



MERIKOTKA
KOTKA MARITIME
RESEARCH CENTRE

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Annual Report 2023



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Foreword

Our new strategy period began in 2023 with the goal of establishing us as a recognized international interdisciplinary research network. Although progress has been made during previous strategy periods, we acknowledge the ongoing effort required to achieve even deeper interdisciplinarity and stronger societal interaction. This goal demands time, resources, and continual attention to the interface between scientific disciplines. However, as this goal is at the very core of our existence, we are ready to put effort into it.

One key objective is to maintain the desirability of KMRC research network membership. We emphasize our ability to produce maritime experts with broad expertise and vision through cooperation, fostering a high standard of operations. Transparency and openness within the network are crucial, with self-evaluation and inquiries providing valuable insights for comfort and satisfaction. The Core Research Network (CRN) feedback process is essential for refining our research initiatives and staying responsive to evolving needs.

Two noteworthy new actions include the impactful Kotka Maritime Research Conference, offering a platform for researchers and stakeholders to exchange ideas, showcase results, and shape our community's future. Additionally, the establishment of the KMRC alumni network aims to build connections, enrich the community, and promote the exchange of knowledge and experiences.

In conclusion, our first year of implementing the updated strategy brought new opportunities, guiding us in the right direction for the future. We look forward to continuing this positive trajectory.



Anna Kiiski

Executive
Director

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Kotka Maritime Research Centre in Brief

Kotka Maritime Research Center specializes in interdisciplinary research concerning maritime transport and logistics, addressing safety, environmental, and economic considerations.

This collaborative initiative involves leading Finnish universities and research institutes sharing a common goal of advancing sustainable development within Finland's maritime sector.

The research conducted is driven by identified problems and geared towards providing practical solutions, offering scientifically validated responses to societal and environmental challenges. The core researcher network consists of 28 experts, and the Centre actively engages with partners such as the Finnish Transport and Communications Agency, Natural Resources Institute, several governmental and regional agencies, and interest organizations.

Established in 2005 by the city of Kotka, the research centre is dedicated to comprehending and mitigating risks associated with maritime transport. Leveraging the collective knowledge of diverse universities, KMRC focuses on producing high-quality research in areas such as marine transportation, traffic safety, and environmental impacts.

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University of Turku Petteri Alho & Johanna Yliskylä-Peuralahti
South-Eastern Finland University of Applied Sciences Ville Henttu & Noora Talsi
Cursor Oy Carina Pulkkinen & David Lindström

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Interdisciplinary Research for Sustainable Maritime Transport

Kotka Maritime Research Centre conducts interdisciplinary research to understand and develop the functioning and dynamics of ship operations and technology, maritime traffic, logistics, and maritime policymaking; assess environmental and safety risks related to maritime traffic, acknowledging the joint effects of other, cumulative stress factors; estimate the positive and negative impacts of maritime traffic on regional wellbeing, safety, and environment; develop new intelligent tools for navigation, maritime spatial planning, and management purposes; and 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, 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, social, and environmental aspects together.

In addition to planning and implementing research projects, [KMRC's network of researchers and experts](#) regularly convenes with each other and with stakeholders through various activities. Through the dialogue in these meetings, we promote collaborative learning and update our understanding of society's knowledge needs related to sustainable maritime transport and its development.



**Annuikka
Lehikoinen**

Photo: Veikko Somerpuro



Aalto University

Aalto

Marine and Arctic Technology at Aalto focus on the behaviour of ships, offshore structures, and their systems in normal and extreme environments, such as extreme wave and ice conditions. Our research, based on fundamentals of solid and fluid mechanics, safety science, and scientific computing, considers the safety of maritime transportation and operations, as well as the experiences the marine environment can offer to cruise vessel passengers.

The research section on Risks and Intelligence in Marine Systems is focused on developing concepts, methods, tests, and frameworks for creating safe technological and socio-technological systems and managing associated risks. These advances in risk analysis and safety science are applied to specific problems in maritime and materials engineering. This serves society by increasing our understanding of how maritime and structural safety is created and maintained and how safety risks can be managed effectively.

