IALA GUIDELINE

G1124
THE USE OF PORTS AND WATERWAYS SAFETY ASSESSMENT (PAWSA MKII)

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DOCUMENT REVISION

Revisions to this document are to be noted in the table prior to the issue of a revised document.

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June 2017	First issue	Council 64
January 2022	Edition 1.1 Approved by Council December 2021 and published January 2022, in alignment with IMO Resolution A.1158(32) Guidelines for Vessel Traffic Services.	Council 74
June 2022	Edition 2.0 Major revision and separation of Guideline from annex A, Implementation Guide and appendices 1 to 6 (annex A and appendices to now form the "PAWSA MKII Manual")	Council 75

CONTENTS

1. INTRODUCTION

SOLAS regulations V/12 and V/13 recognize the establishment of vessel traffic (VTS) services and aids to navigation (AtoN), respectively. In particular:

> *Regulation 12* - states that Contracting Governments undertake to arrange for the establishment of VTS where, in their opinion, the volume of traffic or the degree of risk justifies such services.
>
> *Regulation 13* – states that Contracting Governments undertake to provide, as it deems practical and necessary either individually or in co-operation with other Contracting Governments such aids to navigation as the volume of traffic justifies and the degree of risk requires

Risk assessment provides a useful systematic process to identify, analyse and mitigate potential hazards and the risks associated with it. IALA, together with others, has developed the IALA Risk Management Toolbox to provide appropriate tools to conduct such maritime risk assessments.

The IALA Risk Assessment Toolbox is recognised by the IMO via *SN.1/Circ.296* [1]. Further, IMO Resolution *A.1158(32) Guidelines for Vessel Traffic Services* [2] states that "Contracting Governments are encouraged to take into account IALA standards and associated recommendations, guidelines and model courses".

IALA *Recommendation R1002 Risk Management for Marine Aids to Navigation* [3] (as a normative Recommendation of IALA Standard *1010 AtoN Planning and Service Requirements* [4]) recommends the use of risk management and IALA risk management tools when assessing the risks in waterways, as part of the decision-making process for AtoN. IALA guidelines associated with Recommendation R1002 include:

- Guideline *G1018 Risk Management*
- Guideline *G1123 The Use of IALA Waterway Risk Assessment Programme (IWRAP)*
- Guideline *G1124 The Use of Ports and Waterways Safety Assessment (PAWSA) MkII Tool* (this Guideline)
- Guideline *G1138 The Use of the Simplified IALA Risk Assessment Method (SIRA)*

2. PURPOSE

The purpose of this Guideline is to provide an overview of the Ports and Waterways Safety Assessment (PAWSA MKII) methodology which:

- identifies major waterway safety hazards;
- estimates risk levels, evaluate potential mitigation measures; and
- sets the stage for implementation of selected measures to reduce risk.

Note: The necessary information to undertake a PAWSA MKII is contained within the PAWSA MKII manual (subsequently referred to as "the manual"). The manual and information on appropriate PAWSA MKII training courses can be obtained by contacting the IALA World-Wide Academy at academy@iala-aism.org.

3. BACKGROUND

The United States Coast Guard (USCG) developed PAWSA in the late 1990's as a means to identify minimum user requirements for new VTS systems in consultation with local officials, waterways users and port authorities.

The USCG PAWSA Workshop Guide (the Guide) highlights the goal of PAWSA:

> "…is not only to establish a baseline of waterways for VTS consideration, but to provide the local host and waterway community with an effective tool to evaluate risk and work toward long term solutions tailored to local circumstances. The goal is to find solutions that are both cost effective and meet the needs of waterway users and stakeholders."

In 2010, IALA published Recommendation *O-134 The IALA Risk Management Tool for Ports and Restricted Waterways* (revoked in June 2017), which included PAWSA. In 2014, the Directorate General of Coastal Safety (DGCS) in Turkey reviewed the PAWSA methodology and proposed an updated version of the Guide (which now forms the content of the manual) and is referred to as PAWSA MKII.

The United States Coast Guard, the copyright holders of the Excel™ workbooks and the Guide, graciously confirmed that it has no objection to the publication of the DGCS updated Guide (PAWSA MKII) nor its use by other IALA members. The IALA PAWSA MKII manual is the recommended document to accompany this Guideline.

4. PAWSA MK II AND THE IALA RISK MANAGEMENT TOOLBOX

Guideline *G1018* briefly introduces the tools included in the IALA Risk Management Toolbox, recognising the *Formal Safety Assessment (FSA)* process adopted by the IMO [9]. G1018 also summarizes the principles of ISO 31000 Risk Management [10], which are implicit in the recommended risk assessment approach.

Further information on the *FSA*, *ISO 31000 Risk Management*, and their relationship to the IALA Risk Management Toolbox is contained within *G1018*.

