstrative application to independent verification

Methodological rigour does not mean that all evaluators must reach identical conclusions, but rather that they must use consistent definitions, explicit criteria and documentation that allows the path from evidence to diagnosis to be traced. An MSCF–IMSA analysis is verifiable if an independent assessor can identify the subject of the research, the sources, the rules for selection and interpretation, the uncertainties and the justification for each classification.

There are three distinct levels of verification: (i) procedural consistency, concerning the application of stages and rules; (ii) the validity of inferences, concerning the link between evidence and conclusions; and (iii) additional explanatory power, concerning the framework's contribution relative to alternative methods. Success at the first level does not automatically demonstrate success at the other two.

Minimum application dossier and traceability of decisions

For each application, the analytical dossier comprises: the research question; the geographical, functional and temporal scope of the MSE; the strategic functions sought; an inventory of components and sources; the identification of MSCoG candidates; documented MSC mechanisms; separate MSR and MSEL assessments; cognitive analysis and the comparison period, if MCS is invoked; IMSA verification; the final diagnosis and its limitations.

A classification is accompanied by the identification of the evidence, the criterion used and the reasoning linking them. Where information is incomplete or contradictory, the result is 'undetermined', not negative by default. The labels 'candidate', 'documented', 'conditional' and 'undetermined' describe the epistemic status of the conclusion, not numerical performance scores.

Table 14. Minimum traceability record for the diagnosis

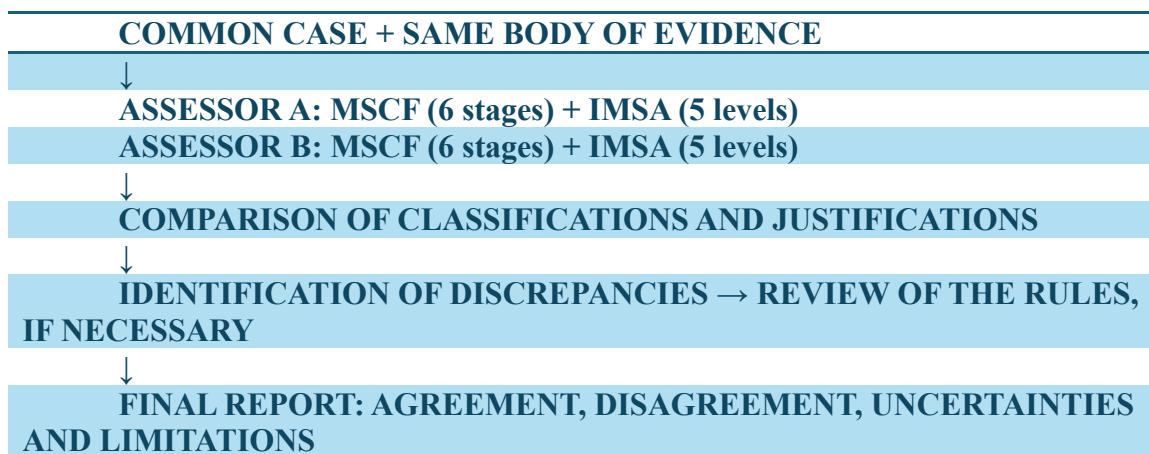
Element	Required record	Quality control
Strategic function	Which function is being analysed and over what time period?	Explicit scope
Evidence	Source, date, type of information	Verifiability and provenance
Criterion	Rule applied to the relevant concept	Terminological consistency
Inference	The link between observation and classification	Exclusion of causal leaps
Uncertainty	Gaps, alternative interpretations	Stating an indeterminate result
Diagnosis	Findings, implications and conditions	Separation of facts from scenarios

The independent assessment protocol

Two or more assessors examine the same case, under comparable information conditions, independently applying the six MSCF stages and the five IMSA levels. The results are compared across predefined analytical units: ecosystem boundaries, MSCoG candidates, propagation mechanisms, functional continuity, observed reconfigurations, cognitive capacities and institutional constraints.

