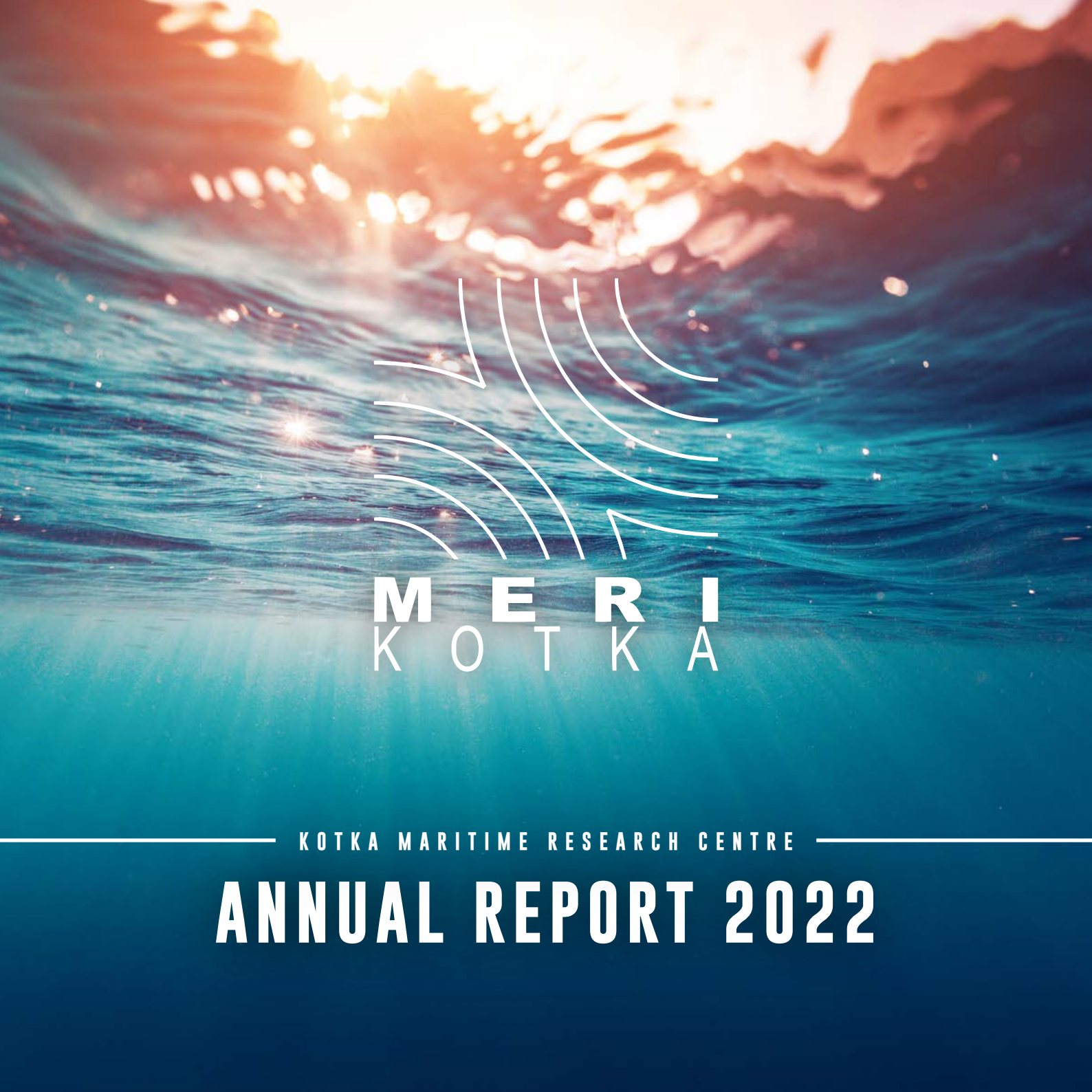

MERI
KOTKA

KOTKA MARITIME RESEARCH CENTRE

ANNUAL REPORT 2022

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1. FOREWORD

ANNA KIISKI

At the end of each strategy period, there is always a need to look back and evaluate how the choices made have been realised. During 2018, based on recommendations on external research evaluation, we chose to invest in the academic quality and interdisciplinary nature of research activities. In practice, we hired a research director as a permanent employee and set out to pursue academically high-level research projects. The work done after this has truly fulfilled the aims set. During 2022, for the first time ever, our joint research project GYROSCOPE received funding from the Academy of Finland.