PAWSA MKII is one of the recommended risk assessment tools within the IALA toolbox. PAWSA MKII provides a structured and systematic approach to:

- identify major waterway safety hazards;
- estimate risk levels, evaluate potential mitigation measures; and
- set the stage for implementation of selected measures to reduce risk.

As a *qualitative* tool, PAWSA is exploratory and the analysis seeks a deeper understanding of why a certain phenomenon occurs, its associated consequences, and the potential effectiveness of additional mitigation measures.

In comparison, other risk assessment tools included in the toolbox include, and are summarized in:

- Guideline *G1123 IALA Waterway Risk Assessment Programme (IWRAP MK II)* – a standardized, *quantitative* method to evaluate the probability of collisions and groundings in a given waterway, using AIS data and a Windows-based software program.
- Guideline *G1138 The Use of the Simplified IALA Risk Assessment Method (SIRA)* - a simplified *qualitative* method to assess the volume of traffic and degree of risk and identify potential risk mitigation options to reduce the risks to acceptable levels.

5. OVERVIEW OF PAWSA MKII

The PAWSA MKII methodology is a structured approach to qualitative risk assessment.

5.1. PRINCIPLE OF PAWSA MKII

PAWSA MKII applies the Delphi[1] method to identify major waterway safety hazards, estimates risk levels, evaluates potential mitigation measures, and provides specific recommendations for selected measures to reduce risk. The Delphi method is a structured communication technique that converts the expert opinion of stakeholders into a quantitative appraisal of risk.

Delphi is based on the principle that predictions (or decisions) from a structured group of individuals are more accurate than those from unstructured groups. Invited experts answer questionnaires in two or more rounds. After each round, a facilitator provides an anonymised summary of the experts' forecasts from the previous round, as well as the reasons they provided for their judgments. Thus, experts are encouraged to revise their earlier answers in light of the replies of other members of their panel. It is believed that during this process the range of the answers will decrease and the group will converge towards the "correct" answer.

5.2. METHOD

PAWSA is undertaken by means of a structured, two-day workshop, evaluating risk and potential mitigation measures through expert inputs.

During the workshop, waterway users and stakeholders discuss and estimate risks levels for 24 different risk factors, organised into six risk categories, collectively termed the Waterway Risk model (see Figure 1).

The participants provide numerical values (using a scale of 1 to 9) to quantify their subjective assessments of the risk factors and these values are organized in logical segments, referred to as “books”, providing a comprehensive but simple picture of the participants’ assessment.

As each book is completed, values are input in the PAWSA MKII software (a Microsoft Excel spreadsheet). The responses are recorded in aggregate form and the results are used in the appropriate subsequent phases of the PAWSA MKII process as a basis for discussion among the participants on the effectiveness of existing risk mitigation strategies and additional mitigation actions.

5.3. WORKSHOP

The workshop requires the participation of maritime experts and other stakeholders to ensure that important environmental, public safety, and economic consequences are given appropriate attention as mitigation measures are selected.

Workshops are typically conducted with 30 participants (in 15 teams of two persons each), using the expertise of an experienced facilitator and a trained note-taker.

1 See Wikipedia for further information on the Delphi method: https://en.wikipedia.org/wiki/Delphi_method#:~:text=The%20Delphi%20method%20or%20Delphi,on%20a%20panel%20of%20experts

5.4. PAWSA MKII WATERWAY RISK MODEL

Risk can be defined as the product of the probability of an incident and its consequences. The PAWSA MKII Waterway Risk model includes variables describing both the causes of waterway scenarios, and their consequences. The six risk categories used in the model are as follows:

1 *Vessel Conditions* – the quality of vessels and their crews that operate on a waterway.

2 *Traffic Conditions* – the number of vessels that use a waterway and their interactions.

3 *Navigational Conditions* – the environmental conditions that vessels must deal with in a waterway relating to wind, water movement (i.e., currents), and weather.

4 *Waterway Conditions* – the physical properties of the waterway that affect how easy it is to manoeuvre a vessel.

5 *Immediate Consequences* – the immediate impacts of a waterway casualty: people can be injured or killed, petroleum and hazardous materials can be spilled and require response resources, and the marine transportation system can be disrupted.

6 *Subsequent Consequences* – the subsequent effects of waterway casualties that are felt hours, days, months, and even years afterwards, such as shore side facility shut-downs, loss of employment, destruction of fishing areas, decrease or extinction of species, degradation of subsistence living uses, and contamination of drinking or cooling water supplies.

Figure 1 shows the six risk categories and corresponding risk factors in the Waterway Risk model.

