Grant Agreement No: 605221
Project Acronym: SHOPERA
Project Title: Energy Efficient Safe **SH**ip **OPERA**tion

Deliverable D7.3

Proceedings of 3rd workshop

Due date of deliverable: *31-03-2016*

Actual Submission date: 05-05-2016

George Zaraphonitis	NTUA
-name of 1st author	*1st author's organization*
-name of 2nd author	*2nd author's organization*
-document approved by-	
~~CO / CA / RE /~~ PU (please select one)[1]	
-dissemination level-	

Status of Deliverable: *~~Draft/~~Final*

Document Reference Number: *SHOPERA-D7.3-rev01*

[1] **dissemination level**	
CO	Confidential, only for members of the consortium (including Commission Services)
CA	as CO plus Advisory Committee members
RE	as CA plus to a selected group specified by the consortium
PU	Public

Disclaimer

Document History

Document ID.	Date	Description
SHOPERA-D7.3-rev01	28-04-2016	Description and basis of changes

Document Control Sheet

Title:

Abstract

The third public SHOPERA workshop was hosted by LR and jointly organised by LR, NTUA and ITTC Manoeuvring Committee on April 14, 2016 in London with representatives from the ITTC Seakeeping, Stability and Performance Committees. The aim of this workshop was to communicate the findings from the elaboration of the project to the wider scientific and technical community, to enhance collaboration of the SHOPERA partners with other research teams working on the same or similar research topics in Japan, Korea, The Netherlands as well as with the ITTC Manoeuvring Committee and Seakeeping Committee and to obtain valuable feedback from the external participants regarding the set objectives and the procedures adopted in order to meet these objectives.

Summary Report:

The third public SHOPERA workshop was hosted by LR and jointly organised by LR, NTUA and ITTC Manoeuvring Committee on April 14, 2016 in London with representatives from the ITTC Seakeeping, Stability and Performance Committees. The aim of this workshop was to communicate the findings from the elaboration of the project to the wider scientific and technical community, to enhance collaboration of the SHOPERA partners with other research teams working on the same or similar research topics in Japan, Korea, The Netherlands as well as with the ITTC Manoeuvring Committee and Seakeeping Committee and to obtain valuable feedback from the external participants regarding the set objectives and the procedures adopted in order to meet these objectives.

State of the Art

The State of the Art was presented by external speakers and by project partners presenting the progress of work during the elaboration of the project, including research on numerical tools, experimental studies, validation of tools and development of criteria.

Value added to SHOPERA

The main added value of the workshop is the communication of the outcome of the project to the wider community of experts and the feedback from external experts regarding the set objectives and the procedures adopted in order to meet these objectives.

Achievements

One-day workshop with 6 presentations by external experts and SHOPERA partners. The workshop was attended by 29 SHOPERA partners, 4 Advisory Committee members and 36 external experts.

Not achieved

N/A

Input from other Deliverables

During the workshop, the outcome of WP1, 2, 3 and 4 was presented.

Exploitation of results

The proceedings of the workshop will be publically available and widely distributed through the project's web site. The input from the external experts will be exploited during the final phase of the elaboration of the project.

This executive summary may be published outside the SHOPERA consortium. YES/~~NO~~	
Work carried out by	**Approved by**
Please declare the names of persons and their affiliations who contributed substantially to this document as applicable.	*Name of internal reviewer and date of acceptance:* Reddy Devalapalli 03/04/2016
	Name of external reviewer(or WP leader) and date of acceptance: Apostolos Papanikolaou, *05/04/2016*

Table of contents

1 Introduction

1.1 Background

The introduction of the Energy Efficiency Design Index (EEDI) was a major step towards improving energy efficiency of shipping and reducing GHG emissions. At the same time, it has raised concerns that ship designers and ship builders might choose to lower the installed power and ship's speed to achieve the EEDI requirements, instead of optimizing ship's speed-powering performance. This may lead to insufficient propulsion power to maintain manoeuvrability of ships under adverse weather conditions. The above concerns refer especially to Phase 3 of the EEDI implementation, from 2025-01-01, when the required EEDI is to be reduced by up to 30% compared to present base level (2013). Following a proposal from the International Association of Classification Societies (IACS), the following requirement was added to the Reg. 21, Ch. 4 of MARPOL Annex VI: "*For each ship to which this regulation applies, the installed propulsion power shall not be less than the propulsion power needed to maintain the manoeuvrability of the ship under adverse conditions as defined in the guidelines to be developed by the Organization.*" Work carried out by IACS to develop such guidelines, see MEPC 64/4/13 and MEPC 64/INF.7, served as basis for the *Interim Guidelines for Determining Minimum Propulsion Power to Maintain the Manoeuvrability of Ship in Adverse Weather Conditions*, MSC-MEPC.2/Circ.1 (2012) referring at first to bulk carriers, tankers and combination carriers. Discussions within IMO led to *2013 Interim Guidelines for Determining Minimum Propulsion Power to Maintain the Manoeuvrability of Ship in Adverse Weather Conditions*, ref. MEPC 65/4/3, Annex 1 (2013), see IMO Resolution MEPC 232(65), valid for Phase 0 and Phase 1 of EEDI implementation (until 2020-01-01).