However, the good work must continue. The next steps forward were defined together, and a new strategy for the years 2023-2025 was planned. This time the focus was set on highlighting the role of researchers, and on this basis a new kind of strategic aim was created. The attraction and retention power of researchers belonging to the network was selected as one of the strategic aims. We want to serve activities that maintain the motivation of researchers to be part of the network and ensure their experiences of how the network benefits them. A good atmosphere and trust between individuals create an environment where genuine dialogue between scientific disciplines has room to exist and develop towards interdisciplinarity. By supporting this, we also make it possible to conduct interdisciplinary research on a high academic level, which was set as the first strategic goal. The third goal strongly culminates in our desire to do research that has great social significance. The goal is to identify and produce relevant information to promote sustainable maritime activities. This of course means that stakeholders are involved, and the focus of the research is on the current and future needs of society.

The hard work must continue so that in a few years we can once again be happy about the fulfilment of our strategic goals.

Executive Director
Anna Kiiski

2. KOTKA MARITIME RESEARCH CENTRE IN BRIEF

Kotka Maritime Research Centre (KMRC) specialises in the interdisciplinary study and development of maritime transport and logistics, taking into account a wide range of safety, environmental, and economic aspects. The common vision of the research community operating under the Centre is to promote sustainable maritime activities in general. Research is problem-driven and solution-oriented, seeking for scientifically validated answers and feasible solutions to topical socio-environmental questions and problems.

Good societal decision-making needs to be based on scientifically verified information. KMRC's expertise is built upon research carried out at the University of Helsinki, Aalto University, University of Turku, and South-Eastern Finland University of Applied Sciences (XAMK). Kotka Maritime Research Association (KMRA) acts as an umbrella organisation that coordinates, manages, and supports the universities' joint research projects. At the moment, our core researcher network consists of 26 experts.

Beyond academia, the research centre works closely with a great number of experts in related fields. Our partners include such organisations as the Finnish Environmental Institute, Natural Resources Institute, Finnish Transport and Communications Agency, Finnish Transport Infrastructure Agency, and Metsähallitus, as well as the development company Cursor Ltd, South Kymenlaakso Vocational College (EKAMI), and Kotka Maretarium.

KMRA was founded in 2005 at the initiative of the city of Kotka. Because seafaring is a key industry in the city, they wanted to know more about the risks related to maritime transport and how to control such risks. For this purpose, the research centre was established to make use of the knowledge held by various universities and to produce high-quality research on maritime transportation, marine traffic safety, and their impacts on the marine environment.

3. GREETINGS FROM THE RESEARCH DIRECTOR

PHOTO:VEIKKO SOMERPURO

ANNUKKA LEHIKOINEN

NEW ACHIEVEMENTS IN THE FIELD OF COOPERATION

2022 was the first full year of working with our re-established and updated post-COVID era Core Research Network. I am very impressed by the breadth of expertise and know-how in this multidisciplinary community, as well as the open-mindedness of the members to face people coming from very different scientific and professional backgrounds and work with them, no matter what the task. In addition to regular meetings, the network decided to start a series of new types of workshops to share knowledge, skills, and ideas within the community. The topics of these meetings arise from the discussions, interests, and knowledge needs of the members. All in all, the community is gradually moving towards a more bottom-up approach, where the researchers and experts take stronger roles in directing the contents and forms of their mutual interaction. This is a desired direction, as it ensures that the content and activities are meaningful to the members, increasing their commitment and motivation to participate.