Given the rapid developments in marine technologies, with increased automation, digitalization, and system integration, there is a constant need to ensure the safety of the design and operation of new maritime systems. Scenario-based risk modelling is essential for the safe operation of ships and maritime traffic systems. Advanced ships require new and improved designs and smart situation awareness, and decision support systems. To achieve this, our research focuses on the development of innovative ship designs accounting for efficient traffic management systems and navigation safety controls.

Data mining, machine learning, and AI techniques are used to support intelligent decision-making. Besides high performance, the explainability and trustworthiness of these algorithms are investigated for a safe, fair, and sustainable maritime-AI transition. In the context of Arctic navigation, the current design regulations for ice-going ships and offshore structures fail to predict the actual safety and required safety level of the operations. Holistic risk analyses typically include the

definition of hazard scenarios, their probability of occurrence and the severity of their consequences. Such an assessment is challenging for Arctic operations, as operational data is scarce. In this area, one of the goals is to apply similar methods to those developed for the safety of marine traffic in open waters - particularly the heavy tanker traffic in the Gulf of Finland - to ice-covered waters.



Osiris Valdez Banda



Mashrura Musharraf



XAMK

South-Eastern Finland University of Applied Sciences focuses on applied research regarding logistics and seafaring. In the 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 transition of logistics, 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. The research and development activities in logistics and seafaring are conducted by working closely with authorities, companies, and public sector organisations.



Justiina Halonen



University of Helsinki

The Fisheries and Environmental Management Group in the University of Helsinki focus on the interaction between ecosystems and the human society. 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 scientific fields.

The research interests of the research group 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 and environmental processes of natural resources in the face of risks and uncertainty of information.

The 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 and their theoretical background, existing models and publications, and expert knowledge. For example in oil spill impact analysis, it is important to develop methodology that allows for maximum learning from previous accidents. It is important to understand that the level of uncertainty is typically high in impact predictions. By creating Bayesian models that can learn from previous accidents, it is possible to reduce uncertainties in assessment of future accidents.



**Sakari
Kuikka**



University of Turku

The research carried out by the research group in the University of Turku (UTU) includes a diverse research agenda in the fields of economic geography, maritime studies and transport, combining business studies and economics with environmental and social sciences. Group specialises in the field of traffic and ports in the Baltic Sea area, as well as corporate governance, social and environmental responsibility, and spatial impacts. It coordinates the interdisciplinary environmental research supporting marine spatial planning and integrated coastal zone management. Sea and Maritime studies are one of the strategic profiling areas at the UTU and the group has been integral part of this profiling since 2018.

There are three main spearheads in the research: 1) Maritime transport and infrastructure, port networks and port operations, maritime safety studies, pilotage operations and future foresight. 2) Maritime cluster and the development of marine industries, cluster dynamics and economic impacts, corporate social responsibility in shipping operations. 3) Marine environment and spatial planning considering an 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 ports system, and integrated knowledge bases for management.



**Tommi
Inkinen**

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PhD dissertation, Sunil Basnet

Sunil Basnet, a member of the KMRC's research network, defended his doctoral dissertation titled "Managing Risks in Maritime Remote Pilotage Using the Basis of Formal Safety Assessment" at Aalto University in the field of marine technology in December 2023. Basnet conducted his thesis work as part of the Research Group on Safe and Efficient Marine and Ship Systems, led by Assistant Professor Osiris Valdez Banda.

Pilotage is a safety service intended to prevent ship accidents, providing navigational assistance by experienced pilots who know the local conditions. Remote pilotage is a relatively new concept, in which the pilot assists the ship crew from a remote location at the shore.



"The idea behind remote pilotage is to improve both safety and cost-effectiveness of the operation", Sunil Basnet tells. "However, the implementation requires adoption of novel data and information sharing technologies both on ships, fairways, and pilot stations. The entity becoming more complex, this may lead to new emergent risks, requiring updates also in the prevailing safety control system", he continues.