1.2 Project SHOPERA

To address the challenges of the problem of norming manoeuvrability of ships in adverse conditions, an European research project called SHOPERA (Energy Efficient Safe SHip OPERAtion, see www.shopera.org), funded by the European Commission in the frame of FP7, was launched in October 2013, aiming at developing suitable methods and tools and systematic case studies which will enable the development of improved Guidelines and their submission for consideration to IMO-MEPC in 2016. A strong European RTD consortium was formed[1], representing the whole spectrum of the European maritime industry, including classification societies, universities, research organisations and model basins, ship designers, shipyards and ship operators. The project will:

- Validate the proposed adverse weather conditions using data from deep water and coastal areas as well as ship accident databases.

[1]National Technical University of Athens (NTUA, coordinator), DNV-GL, Lloyds Register (LR), Marintek (MRTK), Instituto Superior Tecnico (IST), Univ. Duisburg-Essen (UDE), Registro Italiano (RINA), Flensburg Schiffbau Gesellschaft (FSG), Uljanik Shipyard (ULJ), VTT, Flanders Hydraulics Research (EVFH), CEHIPAR, Strathclyde University (SU), Denmark Technical University (DTU), Tech. Univ. Berlin (TUB), Delft University of Technology (DUT), Naval Architecture Progress (NAP), Danaos Shipping Company Ltd. (DANAOS), FOINIKAS Shipping Co., CALMAC Ferries Ltd.

- Develop and fine-tune existing high fidelity hydrodynamic simulation software tools for efficient analysis of the seakeeping and manoeuvring performance and safety of ships in complex environmental and adverse weather conditions (including the consideration of winds and waves).
- Perform seakeeping and manoeuvring model tests in seaway using a series of prototypes of different ship types to provide the required basis for the validation of employed software tools. Validated software tools for the manoeuvrability assessment of ships in adverse weather conditions will be integrated into a ship design software platform and combined with a multi-objective optimization procedure, looking for sufficient powering and steering requirements for safe ship operation in adverse weather conditions while keeping the right balance between ship economy, efficiency and safety of the ship and the environment.
- Put together design teams that comprise designers, shipyards, owners, classification societies and national administrations to conduct investigations on the impact of the proposed new Guidelines for minimum propulsion power and steering efficiency to maintain manoeuvrability in adverse conditions on the design and operational characteristics of various ship types. The impact of EEDI will be investigated in parallel by implementation of the developed holistic optimisation procedure in a series of case studies.

1.3 Structure of the project

The work is organised into the following work packages:

- WP1 - Environmental Conditions and Requirements for Different Ships provides met-ocean data to validate the proposed adverse weather conditions, defines relevant ship types and sizes, conducts a risk analysis of marine accidents related to manoeuvring in adverse weather conditions and proposes safety criteria to be addressed by the project.
- WP2 - Development and Refinement of Numerical Hydrodynamic Tools performs development and refinement of numerical hydrodynamic tools. It is expected to significantly improve the current state-of-the art in the scientific field of manoeuvring in adverse weather conditions by improving the capabilities of a series of numerical methods.
- WP3 - Experimental Studies provides experimental data for validation of the tools by performing seakeeping and manoeuvring model tests for a series of prototypes of different ship types to provide the required basis for the validation of numerical methods.
- WP4 - Validation, Sensitivity Studies and Level 1 Methods validates numerical tools using model test data. Selected test cases will be used for an open international benchmark study to evaluate the present state-of-the-art of numerical methods. Simple models of propulsion and steering devices and engine will be developed for the implementation in the numerical simulation tools. Simplified assessment methods (referred to as Level 1 methods) will be developed to reveal the safety margins of ship designs. Intact stability problems will be addressed in a coupled way with manoeuvrability in adverse weather conditions.
- WP5 - Adaptation/Integration of Tools - Multi-objective Optimisation Platform integrates software tools for hydrodynamic assessment of ships in adverse weather conditions into a ship design software platform and sets up multi-objective optimisation procedures to assess ship's performance holistically,

looking for the manoeuvrability requirements in adverse weather conditions while keeping balance between economy, efficiency and safety.