I am particularly pleased about the four new jointly written publications1-4 involving researchers and experts from different KMRC partner organisations. Collaborative writing in multidisciplinary teams is to my mind one of the most deep-going forms of interdisciplinary collaboration and mutual learning. The writing process finalises and polishes the dialog that starts during the joint planning and implementation stages of the research projects. Interdisciplinary writing is not a bed of roses, as it requires some diplomacy and negotiation skills from the participants. It is about explaining and justifying one's own approach once again and learning from others – respecting

[1] https://doi.org/10.1016/j.ijdrr.2023.103544

[2] https://doi.org/10.1016/j.scitotenv.2022.158316

[3] https://doi.org/10.1016/j.oceaneng.2022.113078

[4] https://www.merikotka.fi/wp-content/uploads/2022/11/SIMREC_roadmap-1.pdf

their expertise and being ready to widen one's own perspective. Even the selection of common terminology – understandable and applicable to all the authors – requires attention and effort. However, publications involving people from scientific backgrounds with different theoretical and methodological traditions bear great potential of providing rich pictures and thus sustainable, applicable solutions, presenting new concepts and ideas, and being interesting and readable to a wide readership.

Collaborative identification of research needs, followed by project planning and the writing of funding applications, are also important forms of idea exchange and places for mutual learning. In 2022, the KMRC Core Research Network was very active in writing joint project proposals for both national and international funding instruments. A highlight of the year was the positive funding decision received from the Academy of Finland in December for the three-year project **GYROSCOPE**. The project brings together researchers from all the three member universities and the association to study the green digital transition of marine logistics, aiming to develop sustainable transition pathways together with key stakeholders. GYROSCOPE is the first academic funding granted for the KMRA and offers the association completely new opportunities to participate in the actual research work of the community.

Despite increasing investments in academic research funding calls, we have not forgotten regional development and interaction with the actors in Kotka and the Kymenlaakso region. On the contrary, in the three ongoing regional development projects, **VISIIRI**, **TLT**, and **Digital Merikarhu**, the association together with XAMK and EKAMI have collaborated actively with local companies and authorities. The projects contribute to the themes of green transition and port safety, with a mission to provide locally relevant knowledge and tools that improve the competency of diverse actors to advance and implement sustainable logistics. Such regional development projects are highly important too, enabling KMRC on the one hand to gather information on the challenges and knowledge needs of the local actors, and on the other to adjust the results and solutions provided by the academic and larger scale projects to local conditions.

Research Director
Annukka Lehikoinen

4. RESEARCH GROUPS

Kotka Maritime Research Centre conducts interdisciplinary research to

1. understand and develop the functioning and dynamics of ship operations and technology, maritime traffic, logistics, and maritime policy-making;
2. assess environmental and safety risks related to maritime traffic, acknowledging the joint effects of other, cumulative stress factors;
3. estimate the positive and negative impacts of maritime traffic on regional wellbeing, safety, and environment;
4. develop new intelligent tools for navigation, maritime spatial planning, and management purposes; and
5. produce information for education and decision-making to support the sustainable development of maritime traffic.

Each research group has its own focus area and scientific field, which are combined in joint research activities in order to address these topics. Based on the results, the aim is to support shipping companies, port organisations, maritime or regional planners, and other stakeholders in developing their activities in a sustainable way, where the sustainability is achieved by considering the economic, social, and environmental aspects together.

