



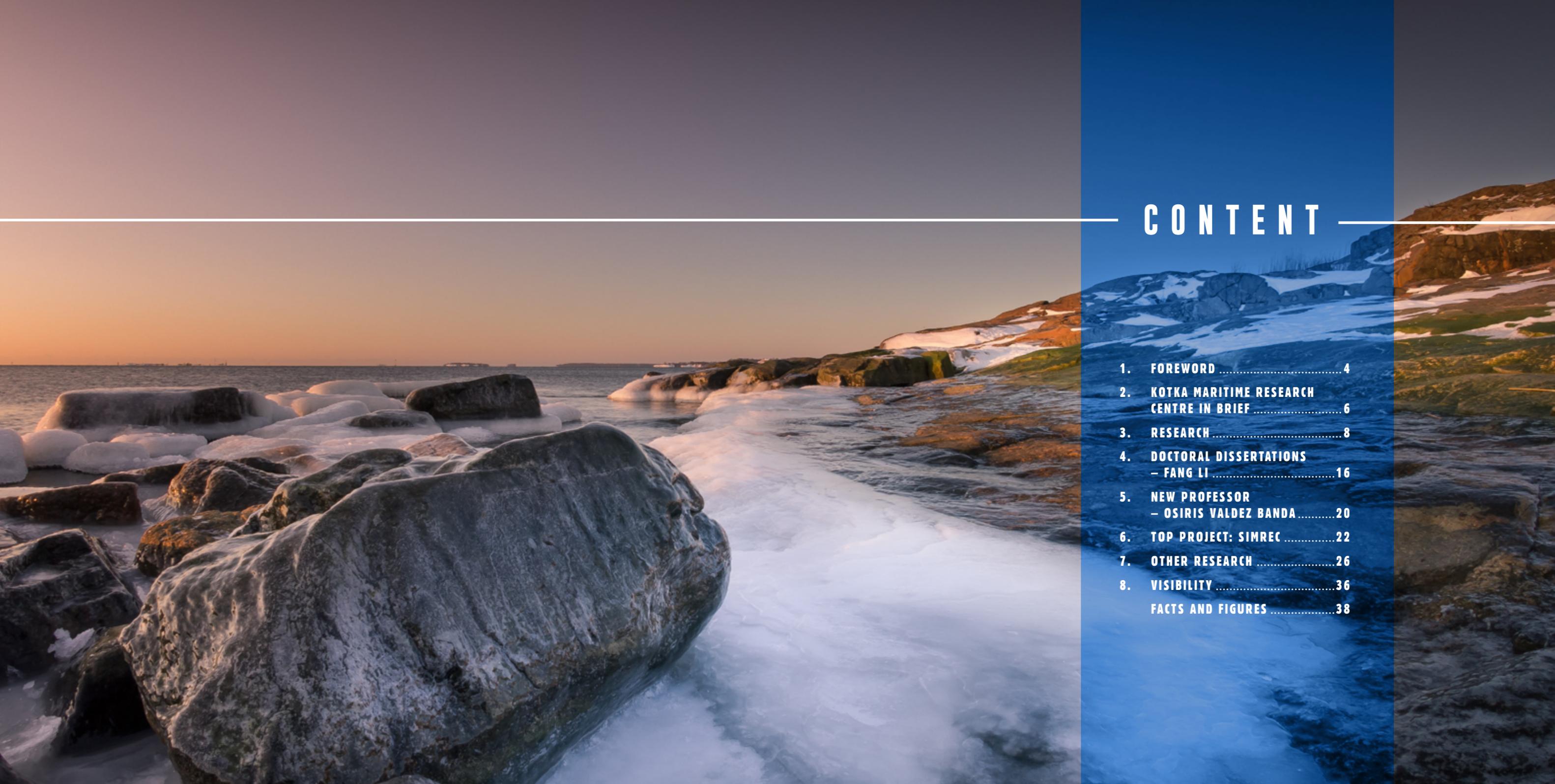
**M E R I**  
K O T K A



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KOTKA MARITIME RESEARCH CENTRE

# ANNUAL REPORT 2020



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# 1. FOREWORD

This year has been very different. For us as a research centre, the ongoing pandemic has not been catastrophic, but it has changed the ways of cooperating with partners and stakeholders. From a positive point of view, we have started utilising more online solutions and reached more cost-effective ways of interaction. The new technical solutions are great and will certainly be utilised also in the future, but face-to-face meetings are considered very valuable, and they are needed as well. We are truly looking forward to having that possibility again.

In 2019, we invited two external reviewers to assess our work that was carried out during the period from 2015 to 2018. The motivation behind this was to provide recommendations for the future development of Kotka Maritime Research Centre. The assessment was aimed at estimating the quality and potential of the research, the success of multi- and interdisciplinary collaboration, as well as the research impact, societal impact, and innovative capacity of our work.

As a result, the introduced research output was assessed to be at an excellent academic level. However, in the future we need to increase our multi- and interdisciplinary collaboration. It is

understood that this is not an easy task. Interdisciplinary research will require more time and resources. As a solution, our board agreed to open a call to recruit a Research Director for a permanent position. With this new resource, we truly want to target efforts on implementing more multi- and interdisciplinary collaboration.