The thesis of Mr. Basnet presents a novel, improved risk management framework that provides a systematic protocol with practical analysis tools, applicable to the modern remote pilotage systems. The framework is fully compatible with the Formal Safety Assessment (FSA) process developed by the International Maritime Organization (IMO), widely used in risk assessment and management in the context of maritime operations.

"This study lays strong and comprehensive foundations for effective risk management in the evolving field of remote pilotage, where there haven't been existing risk management framework so far", Sunil Basnet states and continues: "Method-wise, presenting a novel approach of integrating advanced systems modelling techniques, my thesis even fills some common gaps in the application of the Formal Safety Assessment. This is important for advancing the overall safety of maritime systems and operations."



**Sunil
Basnet**

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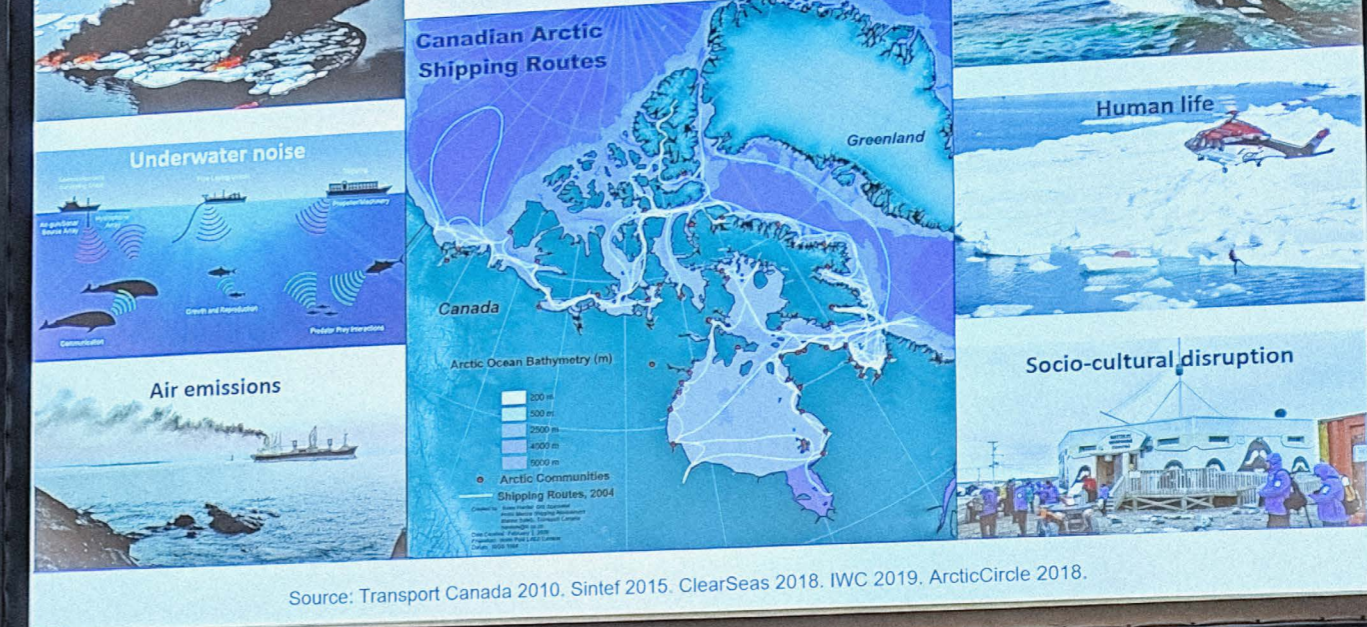
The Kotka Maritime Research Conference

The inaugural Kotka Maritime Research Conference (Komarec), held on November 8-9, 2023, at Kotka's new Event Centre Satama, successfully focused on sustainable development in maritime operations. Planned collaboratively by the KMRC research network, stakeholders, and Satama's event management team, Komarec aimed to unite researchers, authorities, companies, and interest groups for knowledge sharing on sustainable maritime practices. The conference featured 80 participants from diverse backgrounds, including research and educational organizations and stakeholder entities from Finland, Estonia, Poland, and Canada.