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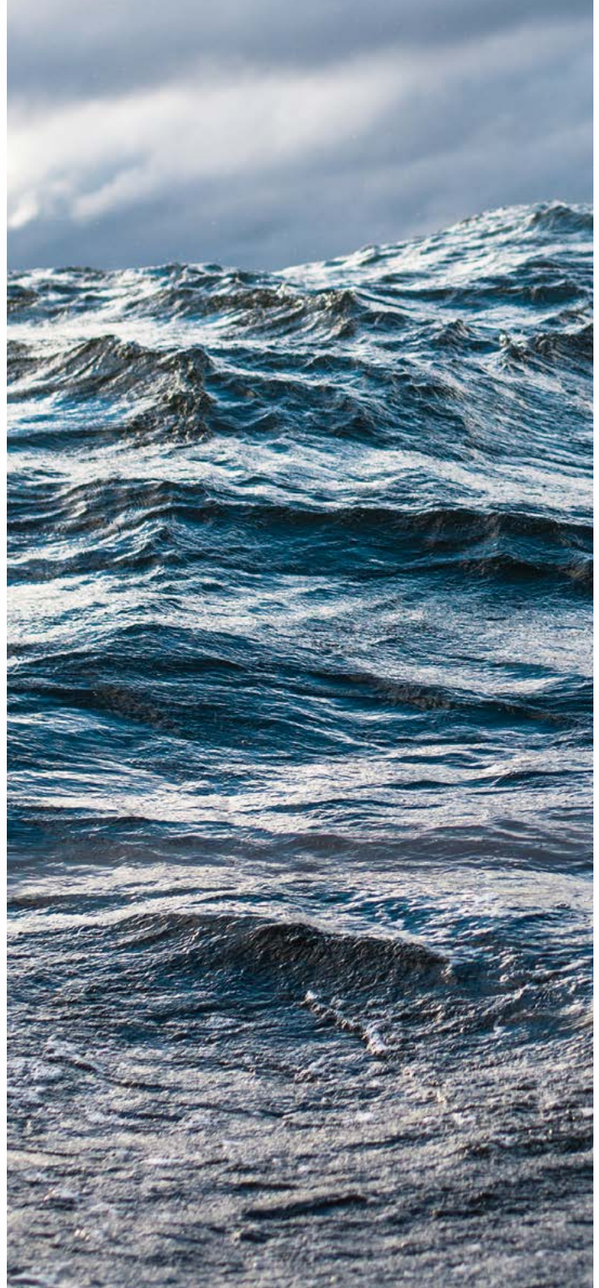
OSIRIS VALDEZ BANDA

Assistant Professor Osiris Valdez Banda from **Aalto University** is leading the Research Group on Safe and Efficient Marine and Ship Systems. His group is focused on the development of scientific principles, models, and tools for the analysis of marine risks and safety systems engineering with applications in the concepts of intelligent shipping in diverse operational contexts. The group has been involved in the development of MASS concepts and smart or intelligent shipping services in large research initiatives. This has basically positioned them as a leading research group in the analysis of risks and the management of safety of MASS concepts and smart or intelligent shipping services. Thus, this work has generated impactful scientific publications worldwide.

MASHRURA MUSHARRAF

Assistant Professor Mashrura Musharraf from **Aalto University** is leading a research group focused on intelligence in marine systems, human-centred automation, big data analytics, machine learning, and human factors in this context. Her group is combining machine intelligence and human factors, which is a rare but necessary combination to make automation successful. The group has been very successful and received academy funding for a research project, and published their results in high-ranking academic journals.



TOMMI INKINEN

Professor Tommi Inkinen from the **University of Turku** is leading a research group focused on port digitalisation, port management, maritime transport volumes and value, port-city relations, and transport connectivity. The latest research of his group has developed a proposition for an easy-to-use environmental management tool for small ports operating in the Baltic Sea. Other current research venues include corporate social responsibility, alternative energy solutions in the Baltic Sea, and port digitalisation future scenarios in ports. The Finland Futures Research Centre in UTU is leading the academy project GYROSCOPE, in which all KMRC universities are involved.