A major acknowledgement in the year 2020 was the TRA VISIONS 2020 award, which was given to Professor Pentti Kujala. The award is presented to a leading transport researcher to recognise their contribution for transport development in EU-funded projects. Professor Pentti Kujala was the winner of the waterborne sector and he is recognised for his research on Arctic shipping and operations.

Our warmest congratulations to Professor Kujala!

**Anna Kiiski**  
*Executive Director*  
*Kotka Maritime Research Association (KMRA)*



ANNA  
KIISKI



## 2. KOTKA MARITIME RESEARCH CENTRE IN BRIEF

Kotka Maritime Research Centre is an international research centre. Our aim is to do multi- and interdisciplinary applied research to improve maritime safety, prevent accidents, and protect the marine environment.

The research centre has an extensive global partner network. In addition to universities and research centres, we also work with other types of organisations.

Kotka Maritime Research Centre was founded in 2005 at the initiative of the City of Kotka. Because seafaring is important to the city, there was an urge to know more about the risks related to maritime transport and how to control them. For this purpose, a research centre was created to make use of the knowledge held by various universities and to produce high-quality research on maritime transportation, maritime safety, and the marine environment.

### **CUTTING-EDGE RESEARCH BY FOUR UNIVERSITIES**

Good societal decision-making needs to be based on scientifically verified information. Kotka Maritime Research Centre'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. Kotka Maritime Research Association acts as an umbrella organisation that coordinates, manages, and supports the universities' joint research projects. At the moment, our researcher network consists of over 30 experts.

Beyond academia, the research centre works closely with a great number of experts in related fields. Our partners include organisations such 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, Etelä-Kymenlaakso Vocational College, and Kotka Maretarium.



## MULTI- AND INTERDISCIPLINARY RESEARCH FOR SUSTAINABLE MARITIME TRANSPORT

**Merikotka conducts multi- and 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 then combined in joint research activities in order to address these topics. Based on the results, our aim is to support shipping companies, port organisations, maritime/regional planners and other stakeholders in developing their activities in a sustainable way, where the

sustainability is achieved by considering the economic, safety-related and environmental aspects together.

**Maria Hänninen,**  
*Research Director, KMRA*



### MARITIME RISKS AND SAFETY

#### **Aalto University**

The Aalto University research group offers a diverse research agenda which focuses on analysing the safety of maritime traffic, ships, and structures. In particular, it investigates the responses and strengths of ships in complex physical environments where ice and wave-induced loads are present. The research is carried out by conducting extensive full-scale trials onboard ice-going ships, by utilising the Aalto Ice Tank, and by developing theoretical models and analysing the ultimate strength of structures.

The Aalto University research group also investigates system-level issues at the scale of shipping systems/fleets, individual ships, and ship sub-systems. The focus is on passenger ships, ice-going vessels and advanced ship concepts such as



autonomous ships. The core value of research is to guarantee safety, to enable sustainability by way of advanced solutions, and to focus on the first principles of applied mechanics, statistical methods, and systems engineering. The research on safety focuses on developing concepts, methods, tests, and frameworks for creating safe technological and socio-technological systems and for managing the associated risks. These advances in risk analysis and safety science are applied to specific problems in maritime engineering. This serves the society by increasing our understanding of how maritime safety is created and maintained and how safety risks can be effectively managed.

In all the above-mentioned topic areas, the Aalto University research group focuses on conducting high-quality research and educating the future leaders responsible for ensuring the safety of maritime traffic operations. Our projects are funded both nationally and internationally. They are focused on ensuring the safety of maritime traffic, ships, people on board, and the entire maritime ecosystem, with the help of analyses developed by a multidisciplinary

nary research group and with the support of national and international key partners in maritime safety.

**There are three main spearheads in our research:**

- 1) Ship Technical Safety, focusing on safety in ship design.
- 2) Ship Operational Safety, focusing on safety in ship operations (e.g., ship safety performance).
- 3) The safety of maritime traffic, focusing on the management of safety among all the maritime safety stakeholders.

The key personnel are Professors Pentti Kujala, Osiris Valdez Banda, and Spyridon Cheirdaris, Post Docs Ketki Kulkarni, Mikko Suominen, Martin Bergström, Fang Li, and Ahmad Bahoo Toroody, and doctoral students Roman Repin, Lu Liangliang, Meriam Chaal, Aleksandr Kondratenko, and Sunil Basnet.



**MARITIME INDUSTRIES AND LOGISTICS**

**University of Turku**

The research carried out by the Centre for Maritime Studies (CMS) at the University of Turku (UTU) includes a diverse research agenda in the fields of maritime industries and logistics, combining business studies and economics with environmental and social sciences. CMS specialises in the field of traffic and ports in the Baltic Sea area, as well as logistics chains and infrastructure in the marine industry sector. It coordinates the interdisciplinary environmental research supporting marine spatial planning and integrated coastal zone management.

**There are three main spearheads in the research:**

- 1) Shipping and maritime logistics, including: Maritime transport and infrastructure, port networks and port operations, maritime safety studies, pilotage operations and national security of supply.
- 2) Maritime cluster, including: Development of marine industries, cluster dynamics and economic impacts, corporate social responsibility in shipping operations together with studies focusing on Blue Growth.
- 3) Marine environment and spatial planning, including: Efficiency and impacts of environmental regulations in shipping, environmental status of

ports, marine spatial planning, shipping and offshore activities in the Arctic, performance and impact of the European ports system, and integrated knowledge base and management system for ports.