Waterway Risk Model					
Vessel Conditions	**Traffic Conditions**	**Navigational Conditions**	**Waterway Conditions**	**Immediate Consequences**	**Subsequent Consequences**
Deep Draft Vessel Quality	Volume of Commercial Traffic	Winds	Visibility Impediments	Personnel Injuries	Health and Safety
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic

Figure 1 PAWSA MKII Waterway Risk model – categories and risk factors

5.5. PAWSA MKII PROCESS AND BOOKS

The five main steps used in the PAWSA MKII process are described below and Figure 2 provides a simple overview of the process:

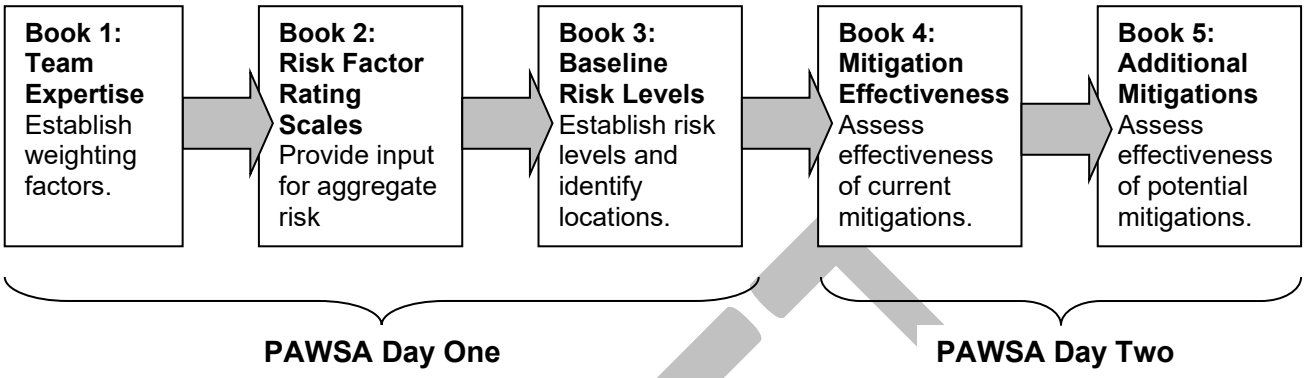

Figure 2 PAWSA MKII process steps

- *Book 1 – Teams Expertise*

  At the start of the PAWSA workshop, the maritime experts and waterway users participating in the workshop are divided into teams with similar expertise. There is no expectation that each participant will be equally knowledgeable in all 24 risk factors being assessed, therefore, the relative level of expertise of each team is determined.

  The results of Book 1 are used to weight each team's input in all other Books.

- *Book 2 - Risk Factor Rating Scales*

  Measurement scales are established for each of the 24 risk factors in the Waterway Risk model. Book 2 is only developed if the historically developed measurement scales do not characterize the range of possible conditions that affect risk within the waterway for each risk factor. Otherwise, the default values are used.

  Book 2 develops the four point rating scale for each risk factor. Specifically, the output from Book 2 is the four levels of risk described for each of the 24 risk factors. That is:

  - *"A Value"* - The lowest level of risk describing the best case situation.
  - *"D Value"* - The highest level of risk describing the worst case situation.
  - *"B and C Values"* - Two intermediate risk level descriptions also are given – the "B" and "C" values.

- *Book 3 - Baseline Risk Levels*

  The measurement scales developed in the second step are used to determine the levels of risk within the waterway due to each risk factor. In this step, the existing mitigation measures applied to reduce risks in the waterway *are not considered.*

  Book 3 is used to determine a baseline risk level value for every risk factor in the Waterway Risk model. In summary:

  - It uses the same four qualitative descriptors for each risk factor as were used in Book 2 (i.e., Values A, B, C and D).

- The risk level values that are produced by Book 3 are not intended to take into account any actions already implemented to reduce risk in that waterway (i.e., before any mitigation measures).

- *Book 4 - Mitigation Effectiveness*

  The existing mitigation measures used to reduce risks within the waterway, as well as their effectiveness in reducing the level of risk for each risk factor, are assessed. The result is the present level of risk, considering the existing mitigation.

  Book 4 is used for two purposes

  - To evaluate the effectiveness of existing mitigation strategies in reducing the risk level for each factor in the model (i.e., the present risk level).
  - To determine whether the risk mitigation strategies already in place adequately balance the resulting risk level, or not.

- *Book 5 - Additional Mitigation*

  For those risk factors that are not adequately mitigated or balanced by the existing mitigation measures, additional mitigation measures are identified and their effectiveness in reducing the levels of risks are assessed. Book 5 is used to focus discussion on those risk factors where the present risk level is not well balanced with existing mitigation measures.

  This serves as a starting point for evaluating the possible effectiveness of new mitigation strategies. The output from Book 5 displays:

  - Which category most teams have chosen.
  - How much risk improvement would result from the ideas put forward as new mitigation strategies.
  - Which category was judged to be the most effective.

