

Real-Time Risk Modelling for Autonomous Ships

AUTONOMOUS SHIP
Integrated authentication
system Document Technology
Integrated system



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Introduction to Hyungju

Educational Background and Work Experience



- **PhD:** Department of Mechanical and Industrial Engineering, NTNU (2016)
(Maritime Safety - An analysis of accident causation and measures for reducing risk at sea)



- **Naval Architect:** SAMSUNG Heavy Industries, South Korea (2004 – 2012)
(Cruise & Ferry Design Team + Sea Trial Department)



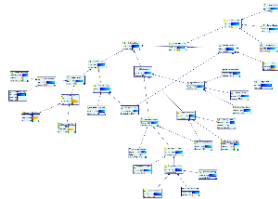
- **Master & Bachelor:** Naval Architecture and Ocean Engineering
(Seoul National University, South Korea)

Main Research Area

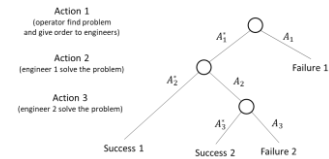
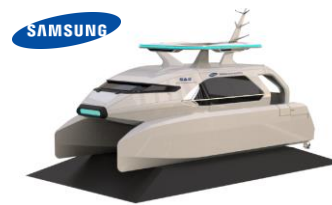
- Risk analysis for zero-emission vessels and autonomous ships



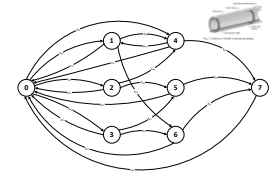
Barrier Analysis for Autonomous Ferry



Real-time Risk Model for Autonomous Ship



Human Factor for Autonomous Ferry



QRA for Ammonia fuelled ship

About KASS Project

KASS Project



<https://www.youtube.com/watch?v=ug-FzWj8lIQ>

Development of Autonomous Ship Technology Outline

Project

Development of Autonomous Ship Technology

Host Ministry

Ministry of Oceans and Fisheries & Ministry of Trade, Industry and Energy (joint promotion)

Business Period

2020~2025 (6 years: Technology development in year 1~4 and demonstration/operation in year 5~6)

Operating Costs

Total 1,603.16 Billion KRW
(Governments 1,196.64 Billion, Local Governments 45 Billion, Private Capital 361.52 Billion)

Purpose

- 1) Development of **core technology** for autonomous ships
- 2) Establishment of **basis for commercialization** through step-by-step demonstration
- 3) Core technology for autonomous ships:
 - ① Intelligent Navigation System
 - ② Machinery Automation System
 - ③ Performance Demonstration Center and Demonstration technology
 - ④ Operational Technology and Standardization
- 4) Based on Commercialization: International navigable medium-sized autonomous ships
(ocean IMO level 3, coastal IMO level 2)






















* 2 general tasks, 4 core technologies, 13 detailed tasks (51 participating organizations)

Consortium

Shipping sector

 KAIST	 Changwon National University	 Pukyong National University	 Inha University
 Seoul National University	 UANGEL	 NSONESOFT	 SAMSUNG Heavy Industries
 SYNC TECHNO	 Korea Register	 COMESTA, Inc.	 ACE Technologies
 i-Storm	 Penta SECURITY	 T1 Information Technology	 Korea Maritime Institute
 Korea Maritime & Ocean University	 GMT	 KJ Engineering	 Sea net
 Scanjet	 Leeyoung SND	 Marine Tech	 Pudan National University
 Korea Institute of Maritime and Fisheries Technology	 Mokpo National Maritime University	 University of South Eastern Norway	 Global Control Systems Inc.
 KIMS	 KL Net	 SEADRONIX	 Marineworks
 Korea NonDestructive Examination	 ADIA LAB	 Korea Maritime Transportation Safety Authority	 Korea Marine Equipment Research Institute