The three spearheads are reflected in the collaboration between Kotka Maritime Research Centre and UTU and in the projects conducted in 2020. These include the UTU-led MEROS project (development of maritime competence in Finland), funded by the Prime Minister's Office from 2018 to 2020, and the Get Ready project (partnership managed at UTU by Sari Nyroos). The collaboration is tightly connected to the strategic profiling area of maritime studies at UTU. The profiling aims to establish the University of Turku as one of the leading maritime research hubs in the Baltic Sea area. The University of Turku recruited a new post-doctoral researcher through an extensive international call for applications, and Dr. Eunice Olaniyi started in the position in early 2020. She is an expert in maritime business and management.

The key personnel are Professor Tommi Inkinen, post-doctoral researcher Eunice Olaniyi, Senior Researchers Reima Helminen and Tapio Karvonen, Director Sakari Kajander, and Education Manager Sari Nyroos.

## MARINE ENVIRONMENT

### University of Helsinki

The Fisheries and Environmental Management Group (FEM) and Marine Risk Governance Group (MARISK) focus on the interaction between ecosystems and the human society.

#### The research interests are:

- 1) Decision and risk analysis in relation to renewable resources and biodiversity
- 2) Identification and quantification of risks in the use of natural resources and in the various maritime activities
- 3) Integrating different sources of data and knowledge: Bayesian analysis
- 4) Interdisciplinary modelling of exploitation processes of natural resources in the face of risks and uncertainty of information.
- 5) Human, social, and cultural dimensions of managing the use and protection of sea areas and their resources
- 6) Risk management and communication.

All previous applications focus either on fisheries science or on oil spill risk analysis. The SmartSea and Wise projects focus on more generic risks. It is people who cause the main risks to the aquatic ecosystems. Therefore, we need social sciences to solve the problem. The research conducted at the University of Helsinki projects combines biology,

limnology, fisheries management, geography, and sociology and anthropology. Moreover, mathematical sciences produce risk models that have their foundation in these sciences.

The Bayesian analysis forms the backbone of our environmental modelling approach. It provides an effective tool for learning from various information sources. These sources include data, models and their theoretical background, and expert knowledge. For example, the FEM Group has estimated the effectiveness of an oil combating fleet in collecting oil from an oil spill. The Bayesian approach offers a good foundation for decision-making.

In oil spill impact analysis, it is important to develop a methodology, which allows for maximum learning from previous accidents. It is important to understand that the level of uncertainty is high in impact predictions. By creating Bayesian models that can learn from previous accidents, it is possible to reduce the number of uncertainties in terms of future accidents.

The key personnel are Professors **Sakari Kuikka** and **Päivi Haapasaari**, post-doctoral researchers **Annukka Lehikoinen**, **Mirka Laurila-Pant** and **Inari Helle**, and doctoral students **Emilia Luoma** and **Tuuli Parviainen**.



SAKARI  
KUIKKA



PÄIVI  
HAAPASAARI

IT IS PEOPLE WHO CAUSE THE  
MAIN RISKS TO THE AQUATIC  
ECOSYSTEMS. THEREFORE,  
WE NEED SOCIAL SCIENCES TO  
SOLVE THE PROBLEM.

## MARITIME LOGISTICS AND SEAFARING

### South-Eastern Finland University of Applied Sciences (Xamk)

Applied research at Xamk focuses on logistics and seafaring. In seafaring, the focus is on maritime safety and managing 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 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, both in logistics and seafaring.

The research projects are need-based and carried out in close cooperation with end-users, providing practical, ready-to-use research results. RDI activities in logistics and seafaring are conducted by working closely with authorities, companies, and public sector organisations.

The key personnel in collaboration with Kotka Maritime Research Centre are Research Director **Ville Henttu**, Research Manager **Justiina Halonen** (maritime safety and oil spill response), Research Manager **Olli-Pekka Brunila** (logistics), Director of Research Unit **Tomi Oravasaari**, and RDI personnel **Elias Altarriba**, **Emmi Rantavuo**, **Antti Lanki**, **Krista Surakka**, **Joel Kauppinen**, **Tommy Ulmanen**, **Antero Myrén**, and **Vappu Kunnaala-Hyrkki**.



JUSTIINA  
HALONEN



OLLI-PEKKA  
BRUNILA



VILLE  
HENTTU

THE MAIN RESEARCH TOPICS  
INCLUDE POLLUTION PREVENTION  
AND SPILL RESPONSE MANAGEMENT,  
AS WELL AS MARITIME EMERGENCY  
RESPONSE AND DISTRESS  
OPERATIONS.

# 4. DOCTORAL DISSERTATIONS

*Mirka Laurila-Pant*  
*University of Helsinki*

M.Sc. Mirka Laurila-Pant from the University of Helsinki defended her thesis titled 'When do we attain our objectives? On the role of indicators, values and uncertainty in environmental management' on 4 September 2020. The work consists of a summary and three research articles.

The main objectives of environmental management are to safeguard the environmental status and to preserve the services ecosystems provide. The terms describing these broad objectives are multidimensional and cover a number of even partly contradictory sub-objectives. As it is not straightforward to judge whether these objectives have been attained, this thesis proposes multidisciplinary and probabilistic perspectives to support more precise definition of the objectives. The focus is on evaluating ecological, economic, and

sociocultural indicators for measuring biodiversity and the thesis proposes integrating these into a multi-objective environmental management framework.