Discrepancies are documented by identifying different sources, ambiguities in definitions and insufficiently defined rules. If common ordinal categories are used, agreement amongst assessors can be examined using indicators appropriate to the nature of the data; in the absence of such a design, no statistical coefficients are reported. A reasoned reconciliation stage may lead to a revision of the application guide, without deleting the initial assessments.

Diagram The independent verification process



Conceptual validity and empirical testing

Content validity concerns the appropriateness of definitions in relation to the phenomena under investigation; discriminant validity concerns the distinction between the concepts MSCoG, MSC, MSR, MSEL and MCS, both amongst themselves and in relation to established notions; explanatory validity concerns the framework's ability to support relevant inferences about systemic relationships and transformations.

MSCoG can be investigated through functional dependencies, connectivity, perturbation effects and substitutability. MSC requires the documentation of a propagation mechanism between domains, not merely

the simultaneity of events. MSR is examined through the continuity or recovery of a function relative to a temporal reference point. MSEL is examined through changes in the configuration that underpins the function. MCS involves an explicit comparator and evidence regarding the performance of interpretation and decision-making.

Indicative indicators do not become arbitrary quantitative thresholds. Establishing scales and performance levels requires theoretical justification, comparable data and testing. In particular, a port's high connectivity does not in itself confirm its status as an MSCoG, nor does the emergence of an alternative route automatically demonstrate the effectiveness of the adaptation.

Geographical transferability and transferability across levels of analysis

Transferability refers to the possibility of using the same definitions and operations in different contexts, not to the identity of the conclusions. In the Baltic Sea, infrastructural and politico-military interdependencies may predominate; in the Red Sea, the security of navigation and the concentration of trade flows; in the Eastern Mediterranean, the relationships between energy, maritime boundaries and the interests of the actors involved; and in the Indo-Pacific, the connections between trade, technology and strategic competition. These are areas of research, not empirical findings that have already been established.

The methodology can be applied at regional, national, sectoral or infrastructure level, provided that the unit of analysis includes the relevant ecosystem relationships. An assessment of a single piece of infrastructure does not become systemic simply by using MSE terminology.

Table 15. Indicative matrix for comparative applications

Scope / level	Possible priority question	Data required
The Baltic Sea	How do disturbances propagate between infrastructures and sectors?	Networks, dependencies, coordination
Red Sea	Which functions are affected by route disruptions?	Flows, times, alternatives
Eastern Mediterranean	How do energy, law and security interact?	Legal regimes, infrastructure
Indo-Pacific	How are strategic dependencies being redistributed?	Trade, technology, capabilities
Infrastructural level	What are the effects on ecosystem functions?	Connections and substitutability

7.6. Testing for additional explanatory power

The MSE–MSCF–IMSA framework cannot be considered superior solely because it integrates multiple dimensions. To test its additional explanatory power, the same case is examined, based on a comparable set of information, using both the MSCF–IMSA framework and established tools such as risk analysis, network analysis, critical infrastructure assessment and maritime governance frameworks.

The comparison aims to identify relevant additional dependencies, clarify propagation mechanisms, distinguish between continuity and reconfiguration, assess diagnostic utility and analyse costs. A more comprehensive result does not automatically constitute a better result; redundancy, complexity and the resources required must also be examined.

Table 16. Methodological comparison protocol

SAME CASE + COMPARABLE QUESTIONS AND DATA	
↙	↘
ANALYSIS USING ESTABLISHED METHODS MSCF-IMSA	ANALYSIS USING
↘	↙
COMPARISON: RELATIONSHIPS EXPLAINED • EVIDENCE • BENEFITS • COSTS	
↓	
CONCLUSION: ADDITIONAL VALUE CONFIRMED / LIMITED / UNDETERMINED	

Standardisation and dissemination of results

The scientific community's adoption of the model depends on the clarity of definitions, the accessibility of the procedure, the availability of verifiable examples, and independent critical review. A bilingual glossary, application sheets, interdependence matrices and the publication of analytical justifications can support the consistent use of terminology.

