**Input paper: [[1]](#footnote-1)** ARM18-9.1.1

**Input paper for the following Committee(s):** **Purpose of paper:**

(Select as appropriate)

ARM  ENG  PAP  Input

ENAV VTS  Information

**Agenda item** [[2]](#footnote-2) n.n

**Technical domain/ Task number** 2 Working Group 3

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**Risk maturity model for the maritime authorities**

# Summary

Maritime authorities have the administrative responsibility for the safety and security of shipping and the prevention of marine and atmospheric pollution caused by ships. This responsibility involves various tasks that can be supported through effective risk management, but currently, there are no models available to evaluate its level of maturity in maritime administrations.

While the responsibility for Aids to Navigation, Vessel Traffic Services, and other related navigational safety services is implemented differently in different states, having tools for AtoN authorities to evaluate their risk management performance would strengthen the alignment of IALA’s guidance on risk management (especially G1018) with the concepts and frameworks presented in the widely used ISO 31000:2018 international standard on which this IALA guideline to a large degree builds upon.

To fill this gap and respond to the needs identified by several maritime authorities, this input paper introduces a new risk maturity model called the R-Mare matrix. This model is built on recent scientific knowledge in the field of risk management, and it has been designed in close cooperation with end-users and maritime risk management experts using the Delphi methodology.

The R-Mare is a qualitative matrix-based model tailored to support the self-evaluation of maritime authorities. The matrix consists of 17 state-of-the-art risk management attributes, a five-step risk maturity scale, and associated risk maturity grid descriptions. These elements can be used to evaluate the current risk management performance of maritime authorities, identify areas for improvement, and develop a plan to achieve a higher level of maturity.

## Purpose of the document

The ARM Committee is invited to take a note on this information paper and consider whether it could be discussed on the Working Group 3.

## Related documents

IALA Guideline G-1018: Risk management. IALA Publication 2022.

IMO Revised guidelines for Formal Safety Assessment (FSA) for use in the IMO rule-making process. MSC-MEPC.2/Circ.12/Rev.2. London: IMO 2018.

ISO 31000 Risk Management. Guidelines (Second edition). SFS-ISO 31000:2018.

Laine, V., Valdez-Banda, O., & Goerlandt, F. (2024). Risk maturity model for the maritime authorities: a Delphi study to design the R-Mare matrix model. WMU Journal of Maritime Affairs, 1-27, doi: 10.1007/s13437-023-00328-z

# Background

The shipping industry serves as the backbone of international trade and the global economy, but it also poses risks to human life, the marine environment, and the global atmosphere [1]. Therefore, there is a need to procure the benefits and manage the risks of this transportation mode, where authorities hold specific responsibilities focused on preventing maritime accidents, minimizing their potential consequences, and ensuring the sustainability of this industry. Although many of these associated tasks are already well established, several factors can introduce uncertainties and jeopardize their successful execution. Some of these factors can be attributed to the internal context of maritime administrations, such as a lack of leadership, resources, or commitment, while others are linked to its external context, including the increasing number of sub-standard vessels, illegal dumping and cyber-attacks, among others. To effectively address this complex array of responsibilities, maritime authorities need to be aware of and understand the risks stemming from both their internal and external contexts [2].

A substantial number of studies have indicated that systematic risk management strongly supports the work of maritime authorities [3]. To this end, various risk management frameworks, processes, and tools have been introduced in academic literature and professional contexts [4]. However, the current selection of available risk assessment tools does not include risk maturity models, despite calls for such applications [5]. These models have proven useful across different industrial sectors [6], transport modes [7,8] and governmental bodies [9]. In the maritime sector, these could also support compliance with international regulations on aids to navigation, goal-based standards, and national contingency planning. Maturity models are also well-suited to help strengthen the implementation of the risk management framework as outlined in the influential ISO31000:2018 standard, on which the IALA Guideline G1018 builds, indicating the relevance for Aids to Navigation authorities. Consequently, there is a need to address the risk maturity models from a maritime perspective and close this identified gap in risk assessment tools for competent authorities.

To take the first step for providing a risk maturity model for the maritime authorities, an extensive background literature review was conducted to explore recent developments in this field. The results of this review formed the basis for the new model development, which was made in close collaboration with the competent authorities and risk management experts through a process based on the Delphi methodology. Following its results, this paper briefly introduces the new risk maturity model called the R-Mare, which is based on the matrix technique. This matrix incorporates 17 risk management attributes, a five-step risk maturity scale and associated risk maturity grid descriptions. By using this matrix, maritime authorities can evaluate their current risk management performance, identify areas for improvement, and develop a plan for achieving a higher level in risk management maturity. Even though the R-Mare matrix has been primarily developed for the maritime authorities of Finland, its approach could also be considered in other coastal and flag states.