Shipbuilding sector

 Korea Research Institute of Ships & Ocean Engineering	 KAIST	 SafeTechResearch	 SEADRONIX
 XR Solution	 Innosimulation	 KL Net	 DSME CONSTRUCTION CO. LTD.
 Mokpo National Maritime University	 Ajou University	 HMM Ocean Service	 Lab021
 Inha University	 POS SM	 Korea Institute of Machinery & Materials	 Electronics and Telecommunications Research Institute
 Korea Register	 XINNOS	 Lloyd's Register	 Korea Maritime & Ocean University
 KOREA SHIPBUILDING & OFFSHORE ENGINEERING	 SAMSUNG Heavy Industries		

Vision of KASS Project

Vision

Taking the lead on future market share and international standards by developing technologies for the autonomous ships

Autonomous navigation systems
 Level 2(coastal) & 3(Ocean)

Global level reliability(99.9%)
 & standardizations(36cases)
 (IACS cert. / cyber security CS2 level)

Autonomous ship
 Leading on market share

National
 R&D project
 (2020~2025)

Operation techniques & Standardization (3 Sub-project)



Autonomous navigation system
 (3 Sub-project)



Autonomous engine system
 (2 Sub-project)

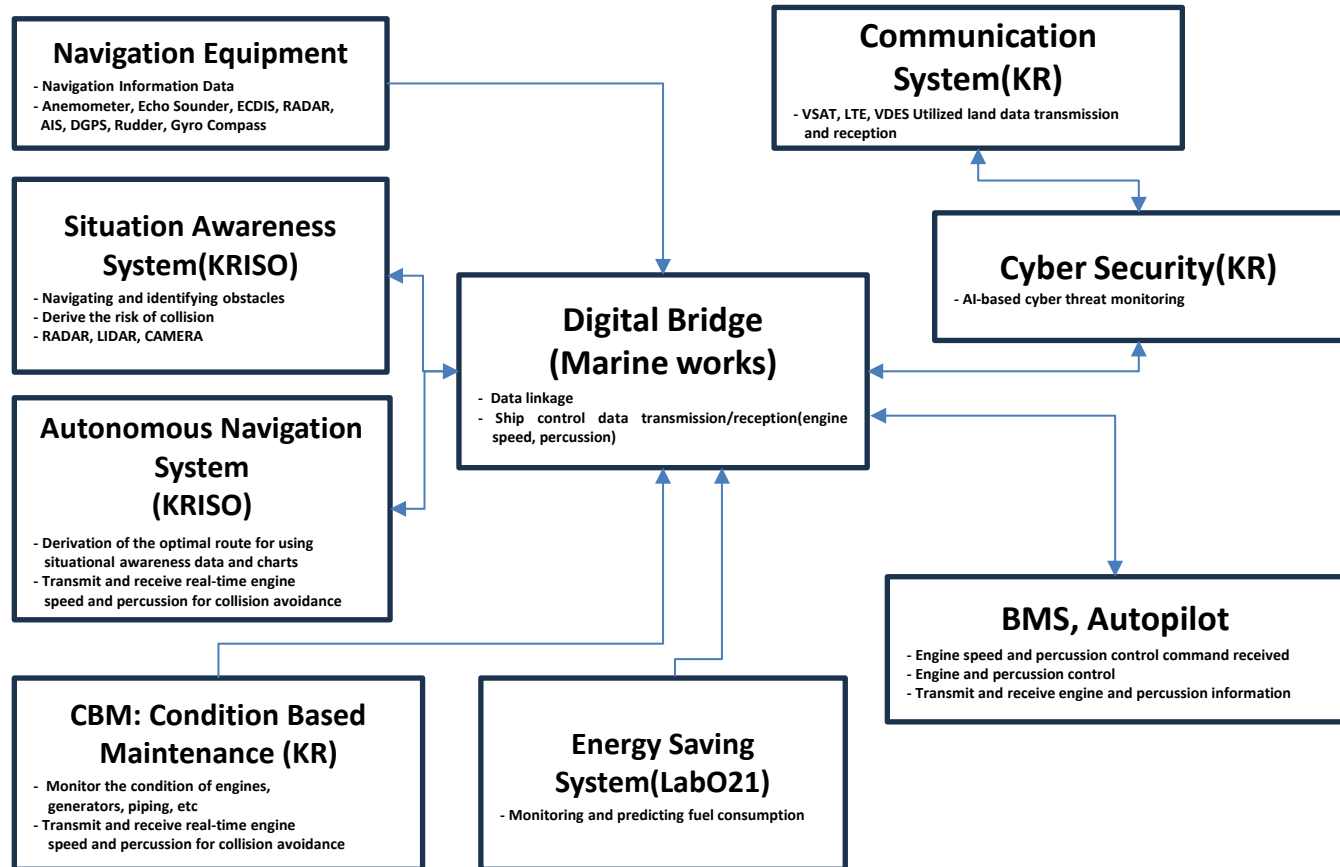


Sea Test-bed & Validation
 (5 Sub-project)