Scientific recognition does not automatically follow from the proposal of a name. It is established through independent use, critical scrutiny and the ability to generate relevant research questions and findings.

Research agenda and conclusion of the chapter

The next steps involve testing the rules for identifying MSCoG, investigating MSC mechanisms, developing distinct indicators for MSR and MSEL, the comparative operationalisation of MCS, and assessing the bidirectional relationship between the MSCF diagnosis and IMSA functional verification.

The contribution of this study lies in the systematisation and demonstrative application of an integrated framework for maritime strategic analysis. Its consolidation as a transferable tool requires independent verification, comparative applications and an evidence-based review of the criteria. Thus, methodological rigour is the prerequisite for moving from a coherent conceptual proposal to an evaluable scientific tool.

General conclusions. Towards an integrated architecture for maritime strategic analysis

The transformations in the contemporary maritime environment highlight the limitations of analytical approaches that examine critical infrastructure, military capabilities, economic and energy flows, emerging technologies, legal regimes and institutional mechanisms in isolation. The interdependencies between these components give rise to processes of convergence, systemic vulnerabilities and adaptive capacities that require an integrated perspective on maritime security.

Building on this premise, the research aimed to develop and operationalise the conceptual architecture of the Maritime Strategic Ecosystem (MSE) by defining complementary analytical categories and articulating them within two instruments: the Maritime Strategic Convergence Framework (MSCF) and the Integrated Maritime Security Architecture (IMSA).

The main conceptual contribution lies in correlating five distinct dimensions of the maritime ecosystem's functioning and transformation: the concentration of strategic functions and dependencies, examined through the Maritime Strategic Centre of Gravity (MSCoG); multidimensional interactions and the propagation of effects, explained by Maritime Strategic Convergence (MSC); the continuity of essential functions, assessed through Maritime Strategic Resilience (MSR); the capacity for structural and functional reconfiguration, expressed through Maritime Strategic Elasticity (MSEL); and the cross-cutting dimension

of information integration, anticipation and decision-making performance, associated with Maritime Cognitive Superiority (MCS).

These concepts are not presented as a substitute for established notions in strategic theory, complex systems research or maritime security studies. The specificity of the proposed architecture stems from the delineation of their explanatory functions and their integration into a common methodological framework. Consequently, the originality of the research is underpinned by the way in which the concepts are articulated and operationalised, whilst its additional scientific value remains open to independent verification and comparison with existing methodologies.

The methodological contribution lies in the structuring of the MSCF into six analytical stages: delineating the ecosystem and identifying strategic functions; identifying the Centres of Maritime Strategic Gravity; examining the mechanisms of Maritime Strategic Convergence; separately assessing Maritime Strategic Resilience and Elasticity; analysing the cognitive dimension; and formulating the integrated strategic diagnosis.

This sequence allows the research to be organised into an explicit process, in which each stage contributes to underpinning the final results. At the same time, the dynamic nature of maritime ecosystems justifies revisiting previous stages when additional information alters the assessment of dependencies, propagation mechanisms or adaptation possibilities.

The rigour with which the methodology is applied depends on defining the functions under analysis, specifying the criteria for identification and classification, using verifiable evidence, and distinguishing conclusions from interpretative hypotheses. Thus, the MSCF provides the framework for organising the analysis, whilst the development of decision-making rules and comparable indicators is a prerequisite for strengthening the verifiability of the results.

The functional contribution lies in the development of IMSA as a model for examining the organisation and coordination of maritime security across five interdependent levels: the strategic, legal and infrastructural environment; the actors; convergence processes; mechanisms of resilience and elasticity; and the cognitive-decision-making dimension.

IMSA does not represent a new institutional structure and does not alter existing legal powers or competences. Its function is to link strategic analysis with actual possibilities for action by identifying infrastructural, legal, institutional and operational constraints.

The relationship between the MSCF and the IMSA is a key element of the proposed architecture. The MSCF enables the identification of vulnerabilities, interdependencies and reconfiguration alternatives, whilst the IMSA examines the conditions under which these alternatives can be activated and sustained. Conversely, the results of the functional assessment may lead to a revision of the strategic diagnosis. This bidirectional relationship allows for the correlation of systemic explanation with the feasibility of institutional and operational responses.