OpenRisk II [10] is an ongoing project funded by the EU Interrerreg Baltic Sea Region. As part of this project, the reliability of the R-Mare matrix is currently undergoing further testing to improve the model´s quality and gain understanding of its practical usefulness, including the reliability of its application across different expert raters. Within the project, a software solution for the R-Mare matrix will also be developed to provide a practice-oriented user interface for the model, for ease of use by the maritime authorities. This software product will be open-access in line with the project principles.

# Discussion

The following Sections 2.1 and 2.2 briefly outline the design specifications and development process of the R-Mare matrix risk maturity model, while Section 2.3 provides an overview of the model itself. For a comprehensive description of the R-Mare matrix model, the reader is referred to the original research article [11].

## DESIGN SPECIFICATIONS

The basic design of the development process for the risk maturity model for maritime authorities is derived from recent studies in this field and risk management guidelines.

First, the study by Maier et al. (2011) was applied to support the specification of the purpose, objectives, end-users and success criteria of the model, as it provides thorough guidance in this regard. Second, the review by Laine et al. (2022) was used to specify the methodology for the development process of the risk maturity model and the technique to be employed in the model itself. Third, the results of this same review were also utilized to determine the initial number of risk maturity levels and risk management attributes for the model, and to identify best practices for describing the model's risk maturity grids. Finally, both the ISO 31000 standard and the IMO FSA guidelines were used as benchmarks to support the definition of the risk management attributes for the model, ensuring its relevance to well-known industry standards and maritime regulatory frameworks.

Table 1 provides a summary of the design specifications, end-user needs, and development basis for creating this so-called R-Mare matrix model.

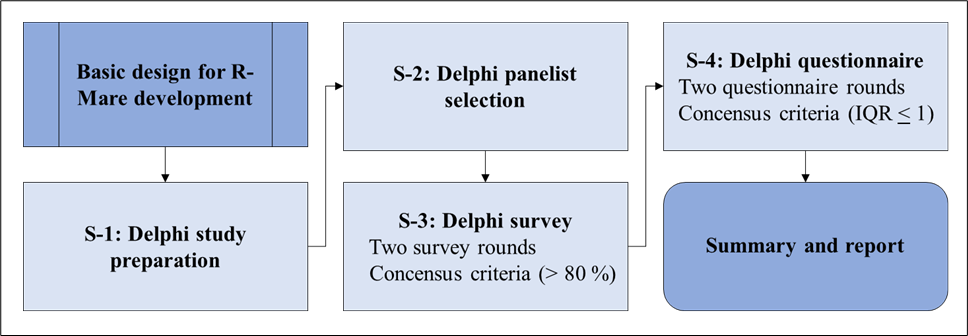
Table 1. Summary of the design specifications for the R-Mare matrix model

|  |  |
| --- | --- |
| Subject | Specification |
| 1. Purpose | Support the development of maritime authorities' risk management performance |
| 2. Objectives | Assist maritime authorities to evaluate their risk management performance, identify areas for improvement, and develop a plan for achieving a higher risk maturity level. |
| 3. End-users | Maritime safety and response authorities of Finland |
| 4. Methodology | Delphi methodology for the R-Mare model development |
| 5. Technique | Attributes-maturity level matrix as the R-Mare model technique |
| 6. Maturity levels | Five risk maturity levels for the X-axis of R-Mare model |
| 7. Attributes | Approximately 20 risk management attributes for the Y-axis of R-Mare model |
| 8. Grids | Best practices to support maturity grid descriptions |
| 9. Benchmarking | ISO 31000 standard and IMO FSA guidelines focusing on risk management attributes |
| 10. Success criteria | Useful to assist the R-Mare matrix model end-users to evaluate and develop their risk management performance |

## MODEL DEVELOPMENT PROCESS

The standard Delphi methodology [12] process used for creating the R-Mare matrix model is illustrated in Figure 1.

This process involved four steps: 1) Delphi study preparations, 2) Delphi panellist selection, 3) Delphi survey and 4) Delphi questionnaire. The aim of the Delphi survey step was to support the construction of the R-Mare matrix, while the questionnaire step focused on evaluating the importance of its risk management attributes. Both steps also considered consensus criteria in line with the principles of the Delphi methodology.