However, the use of indicators does not remove the uncertainty nor the value judgements related to environmental decisions. Therefore, a Bayesian approach is used to estimate the uncertainty related to the process of determining the sufficiently good status of an indicator. As the society has different interests towards the ecosystems, the trade-offs in multi-objective decision-making easily lead to conflicts. A Bayesian approach is developed to analyse the optimal decisions from the perspective of different groups by estimating the variability in the groups' consensus and then visualising the level of difference between them.



**Fang Li**  
*Aalto University*

M.Sc. Fang Li from Aalto University defended his doctoral thesis on 6 November 2020. The thesis focuses on the numerical simulation of ship operation in level ice, which contributes to the design of icebreaking ships and planning of ship operation in ice.

The work starts with a systematic evaluation of state-of-the-art methods used for estimating ship performance in level ice. It is identified that there are large variations between the estimations carried out with different methods, and that the associated level of uncertainty is high. Following that, a framework is established to guide the process of developing numerical models for ship operation in level ice. The thesis then invests efforts into modelling ship-ice interactions with physical modelling methods. Finally, a ship operation

simulation programme is established for the aim of ship design and operational planning. The programme has been benchmarked with full-scale measurement data to ensure its credibility.

The numerical simulation programme has been named Aalto Ship Operation in Ice Simulator (ASOIS). It is developed as a Matlab application which can be easily used by external users. The programme can be used for various purposes, such as ship operation in level ice, ship convoy in ice, and ship in dynamic ice field. The simulation results provide quantitative support for decisions on ship design and operational planning to ensure safe and smooth navigation through ice-covered areas.



# 5. NEW PROFESSOR

## *Osiris A. Valdez Banda*

Osiris A. Valdez Banda was appointed Assistant Professor of Marine Technology at Aalto University in February 2020. He established the research group on Safe and Efficient Marine Systems and Experience. His research group focuses on the analysis of marine risks and safety systems engineering with applications in the concepts of smart shipping and ship winter navigation. The work of his research group focuses on the development of methods and processes for risk and safety management and resilience engineering in maritime transport systems by developing innovative concepts, principles, and tools for making safe and risk-informed decisions in the development of smart ship concepts and winter ice navigation.

Osiris has more than a decade of international experience of working in logistics, quality, and environmental management, as well as of safety research in the maritime sector. In Finland, Osiris started his career as a maritime safety researcher at Kotka Maritime Research Centre in the project Competitive Advantage by Safety (CAFE) in 2012. In this project, he carried out studies to analyse the safety management practices of the Finnish Maritime Cluster. The collaboration between Osiris and the research centre continued in the project “Winter navigation risks and oil contingency plan (WINOIL)”, which included analysing the risk of oil spills in sea ice conditions in Finnish sea areas. Osiris has also been involved in the centre’s research network in the projects

MIMIC and BALTIMARI.

In the context of research collaboration within Kotka Maritime Research Centre, Osiris aims to continue and strengthen the research work on analysing the risks of accidental oil spills in Finnish sea areas. In addition, he aims to involve the centre in studying the safety and efficiency of advanced ship concepts and the development of the autonomous maritime ecosystem. Osiris wants to continue with his research strategy of using science to provide solutions for the demands of the maritime sector. This strategy is based on trilateral collaboration with academic, industrial and authority partners. With academia, the focus is on efficient implementation of the scientific and practical knowledge of Kotka Maritime Research Centre’s university network. The collaboration with the industrial sector focuses on continuing and extending the cooperation with the key organisations involved in the development of new maritime technological solutions. With authorities, the focus is on continuing the collaboration with critical maritime safety authorities on the research of maritime risk and safety management. With this approach, Osiris aims at supporting the delivery of new, practical scientific-based solutions and the introduction of new professionals who will lead the future of the maritime industry.





# 6.

## TOP PROJECT:

### SIMREC - SIMULATORS FOR IMPROVING CROSS-BORDER OIL SPILL RESPONSE IN EXTREME CONDITIONS

The main goal of the SIMREC project is to reduce environmental risks related to oil spills. This will be done by strengthening cooperation and by creating a new simulator-based environment for training for oil spill accidents. By combining the know-how and expertise of authorities and research institutions in Finland and in Russia, the project's objective is to develop tailored training programs and optimise the preparedness of response teams.

The centrepiece of SIMREC is the development of an innovative and cost-efficient simulation environment for training, which enables response teams to maximise the efficiency of their operations. These simulations will be elaborated based on a set of scenarios reflecting potential oil-spills. The scenarios will include data and predictions on maritime traffic, as well as data on the impact of extreme weather and sea conditions on certain areas. Based on this data, hot spots for accidents can be located and all information converted into scenarios that are used for simulation training.

A fundamental pillar of a successful oil-spill response operation is well-considered, responsible, and efficient decision-making. In order to optimise the operations, SIMREC aims to

elaborate protocols and tools that allow the persons responsible to enhance their decision-making and communication. Existing patterns of communication and decision-making will be analysed and converted into a roadmap, providing recommendations for best national and cross-border practices. A key factor in the process of fully understanding the nature of successful decision-making and information sharing during operations is to consider the different settings in Finland and Russia and the country-specific factors affecting operations.

Besides Kotka Maritime Research Centre, the SIMREC partners are University of Aalto, University of Helsinki, Finnish Environmental Institute (SYKE), South-Eastern Finland University of Applied Sciences, State Marine Technical University of St. Petersburg, and Admiral Makarov State University of Maritime and Inland Shipping.

