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Interim Report of the Working Group on Risks of Maritime Activities in the Baltic Sea (WGMABS)

7–11 November 2016

ICES Headquarters, Copenhagen, Denmark

ICES International Council for the Exploration of the Sea

CIEM Conseil International pour l'Exploration de la Mer

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Contents

Executive summary

The Working Group on Risks of Maritime Activities in the Baltic Sea (WGMABS) met in Copenhagen, Denmark, 7–11 November 2016. This was the second meeting of the working group and the objective was to review the current work to understand what kind of scientific tools are available for maritime risk assessment and management. The WGMABS focus area was considerably widened by addressing beside the Bayesian risk assessment methodologies also some novel scientific approaches like System-Theoretic Accident Model and Processes (STAMP), STAMP-Mar as the application of systems-theoretic approach to maritime domain - safety management of sustainable eco-socio-technical maritime transportation system, and the risk based maritime spatial planning (RBMSP). Methodology of the Bowtie analysis of avoidance and mitigation measures within the legislative and policy context of the maritime safety management was outlined and the issue of the underwater sound as the maritime risk factor was addressed based on the Baltic Sea Information on the Acoustic Soundscape (BIAS) project materials. The Next Generation SmartResponse Web (NG-SRW) under development by BONUS STORMWINDS project was introduced as an online information management and exchange software platform enabling, maintaining and sharing the effective Common Situational Awareness (CSA) for maritime emergency management.

System-Theoretic Accident Model and Processes (STAMP) approach considers safety an emergent property of the system, arising from the interaction of system components within a given environment. Based on that the safety management is defined as a continuous control task to impose the constraints necessary to limit system behaviour to safe changes and adaptations.

To address the interaction between the offshore wind and maritime sectors, the current research focuses on the development of a novel concept – 'risk based maritime spatial planning' (RBMSP). RBMSP is essentially a tool-kit consisting of various frameworks, models and methods that can augment traditional MSP approaches, and help decision makers optimize the use of sea space – dynamically.

The STAMP-Mar standard control loop based NG SmartResponse Web application is used to integrate on-line information from: 1) collision/grounding model simulation (simulated depth, amount and duration of oil spill); 2) Seatrack Web spilled oil trajectory simulations; and 3) environmental risk dynamic assessment based on sensitivity map layers imported as a Web Map Services into the system.

As a future perspectives it was suggested to continue activities to further develop the maritime domain related safety science including the Bayesian risk assessment methodologies, STAMP-Mar and RBMSP methodological approaches and the operational tools like NG SmartResponse Web. The WGMABS broad science priority is to focus on: 1) integration of existing maritime transport and ecological risk models, with refinements and extensions; 2) maritime safety management harmonization across Baltic Sea Region; and 3) end-user needs, validation and usability of developed approaches. Recognition of science by WGMABS is achieved by: 1) focusing on stakeholder/ end-user needs and participation; and 2) international networking between the WGMABS and networks/groups with similar aims and scope.

1 Administrative details

Working Group name

Working Group on Risks of Maritime Activities in the Baltic Sea (WGMABS)

Year of Appointment

2015

Reporting year within current cycle (1, 2 or 3)

2

Chair(s)

Sakari Kuikka, Finland

Robert Aps, Estonia

Meeting venue

ICES HQ, Copenhagen, Denmark

Meeting dates

7–11 November 2016

2 Terms of Reference and Summary of Work plan

a) Review the recent studies carried out for ecological risks of maritime activities and to plan ToRs for 2017 WG meetings;

Background: Maritime activities form a major risk for Baltic Sea nature. The WG will contribute to Integrated ecosystem assessments. Building a capacity to asses these risks is needed. This is needed to understand what type of literature is available for Baltic Sea modelling, and what kind of activities the WG agenda should include in near future.
Deliverable: Report of the scientific activities by a review to scientists and managers, and plan the future ToRs for the WG.

b) Review the science of maritime risk analysis in the Baltic Sea;

Background: Review is needed to understand what kind of models are actively used in the risk analysis, and to see the future development needs.
Deliverable: Review paper

c) Plan the ToRs of future WG meetings;

Background:

- Science requirements
- Potential future advice

After the review, there is a need to plan future scientific activities of the WG. For example, it must be planned how the feedback is obtained from potential customers for scientific advice.
Deliverable: ToRs

d) Test the available risk models and operational sea dynamic models, including models that integrate major risks in the Baltic Sea;

Background:

- Science requirements
- Potential future advice

This is needed to get understanding of the current interface of models that are used in the operational risk management support. The integrated risk models and needed e.g. in spatial planning of Baltic Sea.
Deliverable: Part of the report or review paper.

e) Review of existing databases and their applicability to the alternative model;

Background: There is a need to check the data availability for the current and potential future models;
Deliverable: WG report

f) Identification of the need of expert knowledge in the use of the models;

Background: There is need to evaluate the needed use of expert knowledge to populate those part of models where there is no data;
Deliverable: WG report

g) Discussion with end-users on the applicability and relevancy of the models.