Keynote speakers, including Assistant Professor Floris Goerlandt from Dalhousie University and Executive Secretary Rüdiger Stempel from HELCOM, discussed ongoing work and environmentally sustainable maritime activities. Thematic sessions covered multidisciplinary perspectives on environmental impacts, energy-efficient winter navigation, smart maritime traffic, and the importance of risk assessment in maritime safety. Session chairs represented crucial stakeholders in Finnish maritime affairs, emphasizing collaboration and communication across sectors.

Komarec discussions highlighted the need for collaboration at national, regional, and international levels and underscored the importance of context-specific clarity in sustainability discussions. The conference addressed the Green Transition in maritime, emphasizing the global challenge of sustainability and the need for interdisciplinary solutions. The increasing use of artificial intelligence and automation in maritime transport was a key focus, with discussions on mitigating risks and ensuring the well-being of operational personnel.

The KMRC research network's vision to promote sustainable development through scientific collaboration and societal dialogue was supported by Komarec, providing a platform for dialogue, research visibility, and identifying future needs. Positive feedback and suggestions for improvement indicate the event's success, with plans to develop it into a regularly occurring, increasingly international, and larger conference.



Floris Goerlandt
Assistant Professor,
Dalhousie University

Commentary Speech

Honest discussions between academia, regulators and the industry facilitate decarbonization in shipping

Eero Hokkanen

Ministerial Adviser, Alternate Permanent Representative of Finland to the IMO, Ministry of Transport and Communications, Government of Finland

I had the pleasure to co-chair one of the sessions at the Kotka Maritime Research Conference in November 2023. The session concentrated on energy-efficient winter navigation. It highlighted the many challenges in finding an acceptable balance between safe and efficient shipping in ice conditions on one hand, and its effects on the environment on the other.

This balancing act has characterized Finnish policies in the International Maritime Organization (IMO), the EU, and regional cooperation around the Baltic Sea for years when it comes to sulphur and will likely continue to do so as regulation on GHG emissions continues to develop. It is no easy task to put together all the necessary pieces.

Therefore, it is of utmost importance, that regulators listen to not only industry and the civil society, but also researchers, members of the academia. I believe that open and honest discussions between all stakeholders, such as the ones facilitated by the Kotka Maritime Research Centre last November, form one of the keys to decarbonize Baltic Sea maritime traffic in the years to come. I thank colleagues in Kotka for taking the initiative, and hope that they continue to do so also in the future!



**Eero
Hokkanen**

Eero Hokkanen – Ministerial Adviser, Alternate Permanent Representative of Finland to the IMO, Ministry of Transport and Communications, Government of Finland.

Mr. Hokkanen holds a Master's degree in Social Sciences, majoring in International Relations. In addition to representing Finland in the IMO, he coordinates national maritime transport affairs in the Ministry.



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KMRC alumni network

One of the new steps we took during 2023 was the establishment of an alumni network for the Kotka Maritime Research Centre. This network includes almost thirty former community members: professors, researchers, students, or employees of KMRA. We believe this network can serve as a bridge that connects individuals who share a common educational background and history within the operations of KMRC. The alumni network can provide a platform for networking, mentorship, and the exchange of knowledge and experiences. Through yearly events, we aim to help alumni stay connected and informed about developments within the centre, but also to link current members of the KMRC community to alumni.

The inaugural meeting, held in conjunction with the Komarec Conference, marked the commencement of our alumni network. This initial gathering aimed to reconnect former members, provide the opportunity to share experiences, and lay the foundation for a vibrant community. Through engaging discussions and a sense of shared nostalgia, the event successfully kickstarted our alumni network.

In essence, we believe that the KMRC alumni network can form an enduring bond between individuals who share a common educational journey, creating a supportive community that extends far beyond graduation and can play a pivotal role in personal and professional growth.