The project is funded by the South-East Finland – Russia CBC 2014-2020 programme.

More information: [www.merikotka.fi/simrec](http://www.merikotka.fi/simrec)





OSSI  
TONTERI

**Preparedness level and procedures for defining better responses in a changing environment**

*Ossi Tonteri, Researcher,  
Finnish Environment  
Institute, SYKE*



JORMA  
RYTKÖNEN

*Jorma Rytönen,  
Development Manager,  
Finnish Environment  
Institute, SYKE*

In the SIMREC project, SYKE has an expert role due to its long history in oil combating and environmental protection. SYKE's

task will be to carry out a transparent analysis of the current preparedness level of the participating authorities, and to analyse how to change the procedures in order to define better responses in a changing environment. In addition, SYKE will participate in the activities related to the identification and analysis of end user needs and their dissemination.

The data available from Estonia, collected with questionnaires, will be attached to the analyses in order to get an overview of the regional preparedness level of the three countries in the Gulf of Finland area. Further analyses will be carried out on how the trilateral preparedness will match the accident scenarios selected based on the SIMREC project. The

output will constitute state-of-the-art knowledge on the current pollution prevention preparedness and the main factors influencing the response.

The main components in response preparedness will be analysed to prepare comprehensive guidelines for the assessment of response capability. As part of the SIMREC project, SYKE will assess the oil spill response capabilities of the project partners in the south-eastern part of Finland and in the Russian part of the Gulf of Finland. The assessment will be carried out by using the RETOS tool, developed by ARPEL (the Regional Association of Oil, Gas and Biofuels Sector Companies in Latin America and the Caribbean) and approved by the International Maritime Organisation (IMO). The tool can be used to assess the OSR planning and readiness of governments and companies. The assessment results can be compared to the practices of other countries and used to identify challenges, information needs and areas of improvement. One of the plans is to compare the results with the similar efforts made in the other EU-funded research project OILSPILL (<https://blogit.utu.fi/oilspill/>), and then to report on the main findings and lessons learned to HELCOM's Response Working Group (<https://helcom.fi/helcom-at-work/groups/response/>).

The findings and results from the response capability assessment will be used in the planning of tabletop exercises. The aim is to define the most critical attributes and investigate them further in the simulator, taken care by the other partners of the SIMREC project.

**SYKE'S TASK WILL BE TO CARRY  
OUT A TRANSPARENT ANALYSIS  
OF THE CURRENT PREPAREDNESS  
LEVEL OF THE PARTICIPATING  
AUTHORITIES, AND TO ANALYSE  
HOW TO CHANGE THE PROCEDURES  
IN ORDER TO DEFINE BETTER  
RESPONSES IN A CHANGING  
ENVIRONMENT.**



# 7. OTHER RESEARCH PROJECTS

## CEPOLAR

### **The Lloyd's Register Foundation: Research Centre of Excellence for Arctic Shipping and Operations**

*Pentti Kujala, Aalto University*

*Sakari Kuikka, University of Helsinki*

The topic of Arctic Shipping and Operation will be continued on a new project funded by the Lloyd's Register Foundation (LRF) concerning the recommended practices of scenario-based risk management for polar waters. The LRF awarded EUR 800,000 in funding for the project for the term of 2019–2021. This project develops guidance notes on scenario-based risk management for polar shipping. It builds on previous LRF-funded research in arctic operations to significantly update the recommended practices. It enables the IMO, government agencies, class societies, and industry to establish and maintain the highest standards of excellence for shipping operations in the polar areas.

In 2020, Aalto University and Norwegian University of Science and Technology co-authored a summary report on future scenarios related to ship transport, cruise ship activities, and the oil and gas industry, and the report was presented in the OMAE 2020 conference. A framework for integrating life-safety and environmental consequences into conventional Arctic shipping risk models has been reported by Memorial University (MEMORIAL). This model was first proposed by

the MUN team to the wider LRF project team at the first project team meeting in St. John's in July 2019, where it was endorsed as an appropriate basis for the risk model. Led by MEMORIAL, all partners (especially Aalto and University of Helsinki) have been actively taking part in developing this model further and conducting some case studies to, for example, apply the model on an oil tanker navigating in the northern Canadian waters (Final risk model). The capabilities of our current discrete element method tools and possibilities of upgrading them have been analysed by Aalto and compared to full-scale ice load data. In addition, new approaches have been developed by Aalto for the evaluation of ice-induced loads on ships in varying ice conditions through numerical simulations and analysis of the measured full-scale ice load data. The development of a numerical structural model has also progressed well at Hamburg University of Technology (TUHH), and TUHH experts have also carried out extensive testing of the ice crushing process and structural failures in their laboratory. In addition, TUHH has developed new approaches to the numerical modelling of ice failures. During 2020, 17 journal papers were published, three journal papers submitted, and four conference papers published.

Funded by Lloyd's Register Foundation (2019–2021)

More information: [www.aalto.fi/fi/koneteknikan-laitos/centre-of-excellence-for-scenario-based-risk-management-in-polar-waters](http://www.aalto.fi/fi/koneteknikan-laitos/centre-of-excellence-for-scenario-based-risk-management-in-polar-waters)

## AUTOMATE

### Real-time remote observation of voyage and navigational data and integrated automation system information

Joel Paananen,

South-Eastern Finland University  
of Applied Sciences (Xamk)

The AutoMate project studies the available technologies for robust and secure data transfer between a target vessel and the educational environments at the XAMK campus. It creates a testing and piloting platform for all interested parties. Based on the results of the technology review, two different systems for data transfer were set up and tested.