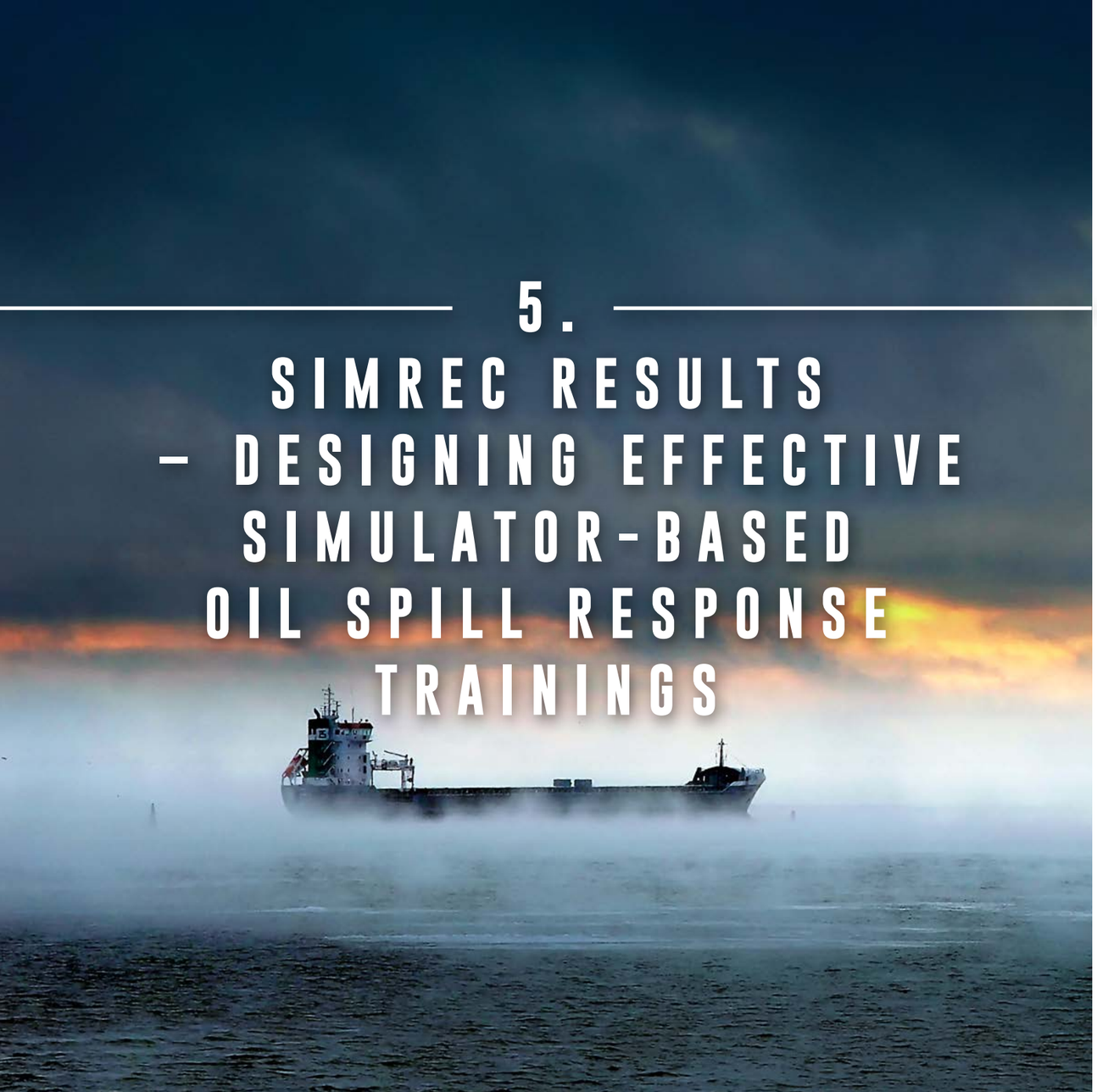
SAKARI KUIKKA

Professor Sakari Kuikka from the **University of Helsinki** is leading the Fisheries and Environmental Management Group which focuses on environmental risk and decision analysis. The research conducted combines biology, limnology, fish stock assessment, and fisheries management. Moreover, mathematical scientists produce risk models that have their foundations in these sciences. Bayesian analysis forms the backbone of the group's environmental modelling approach. It provides an effective tool for learning from various information sources. These sources include data, models, existing publications (meta-analysis) and their theoretical background, and expert knowledge. During 2022, the group has been successful and received funding from the Academy of Finland.