The application of the methodology to the Black Sea ecosystem, during the period 2022–2026, constitutes the main empirical component of the research. The analysis examined documented transformations associated with the application of the Montreux Convention in the context of the Russian–Ukrainian war, the operation and cessation of the Black Sea Grain Initiative, the development of alternative routes via the Danube and the European Union’s Solidarity Corridors, as well as the operation of the Ukrainian maritime corridor after August 2023.

An examination of these developments has enabled the identification of relevant strategic configurations, the mechanisms through which disruptions spread, and the transformations by which certain commercial functions were maintained or restored. The results highlight the fact that changes in security conditions can have an impact on infrastructure, economic flows, administrative procedures and coordination mechanisms, including beyond the maritime domain itself.

A key finding concerns **the distinction between Strategic Maritime Resilience and Strategic Maritime Elasticity**. The analysis shows that maintaining or restoring a strategic function is not equivalent to reconfiguring the structures and relationships through which it is carried out. The two processes may evolve simultaneously, but they have different analytical implications and require distinct evaluation criteria.

In the case of the Black Sea, the continuity of certain trade flows has been sustained through successive mechanisms and configurations, including the use of alternative routes and the adaptation of institutional coordination. These transformations highlight the ecosystem’s capacity for adaptation, but do not demonstrate the elimination of vulnerabilities or a full recovery to pre-disruption performance levels.

The integrated strategic assessment indicates the existence of an ecosystem characterised by differentiated functional continuity, adaptive reconfigurations and the redistribution of strategic dependencies. The development of alternatives may reduce certain vulnerabilities, but may simultaneously generate new concentrations of flows, pressures on infrastructure and additional coordination requirements.

From this perspective, resilience and elasticity cannot be assessed independently of legal, logistical, economic and institutional conditions. The availability of an alternative infrastructure does not guarantee the effectiveness of its use, and changing a trade route does not, in itself, constitute evidence of superior strategic adaptation.

Analysis of the cognitive dimension highlights the importance of integrating information, monitoring interdependencies and anticipating systemic transformations. However, identifying capabilities for coordination and information processing is not sufficient to demonstrate Maritime Cognitive Superiority. Such a conclusion presupposes the existence of an explicit benchmark and indicators of informational and decision-making performance.

The results of the application to the Black Sea allow for the formulation of relevant strategic implications. The assessment of critical infrastructure can be deepened by examining the functions they perform and their degree of substitutability. Business continuity planning can incorporate the analysis of alternative configurations, activation times and associated costs. At the same time, coordination between military, civilian, economic and institutional actors can be examined through the lens of interdependencies and mechanisms for the propagation of effects.

The prospective exercise included in the research complements the analysis of documented events, demonstrating how the methodology can structure the examination of future disruptions. Its value lies in the anticipatory organisation of analytical questions and assessment options, without implying a predictive capability that has already been validated.

The limitations of the research are linked to its predominantly conceptual and methodological nature, the uneven availability of data, the absence of uniformly applied quantitative indicators, and the need to independently test the classification rules. The application to the Black Sea supports the framework's usefulness for organising a multidimensional strategic analysis, but does not constitute an exhaustive empirical validation nor does it demonstrate its explanatory superiority over established tools.

The scientific consolidation of the MSE–MSCF–IMSA architecture requires the development of verifiable operational criteria, the independent testing of the identification of Maritime Strategic Centres of Gravity, the comparative evaluation of convergence mechanisms, and the construction of indicators to measure resilience and elasticity separately. Particular attention is given to assessing the cognitive dimension and examining the extent to which the integrated use of MSCF and IMSA yields additional explanatory power.

Applying the methodology to other maritime ecosystems, such as the Baltic Sea, the Eastern Mediterranean, the Red Sea or the maritime areas of the Indo-Pacific region, may help to verify its transferability and identify the conditions under which the proposed tools remain relevant. Comparing the results obtained by independent researchers would also allow for an assessment of the consistency of the procedures and the transparency of the analytical reasoning.