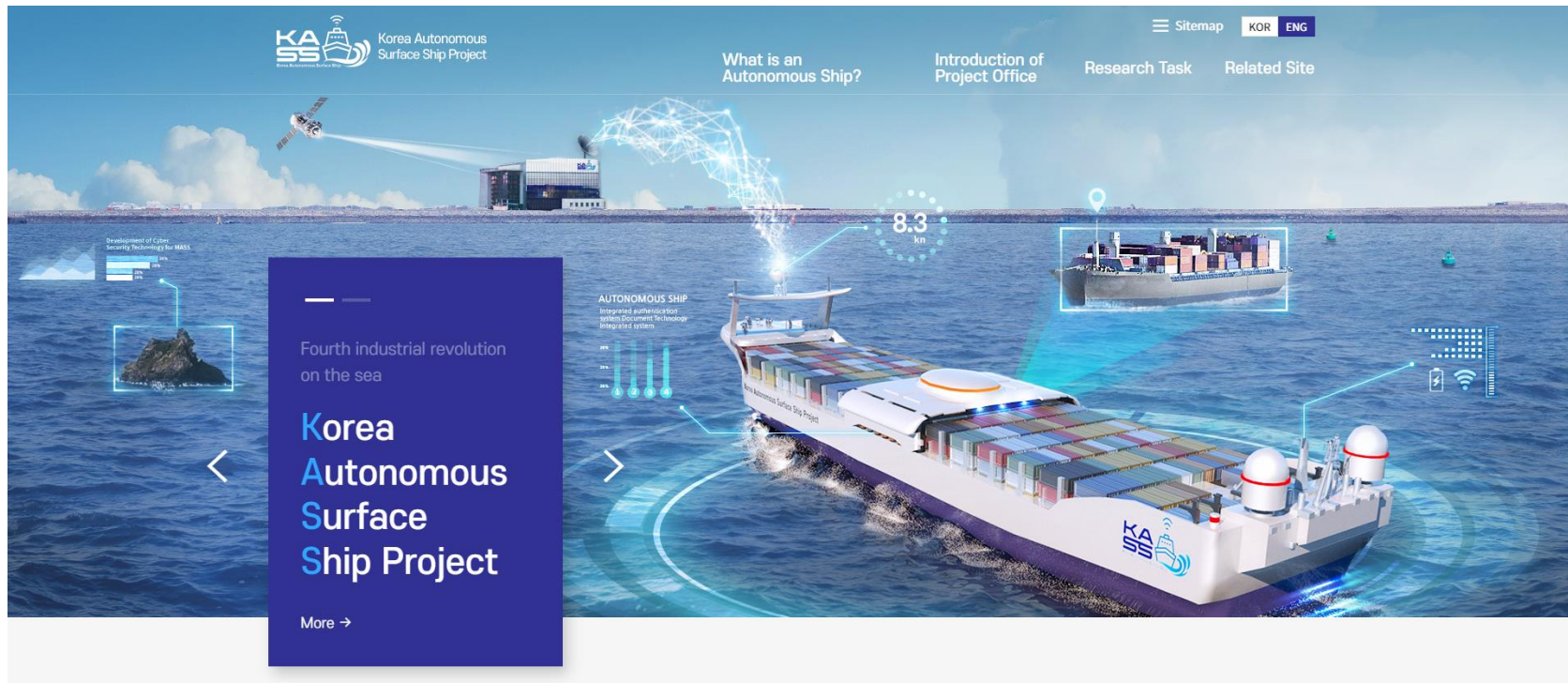
Four Core Technologies

1. Intelligent Navigation System			2.Engine Automation System		3. Performance Demonstration Center and Demonstration technology					4. Operational Technology and Standardization		
Autonomous Navigation System	Situational Awareness System	Digital Bridge	CBM	Energy Saving System	Testbed	Performance Demonstration	Communication System	Cyber Security	Remote Control System	Incident Response System	Operating Technology	Standardization
Development of Autonomous Navigation System with Intelligent Route Planning Function	Development of a Situational Awareness System for Preventing Collisions and Accidents	Development of Integrated Platform & Digital Bridge for Autonomous Navigation, Control of Engine Room	Development of Performance Monitoring, Failure Prediction and Diagnosis Technology for Engine System of Autonomous Ships	Development of Integrated Management and Control System for Energy Saving	Development of Verification and Validation Testbed for Autonomous ships	Development of Validation and Verification Technique for Intelligent System of Autonomous