JUSTIINA HALONEN

OLLI-PEKKA BRUNILA

Research Managers Justiina Halonen and **Olli-Pekka Brunila** are leading the groups at the **South-Eastern Finland University of Applied Sciences**. Their work is focused on logistics and seafaring, but also on oil pollution preparedness and response. In seafaring, the focus is on maritime safety and management of environmental risks related to maritime operations. The main research topics include pollution prevention and spill response management, as well as maritime emergency response and distress operations. In terms of logistics, the focus is on green transportation, innovative business concepts, and ways to integrate digitalisation and new technologies into port operations. Digitalisation and environmental issues are cross-cutting themes in both logistics and seafaring.



5. SIMREC RESULTS – DESIGNING EFFECTIVE SIMULATOR-BASED OIL SPILL RESPONSE TRAININGS

***Antti Lanki**, South-Eastern Finland University of Applied Sciences*

***Mirka Laurila-Pant**, University of Helsinki*

***Annukka Lehikoinen**, Kotka Maritime Research Association*

***Liangliang Lu,** Aalto University*

***Ossi Tonteri**, Finnish Environment Institute*

Training for oil spill response operations is about building performance and the readiness to react, which also makes it a part of building societal resilience for a situation where the worst happens. National preparedness levels, strategic plans, and joint rehearsals are typically built on accident scenarios that are considered probable: on likely spill sizes, accident locations, and environmental conditions. However, the success and efficiency of offshore oil control depends on several situational random factors, such as the weather and the time of day and season, being thus highly uncertain.

Oil spill response field training exercises are typically relatively costly large-scale projects. Although highly important for practicing in the authentic environment and with the real infrastructure, they are limited in terms of repeatability and testing of alternative strategies and ways of operation under controlled conditions. The COVID-19 pandemic also led to a situation where – due to the assembly restrictions – the organisation of authentic field rehearsals was not possible, revealing one vulnerability of the system.

Oil spill operations require collaboration among people with various skills and backgrounds, representing different organisations and having differing roles during the operation. In the Baltic Sea, a large-scale oil accident would also immediately become an international issue, requiring transboundary collaboration. This creates a need for tools and solutions that can cost-effectively support collaborative training by relevant actors across both organisational and national borders.

Project SIMREC - Simulators for improving Cross-Border Oil Spill Response in Extreme Conditions (9/2019 – 11/2022) aimed to meet these needs and tackled the challenges by developing tools and solutions to support cost-effective and safe inter-organisational training of oil spill management operations, including extreme weather conditions. The focus of the project was on the utilisation of a simulator environment for training and on developing risk analytic models and novel protocols for planning effective simulator training events.

The SIMREC Road Map summarises the key results of the project, providing a roadmap for the effective utilisation of simulator environments in the context of oil spill management rehearsals. The project gathered knowledge and developed tools for simulator-based operative response trainings, paying special attention to extreme weather conditions and multi-organisational and cultural contexts.

More information

6. OTHER RESEARCH PROJECTS

COLLABORATION AND INNOVATION PLATFORM FOR THE GREEN TRANSITION IN LOGISTICS (VISIIRI)

Emilia Luoma, *Kotka Maritime Research Association*

VISIIRI is a starting point for work aiming to develop a cross-sectoral collaboration and innovation platform for smart green logistics. There are two main goals for the platform: (1) to support the actors of the logistics sector to create a common situational analysis and, based on that, create a regional strategy for green transition; (2) harness the know-how and innovation potential of the digital and circular economy sectors to solve the problems of the logistics sector in relation to ambitious climate goals and their regulation.

The project conducts an interview survey to study the challenges and needs resulting from the green transition among the logistic companies in the Kymenlaakso region. In parallel, the opportunities and risks that companies in the logistics and digital and circular economy sectors see in the proposed collaboration platform concept are examined, and the type of a potentially functional platform outlined. In addition, a benchmarking survey of similar platform experiments is conducted. As its final activity, the project organises a hackathon where the applied university students brainstorm the platform concept implementation methods and tools that could possibly meet the wishes and views of the target groups.