- WP6 - Application – Case Studies conducts investigations on the impact of the proposed new guidelines on the design and operational characteristics of various ship types, by implementation of the developed integrated holistic optimisation procedure in a series of case studies. This will be achieved by putting together teams that comprise designers, classification societies, yards and universities, while operators and ports will provide expertise and data.
- WP7 - Dissemination, Exploitation, Submission to IMO disseminates the results of the project to the public, provides for exploitation of the results through submission to IMO of new guidelines for sufficient manoeuvrability in adverse weather conditions, including minimum power and steering performance requirements, and develops exploitation plan for resulting knowledge, numerical tools, software and design methods. Wide dissemination of the project results will be facilitated through technical publications in international scientific journals and conferences.

2 Third SHOPERA Workshop

2.1 Summary of presentations and discussion

The third public SHOPERA workshop was hosted by LR and jointly organised by LR, NTUA and ITTC Manoeuvring Committee on April 14, 2016 in London with representatives from the ITTC Seakeeping, Stability and Performance Committees. The aim of this workshop was to communicate the findings from the elaboration of the project to the wider scientific and technical community, to enhance collaboration of the SHOPERA partners with other research teams working on the same or similar research topics in Japan, Korea, The Netherlands as well as with the ITTC Manoeuvring Committee and Seakeeping Committee and to obtain valuable feedback from the external participants regarding the set objectives and the procedures adopted in order to meet these objectives.

The participants to the 3rd public SHOPERA workshop were welcomed by Tim Kent on behalf of the hosting organization (LR) and the project manager Apostolos Papanikolaou (NTUA). Besides representatives of the SHOPERA consortium, there were also presenters and participants form the ITTC Committees for Manoeuvring, Seakeeping, Stability and Performance, members of the SHOPERA Advisory committee and other external experts. The objectives of the workshop were presented by Apostolos Papanikolaou, NTUA.

The morning session started with the presentation of Vladimir Shigunov (DNV), who discussed the SHOPERA Proposal for additional Manoeuvrability Criteria addressing three different adverse scenarios: extreme weather in open sea, escaping increasing storm in coastal waters and low speed in restricted areas. Alternative assessment procedures, i.e. comprehensive and simplified (Level 2) were described.

Hironori Yasukawa, (Hiroshima University) presented the Japanese R & D Project on Manoeuvring in Adverse Condition and Minimum Power Requirement of Ships. The main objectives of this Project are the development of numerical models and procedures to address manoeuvring in waves (both time domain and non-time domain) and wave-induced steady forces (added resistance in regular waves, steady lateral force and yaw moment and wave-induced steady forces in irregular waves), the validation of the manoeuvring model in waves and the development of an analysis method of manoeuvring limit and motion stability in wind and waves.

Yeon Gyu Kim, Dong Jin Yeo (KRISO), Sang Hyun Kim (Inha Univ.) presented current research activities on manoeuvring in waves in Korea. In this respect, objectives and results of six selected papers, published from 2006 to 2015 and two research projects, i.e. *Fundamental research for the analysis of ship's integrated ability of manoeuvring and seakeeping* (KRISO) and *Development Technology Development to Improve Added Resistance and Ship Operational Efficiency for Hull Form Design* (MOTIE) were briefly presented.

Pierre-Emmanuel Guillerm (Ecole Centrale de Nantes), delivered a presentation on the development of manoeuvring in waves standard for model tests and numerical simulation methods addressing related problems (i.e. course keeping in waves, broaching, turning ability in waves), related IMO criteria, current and future challenges and methodologies to address manoeuvring in waves. Finally, results of related work on broaching at E.C. Nantes were presented and discussed.

Yonghwan Kim (Seoul National University) presented the work in ITTC Seakeeping Committee on Seakeeping Analysis Coupled with Manoeuvring Problem. A series of ITTC SKC Procedures were briefly discussed and emerging problems were identified. The formulation for the Seakeeping-Manoeuvring Interaction was discussed and obtained results on turning trajectories were presented. Effects of Seakeeping and Manoeuvring on Ship Operation Efficiency were discussed, including course keeping, speed loss due to wind and waves followed by suggestion for future collaborative works.