Ships	Development of the next Digital Communication Technologies for Ship2Ship2-Shore	Development of Cyber Security Technology for MASS	Development of Shore Remote Control System of MASS	Incident Response System and Reliability Assessment for Autonomous ships	Development of Remote Management and Safe Operating Technology of Autonomous Navigation System	Development of International Standardization Technology for Autonomous Ships
KRISO SNU, UANGEL, KAIST, Changwon Univ, Pukyong Univ, Inha Univ, KSOE, Samsung Heavy Industries	KRISO KAIST, STR, Sea Dronix		KR Lab021, KL-NET, Lloyd's Register, Inha Univ, Mokpo maritime Univ, Innosimulation, XR Solution, DSME, HMM, POSSM		KRISO KR, ETRI, XINNOS	KRISO STR, XINNOS, Lloyd's Register, Mokpo Maritime Univ, KSOE, Samsung heavy Industries	Sync Techno KR, COMESTA, ACE-TECH, KMOU	Penta SECURITY KR, KMI, T1 IT	KMOU KRISO, GMT, SEANET, KJE, NSONESOFT	Scanjet Macron KRISO, KR, LEEYOUNG SND, Marine Tech IN, KSOE, Busan Univ, Mokpo Maritime Univ, USN	KR Busan univ, GCSC, KNDE, Sea-Dronix, KL-NET, KOM Univ, Marineworks, RIMS, ADIA Lab	KMI KOMSA, KR, KIMFT, KRISO, KOMERI