SAFE AND SECURE FUTURE OF LOGISTICS

Maria Kämäräinen*, South Kymenlaakso Vocational College*

Piia Nygren*, Kotka Maritime Research Association*

Emmi ***Rantavuo****, South-Eastern Finland University of Applied Sciences*

The project develops and implements collaborative comprehensive security planning based on research data in the context of port logistics. The project compiles and analyses data related to occupational and environmental safety and security, involving the port-related actors of Kymenlaakso region. The aim is to especially identify the comprehensive security and safety risks posed by disruptions, such as Corona-like pandemics and extreme weather events, and to assist the actors, through joint innovation and piloting, in their risk assessment and management operations. In this way, the project develops the preparedness and resilience of the port sector, which is also important for national security of supply, to new types of risks and exceptional circumstances that may become more common in the future.

More information

DIGITAL MERIKARHU 2.0

***Miina Karjalainen**, Kotka Maritime Research Association*

***Maria Kämäräinen**, Etelä-Kymenlaakso Vocational College*

The project explores the potential of automation and machine learning, as well as intelligent systems, to improve the fuel economy of the Merikarhu school ship, reducing emissions in a cost-effective way. In addition, Merikarhu is developed towards a modern and diverse digital learning environment that serves both maritime and rescue students as well as stakeholder statutory training activities. With the help of data acquisition and machine learning systems installed on Merikarhu, the effect of various variables on the vessel's fuel economy and emissions is studied. So far, a digital learning environment that supports the use of Merikarhu as a school ship and as a training unit to support both maritime education and stakeholder activities has been created. A digital model of the vessel will be utilised in various simulations and the possibilities of carrying out pedagogically functional simulator exercises, linked to the concrete rehearsals on board. In addition, a functional overall plan for port and stakeholder safety and security exercises through piloted chemical, oil, and firefighting exercises have been produced in cooperation with the Port of HaminaKotka.

More information

FUTURE POTENTIAL OF INLAND WATERWAYS (INFUTURE)

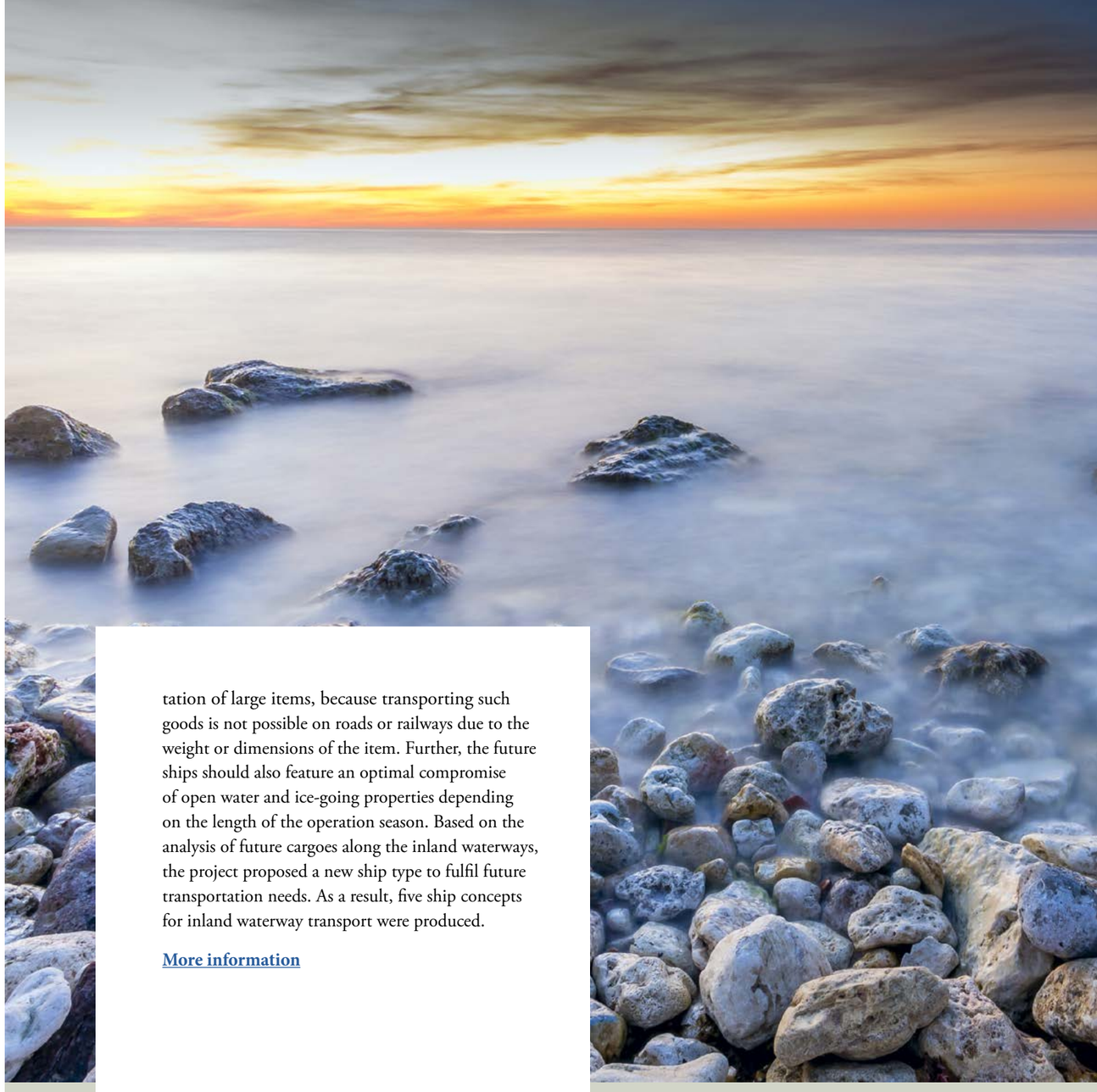
***Anna Kiiski**, Kotka Maritime Research Association*