Commentary Speech

Successful science is made of collaboration

Ulla Tapaninen

Science is an attempt to systematically understand the world with the help of different explanations. Science is not the truth but the attempt to find the truth. Young doctorate students often believe that eventually they will find the truth. Little by little, the researchers begin to notice that countless studies have already been done, and the confidence collapse.

The key to successful research is collaboration. The wider the networks and the more you can get to know the research of others in the same or adjacent fields, the better you can direct your own work.

At this point, many researchers make the mistake of thinking that it is enough only to sit in their room and read the best journal publications in their field. That's where the most assuredly accepted truth can be found. However, the publications are generally accepted, but already slightly outdated information.

The most important way to know where your field is going is to talk to other researchers, companies operating in the field, and even politicians. What are the acute topics in the field and perhaps the most important: what is the difficult question that no other researcher dares to tackle.

Conversations with other researchers can be held at conferences, on printed or social media. Particularly valuable are researcher networks like Kotka Maritime Research Centre, where the same research field is looked at from different angles.

A young beginning researcher learns that the same problem can be looked at from many different points of view. And later in life, acting as a leader of a research group, he or she knows where to contact when the problems come too big to solve alone.



**Ulla
Tapaninen**

Ulla Tapaninen - Tenured Associate Professor Maritime Transport, Estonian Maritime Academy, Tallinn University of Technology and KMRC alumni.

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GYROSCOPE

The project GYROSCOPE investigates opportunities provided by and risks associated with smart digital solutions in the context of green transition of the maritime sector. Applying stakeholder-participatory processes and modern risk analytics, and considering alternative implementation pathways, the project produces a multidimensional picture of the sustainable digital transition to low-carbon maritime logistics.

The project produces a comprehensive picture of sustainable transition to green and sustainable marine logistics in Finland, and potential policy pathways to achieve it. This will be realized by bringing together experts such as researchers, national authorities, and operational actors of the Finnish maritime cluster, to create collective future scenarios in a Digital Foresight Platform (DFP) constructed and tested in the project.

In 2023, we performed several face-to-face interviews and literature review to elaborate manifestation of sustainability thinking in today's operation, the prerequisites for the sustainability of the marine actor's operation and visions of sustainable green transition of marine logistics. In addition, we prepared the expert workshops that will be organized in the year 2024. The workshops can help to better understand the risks and opportunities related to the three topics (alternative fuels, winter navigation and autonomous shipping) when both economic, ecological and social aspects are considered.

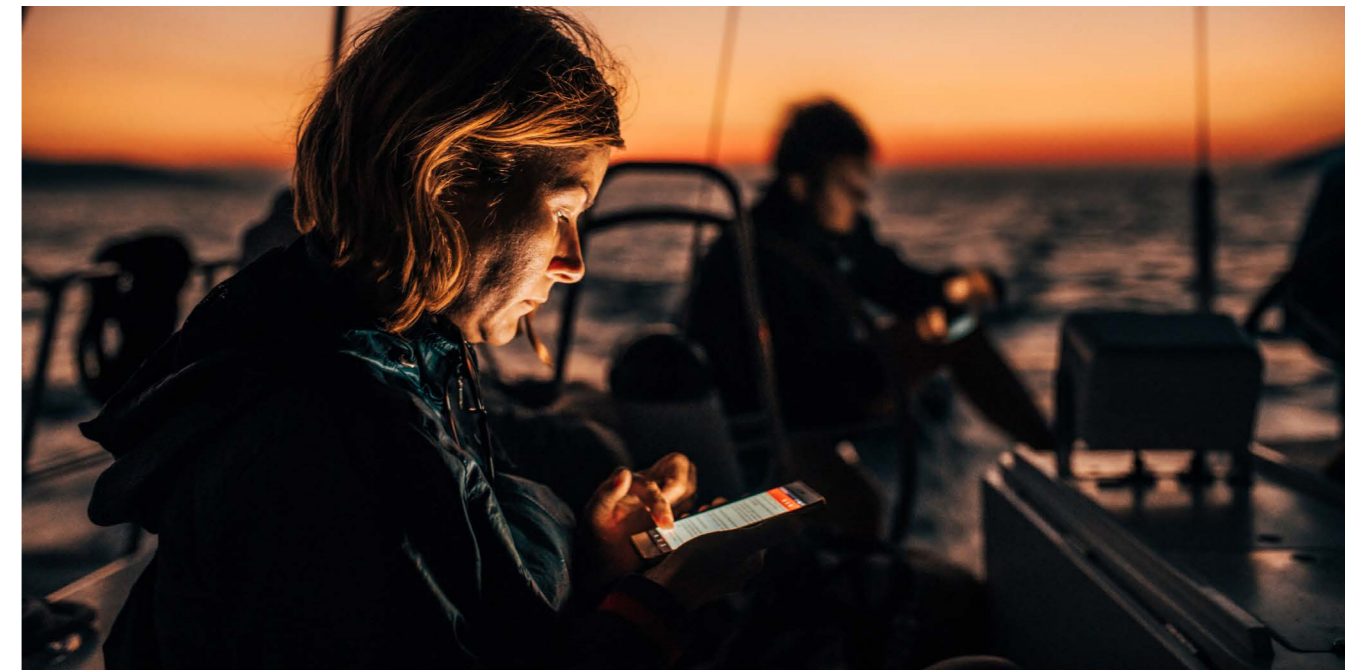
During the project, the DFP will be utilized to support alternative scenario building, risk identification, imagination of unforeseen events, evaluation of their controllability, and creative development of explorative policy pathways. In the long run, the approach is hypothesized to build competence and improved capability of the stakeholder community to (a) do collective scenario planning, (b) make sense of complex management problems and (c) perceive the short-term - long-term transitions as part of the planning processes.