KASS System



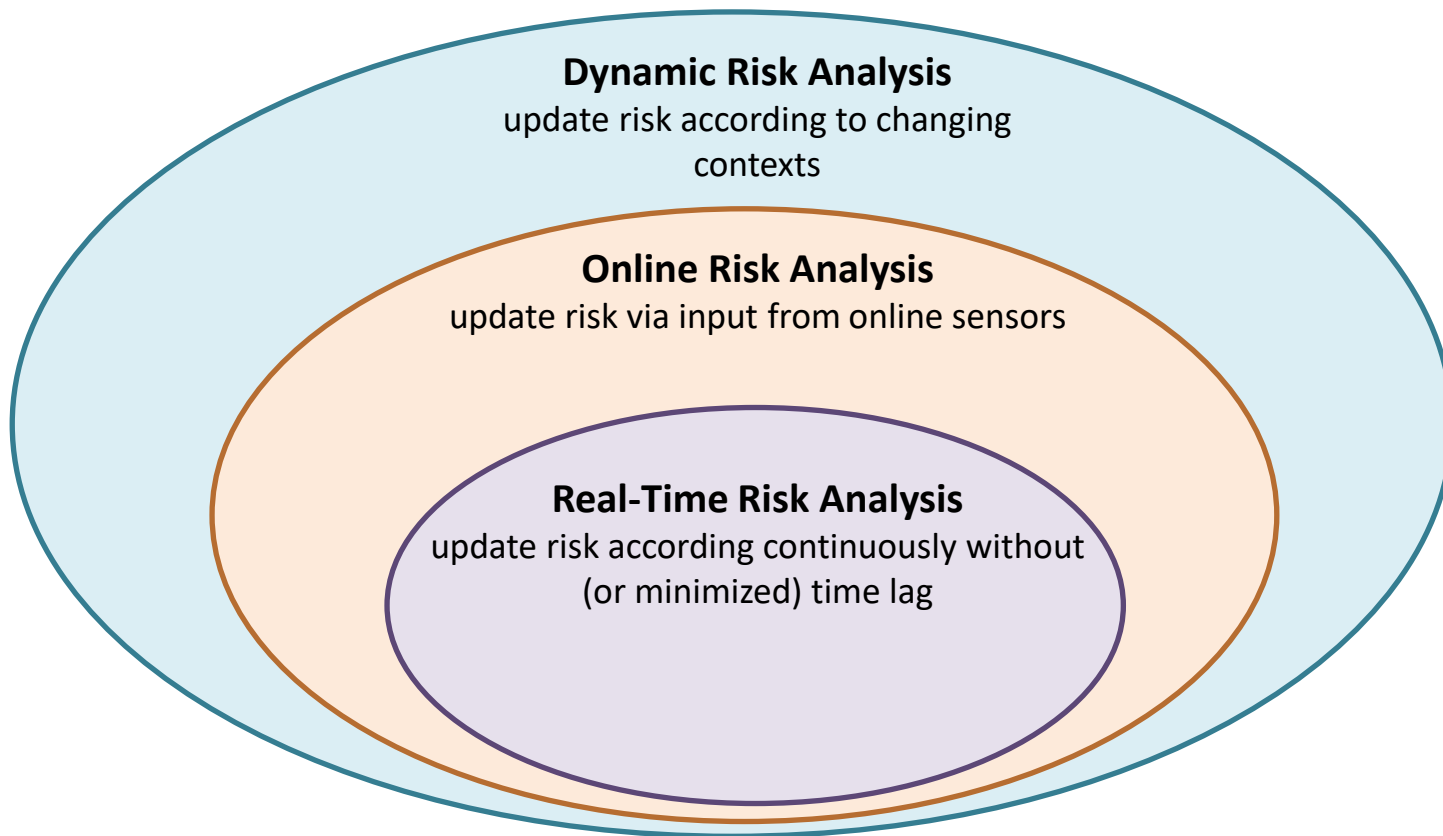
For More Information about KASS Project



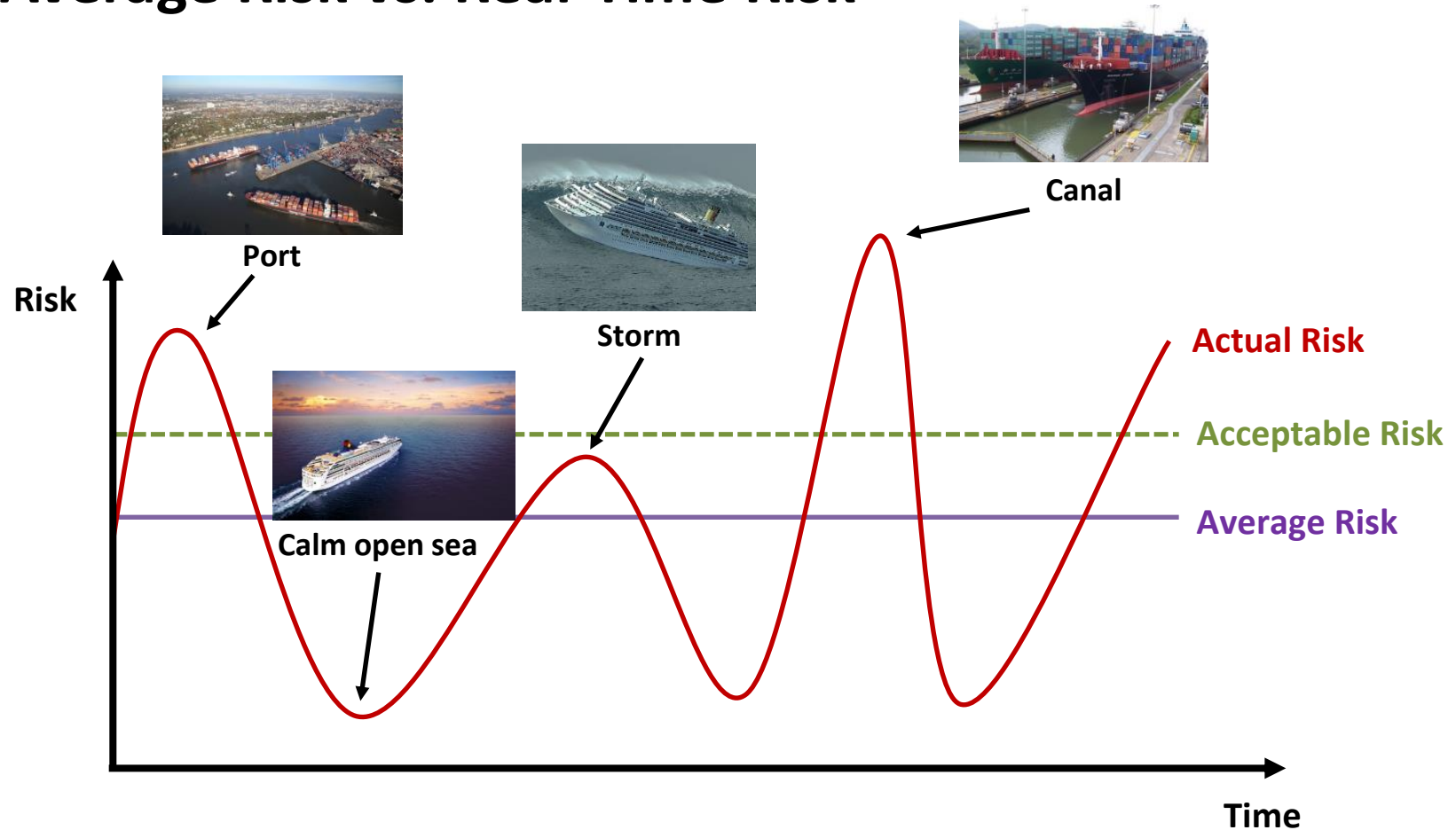
<https://kassproject.org/en/main.php>

Real-Time Risk Analysis

Dynamic / Online / Real-Time Risk

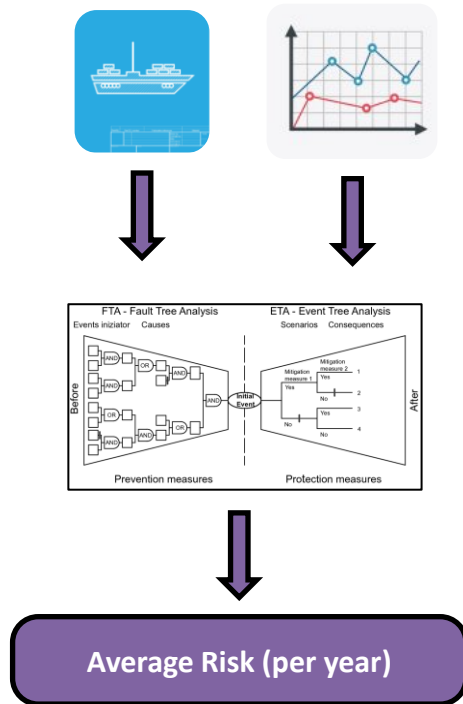


Average Risk vs. Real-Time Risk