***Anna Kiviniitty**, South-Eastern Finland University of Applied Sciences*

***Fang Li**, Aalto University*

The INFUTURE project ended in January 2022. The project aimed to increase the utilisation of inland waterway (IWW) transport between neighbouring regions in relation to its potential. The main problem was the under capacity in river-sea and inland waterway transport logistics practices. INFUTURE proposed a solution to attract related businesses by offering new knowledge-based innovations about environmentally friendly, cost-effective, and sustainable IWW transportation. In practice, this meant increasing possibilities for higher cargo volumes and longer traffic seasons. Smart buoys, intelligent AtoNs, were seen as useful tools when planning arrangements to prolong navigation periods on inland fairways and canal routes. AtoNs work well even in harsh and dark weather conditions, and thus increase the safety of inland waters. The project also identified investment needs in the transportation of large items, because transporting such goods is not possible on roads or railways due to the weight or dimensions of the item. Further, the future ships should also feature an optimal compromise of open water and ice-going properties depending on the length of the operation season. Based on the analysis of future cargoes along the inland waterways, the project proposed a new ship type to fulfil future transportation needs. As a result, five ship concepts for inland waterway transport were produced.

More information



INDICATORS 2022

PERSONNEL

in Kotka 12

elsewhere 21

person-months 312

DEGREES

Bachelor's/polytechnic 2

Master's / Graduate engineer/ upper polytechnic 5

Doctorate 1

PUBLICATIONS

peer-reviewed scientific articles 29

peer-reviewed scientific articles with KRMC partners 3

conference publications, abstracts, posters 15

other publications 73

SEMINARS

Merikotka seminars and events in Kotka 4

other organised seminars 5

appearances in external seminars 16

KMRC BY NUMBERS 2022

PROJECTS

currently running, coordinating role 9

currently running, partner role 11

own budget (€) 3 313 419

submitted applications, coordinating role 11

submitted applications, partner role 14

MEDIA APEARANCES

TV 0

papers and magazines 9

radio 1

RESEARCH CO-OPERATION

participating companies 52

company financing (€) 27 500

KOTKA MARITIME RESEARCH CENTRE

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