The PAWSA MKII process uses various types of information as inputs for the expert ratings for the risk factors.

The PAWSA manual contains guidance on developing a workshop specific guide for the invited stakeholders to ensure they have the relevant facts and figures easily to hand during their discussions. This information includes, but is not limited to:

- Expert knowledge
- Detailed, quality-assured data on maritime traffic, cargoes, and maritime casualties
- Official nautical charts and publications based, where possible, on modern surveys
- Information regarding transport of goods in the waterway
- Meteorological, hydrographic, and oceanographic records
- Proposed or planned maritime projects in or near the waterway under consideration

5.6. OUTPUTS

The PAWSA MKII process converts expert opinion (qualitative input) into quantitative ratings that indicate whether the *existing* risk in a waterway is:

- *Acceptable* and that no further work is needed unless changes occur in significant criteria, such as the traffic pattern or types of vessels using that waterway.
- *Not acceptable* but the risk control options necessary to make the risk level of the waterway acceptable have been identified adequately.
- *Not acceptable* and more detailed study is necessary to enable the risk control options that will make the risk level of the waterway acceptable to be identified adequately.

6. STRENGTHS AND LIMITATIONS

6.1. STRENGTHS

Strengths of PAWSA MKII are:

- The model and process are a proven, simple and powerful tool, with extensive use in the maritime sector; the process has been refined over many years of use.
- It provides a methodology to gain a deep understanding of why a certain phenomenon occurs, its associated consequences, and the potential effectiveness of additional mitigation measures.
- Participants have expert local knowledge, and their involvement improves the suggestions, development, and potential for agreement on, and acceptance of risk control measures.
- The same risk rating scale (“1 to 9”) is used throughout the process, across all five books and 24 risk factors. Therefore, results can easily be compared amongst the 24 factors for the same waterway, across different waterways in a country or in other countries.
- All numerical inputs are weighted by the relative expertise of each team for each risk category. The methodology reduces the risk of single waterway users or stakeholders dominating the workshop and ensures majority agreement on the proposed risk mitigation measures.
- The output is an auditable record of the risk assessment process and the decisions made.

6.2. LIMITATIONS

Some limitations of PAWSA MKII are:

- The process requires time commitment from workshop participants.
- The results are highly dependent on the engagement and contributions of appropriate waterway users and expert stakeholders.
- To ensure a successful outcome of any PAWSA MKII process, it is essential a competent facilitator leads the workshop team and that there are appropriate resources assigned.
- Adequate data and background material that participants can refer to during the workshops, needs time and resources to prepare.

7. FURTHER INFORMATION

PAWSA MKII is a risk assessment methodology requiring experienced facilitators, who are familiar with the process and tools and who can interpret the PAWSA MKII book results. Further information on appropriate PAWSA MKII training courses, together with the manual can be obtained by contacting the IALA World-Wide Academy at academy@iala-aism.org. There are numerous examples of previous PAWSA assessments to be found on the relevant page of the USCG. This is a particularly valuable source of information when assessing potential risk control measures.

8. DEFINITIONS

The definitions of terms used in this Guideline can be found in the *International Dictionary of Marine Aids to Navigation* (IALA Dictionary) at http://www.iala-aism.org/wiki/dictionary and were checked as correct at the time of going to print. Where conflict arises, the IALA Dictionary should be considered as the authoritative source of definitions used in IALA documents.

9. ABBREVIATIONS

AtoN	Marine Aids to Navigation
DGCS	Directorate General of Coastal Safety (Turkey)
IMO	International Maritime Organization
PAWSA	Ports and Waterways Safety Assessment MKII
SN/Circ.	Safety of Navigation Circular (IMO)
SOLAS	International Convention for the Safety of Life at Sea (SOLAS 1974, as amended)
USCG	United States Coast Guard
VTS	Vessel traffic services

10. REFERENCES

[1] IMO. SN.1/Circ.296 Degree of risk evaluation

[2] IMO. Resolution A.1158(32) Guidelines for Vessel Traffic Services

[3] IALA. Recommendation R1002 Risk Management for Marine Aids to Navigation

[4] IALA. Standard S1010 Marine Aids to Navigation Planning and Service Requirements

[5] IALA. Guideline G1018 Risk Management

[6] IALA. Guideline G1123 The Use of IALA Waterway Risk Assessment Programme (IWRAP MkII)

[7] IALA. Guideline G1124 The Use of Ports and Waterways Safety Assessment (PAWSA) MkII Tool

[8] IALA. Guideline G1138 The Use of the Simplified IALA Risk Assessment Method (SIRA)

[9] IMO. MSC-MEPC.2/Circ.12/Rev.2 Revised Guidelines for Formal Safety Assessment (FSA) for Use in the IMO Rule-making Process

[10] ISO. ISO 31000:2018 Risk Management