The navigational systems platform is able to transfer data from a target vessel's radar and ECDIS to the equipment at the campus. In addition, a transfer of live video feed from the surroundings, and additional data points, such as weather conditions onsite, could be transferred to the campus equipment.

The second test platform consists of fully functional automation system hardware that is able to connect to any vessel with a similar IAS setup. As a result, it is possible to study the transferring of the entire IAS data for remote control and observation purposes. In addition, the IAS virtual control room equipment are also coupled with real generator sets and a main switchboard, just like in a real vessel. Therefore, the platform allows for

the conducting of easy local control and operation tests on remote automation systems, while still being plug-and-play ready to connect for a real vessel sailing offshore.

The potential applications of this arrangement are studied with the project partners. The initial uses for these platforms include, for example, using the navigational and environmental data to enhance the situational awareness and decision-making of an operation centre during a crisis situation, and evaluating the status and integrity of a vessel after a collision or accident. This data can also be used to support traffic control in normal and crisis operations.

On the IAS platform, using the virtual control room to evaluate performance data, testing AI-supported condition-based maintenance strategies, remote controlling vessels' parameters to optimise efficiency, or just giving advanced maintenance and operation support are extremely interesting possibilities.

Funded by the Regional Council of Kymenlaakso, European Regional Development Fund (ERDF)

More information: [www.xamk.fi/en/research-and-development/automate-electric-and-automation-systems-and-remote-monitoring-of-ships/](http://www.xamk.fi/en/research-and-development/automate-electric-and-automation-systems-and-remote-monitoring-of-ships/)

## BALTIMARI

### Review and future of risk management in the Baltic Sea

Ketki Kulkarni,  
Aalto University

The Baltic Sea is an area characterised by intense human activities in terms of transportation, food, and offshore energy production. While these activities are important for the livelihood of the region, they also exert pressure on the sensitive sea. There is a high risk to humans, wildlife, vessels, and the ecosystem as a whole. The environmental impacts of shipping are significant and include, for example, air pollution, sewage discharges from passenger ships, invasive species transported in ballast water or on hulls, and the risk of large-scale accidents, like oil spills. The shipping industry is also responsible for approximately two percent of all global greenhouse gas emissions.

The EU BONUS BALTIMARI project provides comprehensive reviews of the state-of-the-art risk management strategies and decision support systems for maritime activities such as shipping in the Baltic Sea, with focus on the Maritime transportation systems (MTS) and offshore energy production systems (OEPS). The project is also aimed at identifying several priorities for future research in risk management based on input from various stakeholders.

The project has resulted in nine journal articles, one conference article, and six policy briefs and

supported one doctoral thesis. Furthermore, a panel discussion was organised to brainstorm ideas for bridging the gap between research and practice. This was followed up by a stakeholder workshop hosted by the World Maritime University, where several industry practitioners were invited.

It has been found that the Baltic Sea Region is a world leader in scientific literature on marine risks and safety. The general trends indicate that the scientific community has incorporated relevant industrial challenges into research agendas. However, while there has been great productivity at the proof of concept level, the majority of the models and solutions have not been validated in real settings. The TRL of the solutions is remarkably low. The future research challenges for the BSR would include improving the applicability of scientific work in the industrial sector.

By documenting the best practices of the industry and academia and preparing a list of key concerns for enhancing research uptake, it is hoped that BONUS BALTIMARI will help narrow the gap between scientific output and industry practices in the future.

Through compiling and comparing the available regional and global knowledge of risk management from the last 50 years, it is hoped that scientific researchers may identify new future research directions that are better aligned with the industry's needs. At the same time, the industry stakeholders may benefit from the summarised insights generated by leading scientific efforts,

guiding the policies of near future and calling for a more informed dialogue with scientists in order to make the models more useful in the real world.

Funded by BONUS, the Baltic Sea Research and Development Programme (2015–2017).

More information: [www.merikotka.fi/baltimari](http://www.merikotka.fi/baltimari)

## COMET

### **Internationally competitive maritime education for modern seagoing and high-quality port services**

*Vesa Tuomala,*

*South-Eastern Finland University of Applied Sciences*

*Annu Jokela-Ylipiha,*

*South Kymenlaakso Vocational College*

The primary aim of the project is to create a joint simulator training framework for maritime education. The maritime simulators of maritime schools in Finland and Estonia are technologically connected so that students can be trained in the same simulated world. Other maritime traffic in the simulated world has previously been mostly computer-generated, but at present, the other ships are controlled by students from other schools and from different countries. When the students need to navigate their way among other human-controlled ships, the simulated environment will better represent the real environment. This also improves the training of human interaction in

a simulated environment, as the students learn, for example, how to communicate in a multicultural environment.

To fully benefit from the possibilities of joint simulation, new simulator exercises are created. Two studies are being conducted with the aim of helping the students focus on the right training objectives and training methods. The study of labour market needs focuses on expert interviews and aims to discover what skills should be trained. The study on best simulator practices aims to find the best ways to conduct simulator training. Additional training in maritime safety management is also arranged for maritime teachers.