From an epistemological perspective, the research proposes examining maritime security as a relational and dynamic property of a complex ecosystem. This approach does not diminish the importance of the distribution of power, control over space, military capabilities or legal regimes, but rather integrates them into a broader interpretation of strategic functions, interdependencies and transformations.

In conclusion, the study's main contribution lies in the development of a conceptual, methodological and functional framework that enables a shift from the separate examination of the components of maritime security to an integrated analysis of the relationships between them. MSE delineates the strategic ecosystem, MSCF organises the analytical process, and IMSA links the assessment to the institutional and operational conditions of the response.

From this perspective, contemporary maritime security is not determined solely by control over space and the availability of capabilities, but also by the ability of ecosystems to manage interdependencies, maintain essential strategic functions, reconfigure their structures, and transform information and knowledge into informed decisions.

The MSE–MSCF–IMSA architecture thus provides a basis for the development of an integrated maritime strategic analysis, geared towards understanding systemic transformations, assessing vulnerabilities and underpinning strategic foresight. The consolidation of this contribution depends on

continued operationalisation, empirical verification and critical reception within the scientific and professional community.

ANNEXES

Annex I. Bilingual Conceptual Glossary of the Maritime Strategic Ecosystem

Romanian–English Terminology Standardisation

A. Conceptual architecture

1. Maritime Strategic Ecosystem (MSE)

English: Maritime Strategic Ecosystem (MSE)

Definition in Romanian: A dynamic system of actors, infrastructures, resources, flows, technologies, legal norms and institutional mechanisms, whose interdependencies determine the functioning, vulnerabilities and transformations of the maritime strategic environment.

English definition: A dynamic system of actors, infrastructures, resources, flows, technologies, legal norms and institutional mechanisms whose interdependencies shape the functioning, vulnerabilities and transformations of the maritime strategic environment.

Analytical function: It constitutes the systemic unit of analysis within which the five derived concepts are examined.

2. Maritime Strategic Centre of Gravity (MSCoG)

English: Maritime Strategic Centre of Gravity (MSCoG)

Romanian definition: A geographical, infrastructural or functional node in which relevant strategic functions and dependencies are concentrated, the disruption or transformation of which may have significant consequences for other components of the Maritime Strategic Ecosystem.

English definition: A geographical, infrastructural or functional node concentrating strategically significant functions and dependencies, whose disruption or transformation may generate substantial consequences across other components of the Maritime Strategic Ecosystem.

Analytical function: Identifies points of strategic concentration and systemic dependencies.

Scope: It is not synonymous with any major infrastructure, maritime chokepoint or centre of gravity in the strict sense of classical military theory.

3. Maritime Strategic Convergence (MSC)

English: Maritime Strategic Convergence (MSC)

Definition in Romanian: A multidimensional process through which interactions among the legal, military, economic, energy, technological, informational and institutional components of the ecosystem generate interdependencies, cumulative effects and systemic transformations.

English definition: A multidimensional process through which interactions among the legal, military, economic, energy, technological, informational and institutional components of the ecosystem generate interdependencies, cumulative effects and systemic transformations.

Analytical function: Explains the relationships between domains and the mechanisms through which effects propagate within the ecosystem.

Scope: Convergence does not necessarily imply cooperation, harmonisation or institutional integration. It may include conflicting interdependencies and destabilising effects.

4. Maritime Strategic Resilience (MSR)

English: Maritime Strategic Resilience (MSR)

Definition in Romanian: The capacity of the Maritime Strategic Ecosystem to absorb disruptions, maintain essential strategic functions and restore their operation under conditions of crisis or transformation.

English definition: The capacity of the Maritime Strategic Ecosystem to absorb disruptions, maintain essential strategic functions and restore their operation under conditions of crisis or transformation.

Analytical function: Assesses functional continuity, resilience and the limitation of the spread of disruptions.

Scope: It should not be confused with invulnerability or the mere physical resilience of an infrastructure.