Gregory Grigoropoulos (NTUA) presented a review of regulatory work in IMO regarding the issue of minimum power lines, followed by a brief review of the objectives and results of the JASNAOE project and the SHOPERA project.

2.2 List of attendees

2.2.1 SHOPERA partners

No.	Name	Surname	e-mail	Organization
1	Apostolos	Papanikolaou	papa@deslab.ntua.gr	NTUA
2	George	Zaraphonitis	zar@deslab.ntua.gr	NTUA
3	Vladimir	Shigunov	vladimir.shigunov@dnvgl.com	GL
4	Elzbieta	Bitner-Gregersen	Elzbieta.Bitner-Gregersen@dnvgl.com	DNV
5	Bingjie	Guo	bingjie.guo@dnvgl.com	DNV
6	Alessandro	Grasso	alessandro.grasso@rina.org	RINA
7	Harry	Bingham	hbb@mek.dtu.dk	DTU
8	Osman	Turan	o.turan@strath.ac.uk	SU
9	Evangelos	Boulougouris	evangelos.boulougouris@strath.ac.uk	SU
10	Shi	He	shi.he@strath.ac.uk	SU
11	Mingyu	Kim	mingyu.kim@strath.ac.uk	SU
12	Andrés	Cura	cura@tu-berlin.de	TUB
13	Antonio	Lengwinat	lengwinat@tu-berlin.de	TUB

14	Jussi	Martio	jussi.martio@vtt.fi	VTT
15	Manases	Tello Ruiz	manases.ruiz@ugent.be	Ghent University
16	Vito	Radolovic	vito.radolovic@uljanik.hr	ULJ
17	Josip	Andrisic	josip.andrisic@uljanik.hr	ULJ
18	Rolf	Nagel	Rolf.Nagel@fsg-ship.de	FSG
19	Guillaume	DELEFORTRIE	Guillaume.Delefortrie@mow.vlaanderen.be	EVFH
20	Florian	Sprenger	florian.sprenger@marintek.sintef.no	MARINTEK
21	Andrew	Ross	andrew.ross@marintek.sintef.no	MARINTEK
22	Adolfo	Marón	adolfo.maron@cehipar.es	CEHIPAR
23	Sergio	Fernández	sergio.fernadez@cehipar.es	CEHIPAR
24	Carlos	Guedos Soares	c.guedes.soares@centec.tecnico.ulisboa.pt	IST
25	Bettar	El Moctor	ould.el-moctar@uni-due.de	UDE
26	Soelhlos	Kouroutzis	skouroutzis@tudelft.ni	DUT
27	**YUE**	**YAO**	**yue.yao@lr.org**	**LR**
28	**Tim**	**Kent**	**tim.kent@lr.org**	**LR**
29	**Reddy**	**D N**	**reddy.devalapalli@lr.org**	**LR**

2.2.2 Members of the Advisory Committee

No.	**Name**	**Surname**	**e-mail**	**Organization**
1	Alessandro	Maccari	alessandro.maccari@fincantieri.it	Fincantieri S.p.A.
2	Sander	den Heijer	heijer@maritimetechnology.nl	SEA Europe
3	Masaru	Tsujimoto	m-tsuji@nmri.go.jp	NMRI
4	Apurba Ranjan	Kar	kar@irclass.org	IRS

2.2.3 External participants

No.	**Name**	**Surname**	**e-mail**	**Organization**
1	Ronnie	Allen	ronald.allen@mcga.gov.uk	MCA
2	Yoshitaka	Furukawa	furukawa@nams.kyushu-u.ac.jp	Kyushu University
3	Dong Jin	Yeo	Lonepier@kriso.re.kr	Korea Research Institute of Ships and Ocean Engineering (KRISO)
4	Yeon Gyu	Kim	ygkim@kriso.re.kr	Korea Research Institute of Ships and Ocean Engineering (KRISO)
5	Kazuyoshi	Hirota	hirota-kazuyoshi@jmuc.co.jp	The Shipbuilders' Association of Japan / JASNAOE
6	Gerhard	Strasser	g.strasser@sva.at	Vienna Model Basin, ITTC
7	Evgeni	Milanov	e.milanov@bshc.bg	Bulgarian Ship Hydrodynamics Centre
8	Janne Flensborg	Otzen	jfo@force.dk	FORCE Technology
9	Ayhan	Akinturk	Ayhan.Akinturk@nrc-cnrc.gc.ca	National Research Council of Canada
10	Jose	Diaz Yraola	Jose.DIAZ-YRAOLA@emsa.europa.eu	EMSA
11	Hironori	Yasukawa	yasukawa@naoe.hiroshima-u.ac.jp	Hiroshima University, Japan
12	John	Richards	jorichards@eagle.org	ABS
13	Ryuji	Miyake	miyake@classnk.or.jp	EEDI Department of ClassNK, Japan
14	Dominic	Hudson	dominic@soton.ac.uk	University of Southampton