*Figure 1. Overview of the Delphi process for R-Mare matrix model development*

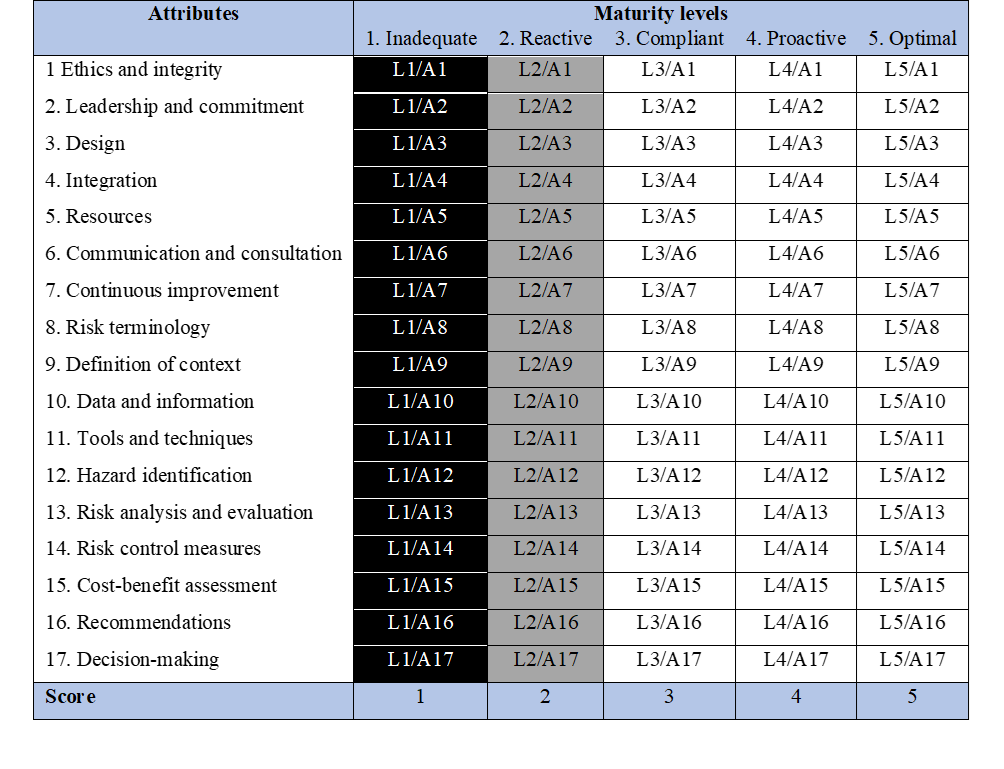
## Overview of the model

The results of the Delphi process provided the R-Mare matrix risk maturity model for maritime authorities. Figure 2 shows the basic idea of this model.

The rows of the R-Mare matrix address the scope dimension of the model, elaborated through 17 risk management attributes. These attributes consider ethics and integrity (1), leadership and commitment (2), basic risk management requirements (3-5), parallel activities (6-7), risk assessment (8-16) and decision-making (17). To support the self-evaluation of the maritime authorities, the reference article [11] provides a detailed list of these attributes and the aspects to be considered in their evaluation.

The columns of the R-Mare matrix focus on the progress dimension of the model. This involves five risk maturity levels namely: Inadequate (1), Reactive (2), Compliant (3), Proactive (4) and Optimal (5). The article provides a detailed description for each level. Their overall aim is to support the self-evaluation of the maritime authorities concerning the maturity of the organizational practices with respect to the 17 risk management attributes.

Each cell of the R-Mare matrix model is further populated with a specific textual grid description to characterize traits of performance at each level and attribute (L1/A1 - L5/A17). To complete the support for self-evaluation of maritime authorities, the article provides general criteria and two practice-oriented examples for all 85 risk maturity grids of the model. By using the associated five-point score system, the authorities can also quantify, visualize and further analyse the results of their self-evaluation as needed.



*Figure 2. Overview of the R-Mare matrix risk maturity model*

# References

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# Action requested of the Committee

The Committee is requested to:

1. Take a note on the study: Risk maturity model for the maritime authorities
2. To consider if the study and its results can be discussed at the ARM WG 3

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-1)
2. Leave open if uncertain [↑](#footnote-ref-2)