5. Maritime Strategic Elasticity (MSEL)

English: Maritime Strategic Elasticity (MSEL)

Definition in Romanian: The capacity of the Maritime Strategic Ecosystem to reconfigure its structures, relationships and functional mechanisms in order to sustain essential strategic functions under changing conditions, including through the development of alternative configurations.

English definition: The capacity of the Maritime Strategic Ecosystem to reconfigure its structures, relationships and functional mechanisms in order to sustain essential strategic functions under changing conditions, including through the development of alternative configurations.

Analytical function: Assesses the structural adaptability and potential for reorganisation of the ecosystem.

Scope: Unlike resilience, elasticity does not necessarily imply a return to the previous configuration.

6. Maritime Cognitive Superiority (MCS)

English: Maritime Cognitive Superiority (MCS)

Definition in Romanian: The relative capacity of an actor or an institutional configuration to integrate and interpret multidimensional information, to anticipate ecosystem transformations and to underpin strategic decisions more effectively than those of an explicitly defined comparator.

English definition: The relative capacity of an actor or institutional configuration to integrate and interpret multidimensional information, anticipate ecosystem transformations and support more effective strategic decisions than an explicitly defined comparator.

Analytical function: Examines information integration, anticipation and cognitive-decision-making performance.

Scope: In the absence of a documented comparison, maritime cognitive capacity can be assessed without asserting the existence of a demonstrated superiority.

B. Operationalisation tools

7. The Maritime Strategic Convergence Framework (MSCF)

English: Maritime Strategic Convergence Framework (MSCF)

Definition in Romanian: An integrated methodological framework through which strategic concentration, multidimensional convergence, resilience, elasticity and the cognitive dimension are analysed in their interdependence, in order to identify vulnerabilities, explain transformations and underpin strategic anticipation.

English definition: An integrated methodological framework through which strategic concentration, multidimensional convergence, resilience, elasticity and the cognitive dimension are examined in their interdependence to identify vulnerabilities, explain transformations and support strategic anticipation.

Analytical function: It organises research through a reproducible protocol, from the delineation of the ecosystem to the integrated strategic diagnosis.

8. Integrated Maritime Security Architecture (IMSA)

English: Integrated Maritime Security Architecture (IMSA)

Definition in Romanian: A functional and systemic model for analysing the organisation and coordination of relationships between the strategic environment, actors, convergence processes, adaptive mechanisms and the cognitive and decision-making capacities of the Maritime Strategic Ecosystem.

English definition: A functional and systemic model for analysing the organisation and coordination of relationships among the strategic environment, actors, convergence processes, adaptive mechanisms and cognitive and decision-making capacities of the Maritime Strategic Ecosystem.

Analytical function: It links the strategic diagnosis to the functional structure, competences, responsibilities and coordination mechanisms.

Scope: IMSA is not a new international organisation and does not in itself alter the competences of existing institutions.

C. Table of terminological standardisation

Abbreviation	Romanian name	English name
MSE	Ecosistem Strategic Maritim	Maritime Strategic Ecosystem
MSCoG	Centru de Greutate Strategic Maritim	Maritime Strategic Centre of Gravity
MSC	Convergență Strategică Maritimă	Maritime Strategic Convergence
MSR	Reziliență Strategică Maritimă	Maritime Strategic Resilience
MSEL	Elasticitate Strategică Maritimă	Maritime Strategic Elasticity
MCS	Superioritate Cognitivă Maritimă	Maritime Cognitive Superiority
MSCF	Cadrul Convergenței Strategice Maritime	Maritime Strategic Convergence Framework
IMSA	Arhitectura Integrată a Securității Maritime	Integrated Maritime Security Architecture

Terminology note: It is recommended that English abbreviations be used consistently in both language versions to facilitate citation and international comparability. The abbreviation **MSCoG** is proposed here as a standardised form; in the original study, references to ‘Maritime Strategic Gravity’, ‘Maritime Strategic Centre of Gravity’ and the associated abbreviated forms should be harmonised.

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