Background: Discussion with end-users is needed to understand the need for additional modelling tools.
Deliverable: WG report

Summary of Work plan

Year 2

Test and report the available risk models and test them with stakeholders.

Year 3

Assessment the possible future directions in developing the safety science related maritime domain in general and to the safety of eco-socio-technical maritime navigation system in particular.

3 List of Outcomes and Achievements of the WG in this delivery period

- Considerable widening of the WGMABS focus area by addressing:

  - Bayesian risk assessment methodologies,
  - System-Theoretic Accident Model and Processes (STAMP),
  - STAMP-Mar as the application of systems-theoretic approach to maritime domain - safety management of sustainable eco-socio-technical maritime transportation system,
  - risk based maritime spatial planning (RBMSP),
  - Bowtie analysis of avoidance and mitigation measures within the legislative and policy context of the maritime safety management,
  - underwater sound as the maritime risk factor.

- The Next Generation SmartResponse Web (NG-SRW) under development by BONUS STORMWINDS project was introduced as an online information management and exchange software platform enabling, maintaining and sharing the effective Common Situational Awareness (CSA) for maritime emergency management.
- List of publications relevant to WGMABS activities (Annex 2)
- Progress Report 2016 (this document)
- WGMABS 2016 - given presentations and developed models (WGMABS SharePoint).

4 Progress report on ToRs and workplan

Progress by ToR

ToR a) Review the recent studies carried out for ecological risks of maritime activities and to plan ToRs for future group meetings

Since 2015, there are several maritime risk papers published for the Baltic Sea. Annex 2 includes the list of earlier papers and the recent papers published in 2015, 2016 and 2017. One of the aims has been achieved in the publications, i.e. that the engineering orientated papers and the biological papers apply to large extent the same methodology, i.e. Bayesian network models. This allow the linking of models together, making them more interdisciplinary than so far. This aspect must be included to future project proposals. WGMABS aims to apply such integrated models in the oil spill risk analysis. In addition recent publications on the application of the System-Theoretic Accident Model and Processes (STAMP) approach to the maritime domain are added, as well as papers producing the required evidence base for developing the risk models, methods for detecting possible near-miss ship collisions in the Northern Baltic sea, and a paper introducing a systematic method for defining key performance indicators in maritime safety management.

ToR b) Review the science of maritime risk analysis in the Baltic Sea

Writing of a review paper was started after the 2015 meeting. The paper has not been submitted yet. The manuscript include e.g. following sections: maritime risk governance, modelling of oil spill risks in the Gulf of Finland, cost-benefit models, development of biodiversity-based utility functions, linking of experimental data and model outcomes:

Bayesian techniques, existing data sets and possible new governance model for the Baltic Sea. It is based on the talks given in 2015 meeting and on existing published papers.

Jimenez Madrid proposed different kinds of oil spill beaching maps for the Mediterranean Sea. These beaching maps can be useful as a complementary tool to vulnerability analysis and risk assessment. Firstly, it was defined an oil beaching map for a single point, which is the case, for example, in the study of an oil platform. Next, one beaching map was defined for a line, examining the main route of oil tankers in the Mediterranean. The final oil beaching maps analysed show the percentage of particles, which reach the coast in an interval of time: one week, two weeks, one month and two months. The data depicted in the maps is based on a general Lagrangian model which can be applied to other locations, e.g. at the Baltic Sea.

Application of the System-Theoretic Accident Model and Processes (STAMP) approach to the maritime domain considers safety an emergent property of the system, arising from the interaction of system components within a given environment. Rather than focusing on particular errors or component failures as in traditional engineering risk analysis, STAMP focuses on safety constraints, hierarchical control structures and control loops. The basic concepts in STAMP are 1) hierarchical regulatory levels, 2) constraints, and 3) control loops and process models. STAMP-Mar coverage is extended beyond the area of socio-technical systems safety into realm of safety of complex eco-socio-technical systems. At the operational level Regional Environmental Sensitivity Index (RESI) is used to integrate the ecosystem components and to add the environmental constraints to the STAMP-Mar safety control structure.

Driven by social conscious and strong political initiatives against climate change, renewable energy schemes have become increasingly common in recent years. The offshore renewables sector, in particular, has seen strong growth and development – best evidenced by the advances in efficiency, and the increase in the sizes and numbers, of offshore wind turbines (OWTs). To address the interaction between the offshore wind and maritime sectors, the current research focuses on the development of a novel concept – risk based maritime spatial planning (RBMSP). Currently, the RBMSP tool-kit consists of three 'tools': 1) a harmonized, transparent framework for navigational risk assessment of vessels operating near offshore wind farms (OWFs), 2) a novel tool based on ship manoeuvring, that can provide decision support for a wide range of stakeholders, including wind farm planners and operational end users such as seafarers or VTS operators, and 3) a method of improving stakeholder communication and feedback through the use of simulators. These tools, while specifically designed to address OWF challenges, can also be adapted for other conflict resolutions as well.