GYROSCOPE receives funding from the European Union, NextGenerationEU instrument, and is funded by the Research Council of Finland under the 2022 call for research on key areas of green and digital transition.

University of Turku Toni Ahlqvist, Mikkel Stein Knudsen & Ville Lauttamäki
Kotka Maritime Research Association Annukka Lehikoinen, Emilia Luoma & Patrik Kauppi

Aalto University Osiris Valdez Banda, Sunil Basnet & Raheleh Farokhi
University of Helsinki Sakari Kuikka, Sami Vikkula, Janne Hukkinen, Nina Janasik, Maija Nikkanen & Mariel Kieval

More information: merikotka.fi/projects/gyroscope



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Other Projects

VISIIRI

The VISIIRI project ended in July 2023. Project served as a starting point for work aimed at developing a cross-sectoral collaboration and innovation platform for smart green logistics. There were two main goals for the platform: (1) to support the actors in the logistics sector in creating a common situational analysis and, based on that, developing a regional strategy for green transition; (2) to harness the know-how and innovation potential of the digital and circular economy sectors to address the challenges of the logistics sector in achieving ambitious climate goals and complying with regulation.

The project conducted an interview survey to study the challenges and needs resulting from the green transition among logistic companies in the Kymenlaakso region. In parallel, it examined the opportunities and risks that companies in the logistics, digital, and circular economy sectors perceived in the proposed collaboration platform concept and outlined the type of potentially functional platform. Additionally, a benchmarking analysis of similar platform experiments was conducted.

The project organized a hackathon in collaboration with South-Eastern Finland University of Applied Sciences, where applied university students brainstormed methods and tools for implementing the platform concept that could possibly meet the wishes and views of the target groups. After the hackathon, the project conducted an additional survey for the logistics, digital, and circular economy sectors to gather more viewpoints and confirm the results obtained from the interview surveys and the hackathon. As the final activity, the project compiled a final report, which includes a comprehensive structural design model for setting up, maintaining, and developing the platform.

Kotka Maritime Research Association Emilia Luoma & Patrik Kauppi
FinnHub ry Elina Multanen

More information: merikotka.fi/visiiri

Safe and secure future of logistics

Safe and Secure Future of Logistics project developed the communal and comprehensive safety and security of port communities and their member companies. The project elaborated the collective safety in ports adopting eight key themes: digitalisation, monitoring and reporting, lessons learnt from Covid-19, training, cargo safety, climate and weather conditions, security culture and communication.