Joint simulated exercises are especially useful for deck officer students, but the project also includes the development of training for engine room and cargo handling students. For cargo handling students, new training frameworks are created to better utilise the simulator training and on-the-job learning. Similarly, new courses are also created for engineering students. Cargo handling and engine room expertise are also included in the study of labour market needs.

Funded by the Central Baltic 2014–2020 Programme.

More information: <https://ekami.fi/kehittaminen/hankkeet/comet-internationally-competitive-maritime-education-modern-seagoing-and-high>

## COMPLETE

### **Completing management options in the Baltic Sea Region to reduce risk of invasive species introduction by shipping**

*Miina Karjalainen,*

*Kotka Maritime Research Association*

The aim of the project has been to develop consistent and adaptive management tools and recommendations for the Baltic Sea Region (BSR) by addressing both major vectors of harmful aquatic organisms and pathogens – ballast water and biofouling – while taking into account the need for non-indigenous species monitoring. The project has partners and collaborators in all Baltic Sea countries.

The COMPLETE project has provided a comprehensive approach on this complex issue. By delivering the required management tools and practical guidelines, it has proposed a harmonised way to comply with the requirements set by the IMO's Ballast Water Management Convention for the Baltic Sea region.

The COMPLETE activities aimed at filling knowledge gaps have constituted the basis for the development of a regional, harmonised Baltic Sea management strategy on biofouling with the purpose of minimising species introduction and spread. Moreover, COMPLETE has provided the knowledge basis for a Baltic Sea-wide harmo-

nisation of processes. This work has been based on information of national regulations, cleaning procedures, biofouling management options, antifouling systems and methods, antifouling efficiency, the benefits of hull cleaning on ships' fuel consumption and emissions, and the ways of optimising hull cleaning needs.

The COMPLETE project has also resulted in recommendations for new methods to be used in the early detection of non-indigenous species (NIS) or harmful aquatic organisms and pathogens, as well as for identifying areas where biofouling monitoring should be conducted to decrease the risk of new invasions and to safeguard the valuable natural areas in the proximity of invasion hot spots.

Funded by the Interreg Baltic Sea Region Programme (2017–2021)

More information: [www.balticcomplete.com](http://www.balticcomplete.com)

## GETREADY

### **Getting Ready for the Cross-Border Challenges: Capacity Building in Sustainable Shore Use**

*Vesa Tuomala,*

*South-Eastern Finland University of Applied Sciences*

*Joona Saari,*

*Kotka Maritime Research Association*

The objective of the project is to increase the cross-border region's preparedness for the existing

and anticipated challenges by introducing the best practices and applying innovative solutions in the field of sustainable shore use. Our work has been focused on topics of maritime spatial planning and the digitalisation of ports' environmental management tools.

As more and more detailed data is available about port areas due to automated real-time measuring devices, environmental management software can produce helpful and easy-to-read predictions, reports, and analyses about the port operations. With the help of these analyses, ports can make their operations more sustainable and, at the same time, achieve better cost-efficiency. The digitalisation process requires expertise and extensive collaboration between the ports' many stakeholders, which might slow down this development. However, there are already many examples of ports that use digital environmental management tools in the Baltic Sea area.

Certified environmental management systems that offer guidelines for good environmental practices are already extensively adopted in the Baltic Sea ports, but improving the environmental performance beyond the current regulations and legislation is necessary. Clearly, the biggest producers of emissions in a port are the ships at berth and waiting access to the harbour. Thus, the biggest change with a positive impact on the environment that a port can do is to start using the Just-In-Time arrival method, which enables the incoming ships to optimise their speed and route. This requires connecting the information manage-

ment systems of the ships and ports to improve communication. This development emphasises the importance of good communication and streamlined exchange of information, which is why digital information management systems will prove to be even more useful in mitigating and tackling the effects of the global pollution disaster.

Funded by the South-East Finland ENI CBC 2014–2020 programme

More information: <https://eco-getready.com/>

## INFUTURE

### Future potential of Inland Waterways

*Tarja Javanainen,*  
*Kotka Maritime Research Association*

The aim of the INFUTURE project is to open new business opportunities and prospects for inland waterways at the Lake Saimaa and Volgo-Balt areas by increasing possibilities for higher cargo volumes and a longer navigation season. During project implementation several topics regarding transportation needs of companies, legislation and customs policies has been studied. Further, a feasibility study for prolonging navigation period in inland fairways and canal routes have been done. Addition to literal tasks, five intelligent AtoN's was installed in Lake Saimaa area (Heinsalmi). Those will be included as part of a full-scale test of 39 AtoN's throughout the summer 2021. Additional two AtoN's were installed to the River Neva and

the Lake Ladoga. Aim is to clarify the performance of devices during wintertime. The work related to new ship concepts is proceeding well. A model of a new ship concept has been done to simulate its ice-going performance in Aalto ice-tank.

One of the specific objectives of the INFUTURE has been to build up strong stakeholder co-operation between Finland and Russia. Facilitation is needed to initiate discussions, cooperation, and partnerships between business stakeholders across the border. Despite of COVID pandemic several on-line events were held to foster this important task.

The project is funded by the South-East Finland – Russia CBC 2014-2020 programme.