It is important to show how the maritime safety science results are used to develop the oil spill response related operational tools like NG SmartResponse Web and risk based maritime spatial planning (RBMSP) being essentially a tool-kit consisting of various frameworks, models and methods that can augment traditional MSP approaches, and help decision makers optimize the use of sea space – dynamically.

ToR c) Plan the ToRs of future WG meetings

Related to the last meeting of WGMABS, the following ToRs are suggested for year 2017:

- Compile and describe all information related to the end user experiences in using maritime risk assessment and management models or their results
- Suggest the future of maritime risk management related science in an ICES expert group and comment the possible future needs of advice.

ToR d) Test the available risk models and operational sea dynamic models, including models that integrate major risks in the Baltic Sea

The issue of testing the available risk models and operational sea dynamic models, including models that integrate major risks in the Baltic Sea was discussed. It was suggested that testing will continue in 2017 and the final results will be presented at the WGMABS final meeting in November 2017 in Helsinki.

ToR e) Review of existing databases and their applicability to the alternative model

The review of the existing databases and their applicability to the alternative model was presented and discussed and it was suggested that review will continue in 2017 and the final results will be presented at the WGMABS final meeting in November 2017 in Helsinki.

ToR f) Identification of the need of expert knowledge in the use of the models

Activities to evaluate the need of expert knowledge in the use of the models were discussed and it was suggested to continue identification of the need of expert knowledge in 2017 and to present the final results at the WGMABS final meeting in November 2017 in Helsinki.

ToR g) Discussion with end users on the applicability and relevancy of the models

The issue of discussion with end-users on the applicability and relevancy of the models was discussed and it was suggested to present the final results at the WGMABS final meeting in November 2017 in Helsinki.

Science Highlights

Development and publication (Aps *et al.*, 2015; 2016) of the STAMP-Mar maritime safety science concept and application positions under development that embrace 1) the hierarchical regulatory levels of maritime navigation safety control, 2) maritime navigation safety constraints, and 3) maritime navigation safety control structure. Ecosystem context of the maritime navigation eco-socio-technical system is characterized by Regional Environmental Sensitivity Index (RESI) that is used for STAMP-Mar based maritime navigation operational safety management as well as for setting the Maritime Spatial Planning processes related environmental constraints.

Justification

The oil transportation in the Baltic Sea is growing and the Gulf of Finland has some of the busiest oil shipping routes in the world. Further development of enhanced maritime navigation safety management system for the Baltic Sea Region is critically important for accident prevention and the accidental spill response activities. A system theoretic approach to operational safety management, originally developed for software and space engineering applications, considers accident occurrence as the result of a lack of, or inad-

equate enforcement of, constraints imposed on the system design and operations at various system levels. This holistic, process-oriented method has been successfully applied in applications ranging from road tunnel safety systems to biodefense and air transportation system security (STAMP-Sec). However, the systems theory based approaches to safety management of maritime navigation have attracted less attention so far. It is shown that the STAMP methodology can be extended beyond the area of maritime navigation socio-technical systems safety into realm of complex eco-socio-technical systems safety. This study is part of the BONUS project "Strategic and Operational Risk Management for Wintertime Maritime Transportation System (BONUS STORMWINDS)".

5 Revisions to the work plan and justification

It was agreed to continue the WGMABS activities in 2017 according to the earlier agreed Work Plan.

Assessment of the possible future directions in developing the safety science related maritime domain in general and to the safety of eco-socio-technical maritime navigation system in particular to be included into the WGMABS Final Report.

6 Next meetings

It is agreed and planned to have two WGMABS meetings in 2017.

- The WGMABS Mediterranean workshop “International Workshop on maritime risks and assessment – from modeller to end-users” is planned for 2–6 October 2017 in Barcelona, Spain.
- The WGMABS Final Meeting is planned for 6–9 November 2017 in Helsinki (Finland). Venue: the Aalto University.

Annex 1: List of participants

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Annex 2: Publications

Aps, R., Fetissov, M., Goerlandt, F., Helferich, J., Kopti, M., Kujala, P. 2015. Towards STAMP based dynamic safety management of eco-socio-technical maritime transport system, Procedia Engineering, 128, pp. 64–73.

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Cormier, R., Kelble, C. R., Anderson, M. R., Allen, J. I., Grehan, A., & Gregersen, Ó. (2016). Moving from ecosystem-based policy objectives to operational implementation of ecosystem-based management measures. ICES Journal of Marine Science, fsw181. https://doi.org/10.1093/icesjms/fsw181

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