The thematic approach highlighted the interconnected nature of port safety and security, emphasizing the need for coordinated actions across various areas and collaboration among responsible individuals. The project emphasized that safety and security concerns may manifest differently depending on roles and tasks within companies. Community-wide engagement was identified as a crucial factor, spanning from individual company personnel to the entire port community.

The project conducted interviews across companies and staff levels to assess the current situation comprehensively. The extensive data was analysed through the lenses of the chosen themes, and workshops were conducted to address issues that resonated with the interviewees. Based on the outcomes, a roadmap document (in Finnish) was published, providing guidelines and recommendations for developing collaborative safety among port actors.

South-Eastern Finland University of Applied Sciences Emmi Rantavuo
Etelä-Kymenlaakso Vocational College Niklas Paasalo
Kotka Maritime Research Association Annukka Lehikoinen & Piia Nygren

More information: merikotka.fi/en/projects/safe-secure-logistics



Digital Merikarhu 2.0

In the Digital Merikarhu 2.0 project, the possibilities of automation, machine learning, and intelligent systems were explored to support the improvement of the fuel economy and cost-effective reduction of emissions on the training ship Merikarhu. During the project, the automation system of Merikarhu was updated to meet contemporary requirements, and a network of systems was created to collect necessary data related to navigation and fuel calculations. This enables the long-term analysis of data collected from the training ship, ultimately optimizing fuel efficiency.

Various digital learning environments were developed in the project to support education on Merikarhu and continuous learning beyond the training periods. This allows for the advancement of teaching and training in a more modern direction while accommodating various learning styles of students. In collaboration with the Port of HaminaKotka and the The Kymenlaakso Rescue Department digital exercises for oil spill response and firefighting were created. These exercises complement on-site training and serve as orientation material for new employees.

Etelä-Kymenlaakso Vocational College Antti Avelin, Anssi Avelin, Kalevi Laine & Jori Spännäri
Kotka Maritime Research Association Miina Karjalainen & Anna Kiiski

More information: merikotka.fi/merikarhu

KymVaKe

This regional project, initiated in November 2023, aims to strengthen local cross-sectoral preparedness cooperation and expertise in the Kymenlaakso region, South-Eastern Finland. Its focus areas include cybersecurity, power supplies, and logistics. The goal is to enhance cybersecurity expertise and collaboration within the region's businesses, develop a simulation model for electricity production, storage, and distribution, and conduct digital security and preparedness exercises. KymVaKe collaborates with stakeholders to create relevant scenarios for preparedness exercises. Additionally, a digital scenario-based exercise platform is being developed in the project. The objective is to facilitate readiness and preparedness efforts for companies, NGOs, educational institutions, and authorities through digital exercises.

South-Eastern Finland University of Applied Sciences Anni Lippo, Jaakko Haapamäki, Riku Heino, Janne Niinisaari & Väinö Petrell
Kotka Maritime Research Association Annukka Lehtikoinen, Piia Nygren & Emilia Pussinen

More information: merikotka.fi/projects/kymvake

OPEN RISK II

The newly started three-year project focuses on providing new, practical and user-centered risk management tools to support the competent authorities in preventing maritime accidents, minimizing their human and environmental consequences and improving the quality of overall maritime risk management, the latter also for other modes of transport.

Aalto University Osiris Valdez Banda
Helsinki University Sakari Kuikka

More information: interreg-baltic.eu/project/openrisk-ii

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Indicators



Personnel

4 professors
28 members in research network



Publications

1 PhD dissertation
30 scientific peer-reviewed articles
2 in the KMRC publication series



Projects

16 ongoing research projects



Budget

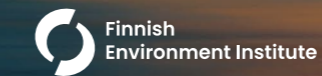
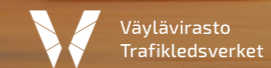
7,1 M€ total budget of project portfolio
184 stakeholders involved

MARETARIUM

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METSÄHALLITUS





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