15	Paul	Crossland	pcrossland@qinetiq.com	QinetiQ Ltd
16	Mario	Calixto	biancarodrigues@fhm.org.br	FUNDAÇÃO HOMEM DO MAR
17	Sergio	Sphaier	biancarodrigues@fhm.org.br	FUNDAÇÃO HOMEM DO MAR
18	Jerzy	Matusiak	jerzy.matusiak@aalto.fi	Aalto University
19	Pierre	Vonier	pierre.vonier@intradef.gouv.fr	DGA Hydrodynamics
20	Tomasz	Hinz	tomasz.hinz@wtif.pl	Aalto University / WTIF
21	Frederik	Gerhardt	fge@sspa.se	SSPA Sweden AB
22	Kees	Metselaar	Kees.Metselaar@minienm.nl	Ministerie van Infrastructuur en Milieu
23	Pepijn	de Jong	p.d.jong@marin.nl	MARIN Netherlands
24	Stephane	Rapuc	s.rapuc@marin.nl	MARIN Netherlands
25	Ko	Koiso	koiso@sajn.or.jp	The Shipbuilders' Association of Japan
26	Matsuda	Akihiko	amatsuda@fra.affrc.go.jp	Fisheries Research Agency
27	Jae-Han	Kim	hankim@dsme.co.kr	Daewoo Shipbuilding and Marine Engineering, Korea
28	Takashi	Yamamoto	t-yamamoto@usukiship.co.jp	The Cooperative Association of Japan Shipbuilders
29	Toru	Katayama	katayama@marine.osakafu-u.ac.jp	Osaka Prefecture Univrersity
30	Pierre-Emmanuel	Guillerm	pierre-emmanuel.guillerm@ec-nantes.fr	Ecole Centrale Nantes
31	Yonghwan	Kim	yhwankim@snu.ac.kr	Seoul National University
32	Rodrigo	Azcveta	rodrigo.azweta@landroverbar.com	Land Rover Bar
33	John	Calleya	j.calleya@ucl.ac.uk	UCL
34	Inno	Gatin	innogatin@gmail.com	University of Zagreb
35	Vuko	Vukcevic	vuko.vukcevic@gm.fob.ht	University of Zagreb
36	Grigorios	Grigoropoulos	gregory@central.ntua.gr	NTUA

2.3 List of presentations

1. Vladimir Shigunov (DNVGL), *SHOPERA: Criteria, Assessment Framework, Methods*
2. Hironori Yasukawa, (Hiroshima University), *Japanese R & D Project on Manoeuvring in Adverse Condition and Minimum Power Requirement of Ships.*
3. Yeon Gyu Kim, Dong Jin Yeo (KRISO), Sang Hyun Kim (Inha Univ.) *Research Activities on Manoeuvring in Waves in Korea.*
4. Pierre-Emmanuel Guillerm (Ecole Centrale de Nantes), *How to develop manoeuvring in waves standard for model tests and numerical simulation methods.*
5. Yonghwan Kim (Seoul National University), *Seakeeping Analysis Coupled with Manoeuvring Problem*.
6. Gregory Grigoropoulos (NTUA), *Towards more rational guidelines to determine minimum propulsion power for Safe Operation under adverse Weather Conditions*

3 Workshop Presentations

3.1 Vladimir Shigunov (DNVGL), SHOPERA: Criteria, Assessment Framework, Methods

3.2 Hironori Yasukawa, (Hiroshima University), Japanese R & D Project on Manoeuvring in Adverse Condition and Minimum Power Requirement of Ships.

3.3 Yeon Gyu Kim, Dong Jin Yeo (KRISO), Sang Hyun Kim (Inha Univ.) Research Activities on Manoeuvring in Waves in Korea.

3.4 Pierre-Emmanuel Guillerm (Ecole Centrale de Nantes), How to develop manoeuvring in waves standard for model tests and numerical simulation methods.

3.5 Yonghwan Kim (Seoul National University), Seakeeping Analysis Coupled with Manoeuvring Problem.

3.6 Gregory Grigoropoulos (NTUA), Towards more rational guidelines to determine minimum propulsion power for Safe Operation under adverse Weather Conditions