More information: [www.merikotka.fi/infuture](http://www.merikotka.fi/infuture)

## MEPTEK

### Benchmarking study of marine emission reduction technologies

*Elias Altarriba,*  
*South-Eastern University of Applied Sciences*

The European Union has set ambitious goals for reducing air emissions to avoid environmental pollution and climate warming. Especially for carbon dioxide emissions, strong reduction targets have been set for the coming decades. In the maritime sector, the reduction of toxic gaseous emissions such as nitrogen oxides is an important goal, too, as these form a typical emission component in

shipping. The chosen framework plays a significant role when assessing the harmfulness level: In the vicinity of housing near port areas, the health effects of emissions on people are more serious than those of emissions on the high seas.

In the MEPTEK project (benchmarking study of marine emission reduction technologies), the main aim is to compare the existing emission reduction technologies that are currently operational in a real environment. The project is being implemented during the period from 1 May 2020 to 31 December 2022 by the South-Eastern University of Applied Sciences, and it is funded by the European Regional Development Fund. The implementation of the project is divided in accordance with the two focus areas of the University: "Forest, the Environment and Energy" and "Logistics and Seafaring".

At present, a wide range of emission reduction technologies are being applied in shipping in the Baltic Sea region. Some of these technologies are obsolete and likely to be phased out in future, such as water injection into the fuel and steam humidification of the intake air stream of the main engines. However, the service life of ships is often measured in decades, meaning that outdated technologies may be applied for surprisingly long periods of time. Many types of catalytic converters provide an effective set of methods in reducing toxic emissions. In the ports, shore power can be utilised to reduce the local gaseous emissions of a berthed ship. When the Baltic Sea region became a sulphur emission control area

(SECA) in 2015, reduction requirements were set for sulphur emissions. As a result, operators had to select a low-sulphur fuel of a higher quality or install sulphur scrubbers to remove excess sulphur compounds from exhaust gases to reach the new requirement levels.

Many of these technologies have been applied in real environments for years. Hereby, a life cycle analysis emphasising information based on literature, statistics, on-board measurements, and end-user experiences can be carried out. During the project, exhaust gaseous emission measurements and voyage data analysis will be done on ships equipped with separate techniques. The beginning of the measurement sessions had to be postponed due to the COVID-19 pandemic, but the new plan is to get started in 2021. In the analyses, the Bayesian network method can be applied in a similar way as earlier in the project called "COMPLETE".

In the future, emission control and green technologies will be research branches of great political interest. However, environmental protection is rarely a straightforward process. Partial optimisation can easily lead to unwanted multiplier effects, and sometimes strongly politicised decisions can lead to situations that other people may experience as unfair, which leads to backward steps for the environment, too. These can be avoided by basing decision-making on research knowledge.

Funded by the European Regional Development Fund.

More information: [www.xamk.fi/meptek](http://www.xamk.fi/meptek)



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## 8. VISIBILITY

As we produce scientific evidence to improve maritime safety and sustainable maritime transport, we are committed to promoting evidence-based decision-making in the private and public sectors alike. In addition to our research projects, this is done through outreach and visibility.

The major effects of the ongoing pandemic have so far focused on our actions related to visibility. Starting from March 2020, all research seminars and stakeholder meetings have been cancelled. Instead of live events, we started organising different kinds of events online. SIMREC simulator training was live-streamed via our YouTube channel, INFUTURE Round Tables were held cross the border as Teams meetings, and two GetReady events were held online.

As the Kotka Maritime Festival was cancelled, we were not able to organise the Baltic Sea Village. However, on October 27th we participated in the Baltic Sea Day and organised a small event, called Pop-Up Baltic Sea Village, which was aimed at all interested parties.

A new form of publications was established during the year of 2020. The first three reports were published in the new series of reports, Kotka Maritime Research Centre Publications. The first publications were the reports of the two external reviewers. The third publication was an output of the GetReady project and described the digitalisation of environmental management tools in ports. The series of KMRC Publications will be available on our website: [www.merikotka.fi](http://www.merikotka.fi)

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KOTKA MARITIME  
RESEARCH CENTRE  
PUBLICATIONS.**

# FACTS AND FIGURES

## VISION



### MERIKOTKA

is a pioneer and a respected research centre in the field of multidisciplinary maritime research

## RESEARCH THEMES

### MARITIME SAFETY



### MARITIME INDUSTRIES & LOGISTICS



### MARINE ENVIRONMENT



## MISSION

RESEARCH FOR SUSTAINABLE MARITIME TRANSPORT



2  
DOCTORAL DISSERTATIONS



37  
SCIENTIFIC ARTICLES

FUNDING  
2,5 M€

## THE VALUES



### 1. WORKING TOGETHER

Learning and solving through interdisciplinary collaboration



### 2. INNOVATIVENESS

Creating novel and competitive solutions through excellent science



### 3. HONESTY

Building trust by understanding and communicating the limitations of our research

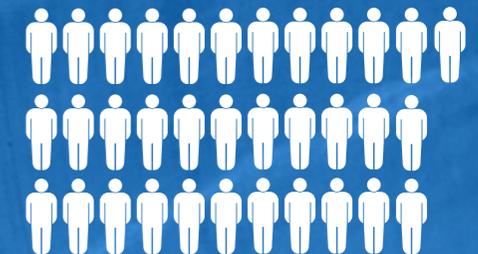


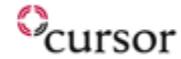
### 4. RESPONSIBLY SERVING SOCIETY

Supporting society by proactive value creation and preservation

EMPLOYEES

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