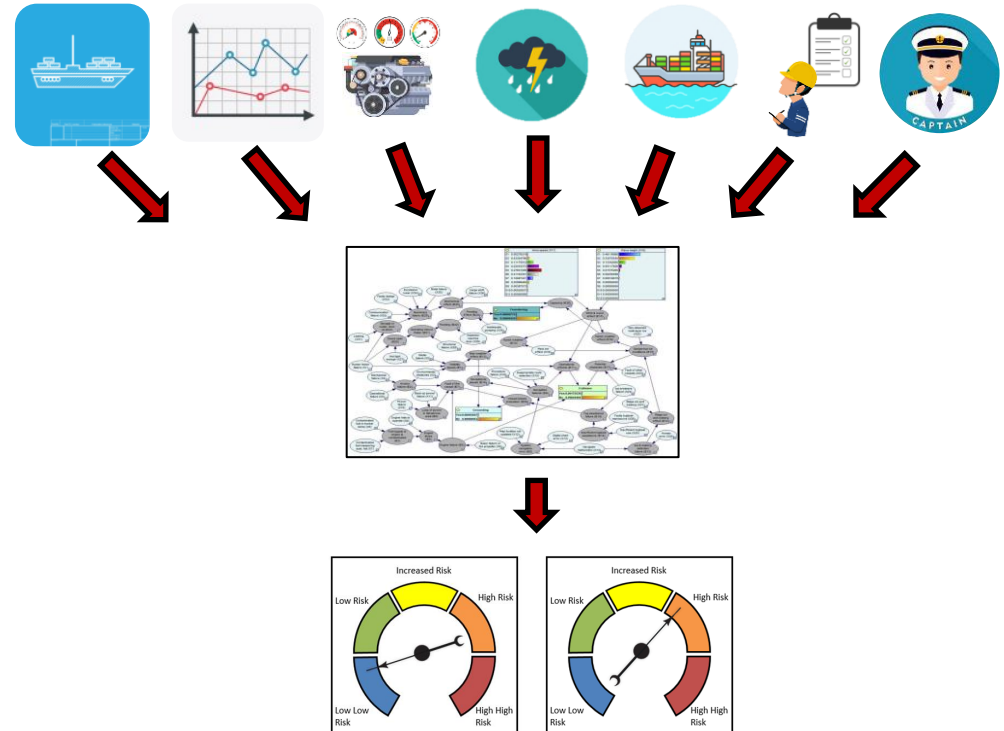


Average Risk vs. Real-Time Risk

Average Risk

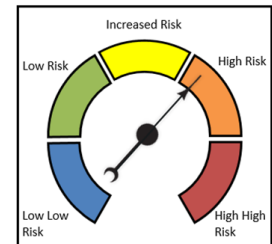
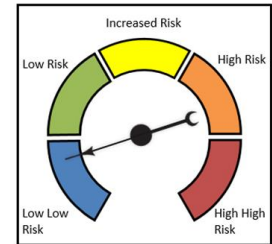


Real-Time Risk

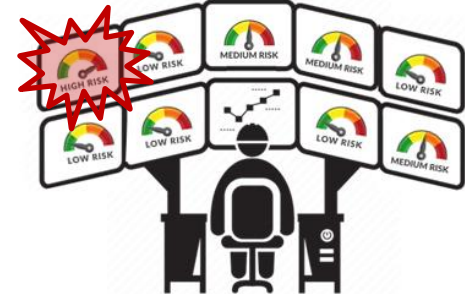


Average Risk vs. Real-Time Risk

	Average Risk	Real-Time Risk
When?	Before operation (in design stage)	Continuously during operation
Input	Historical data and/or expert judgement	Historical data and/or expert judgement + Real time condition
Outcome	Static and average risk	Risk at a specific time (average in a short period of time)



Real-Time Risk for Autonomous Ships

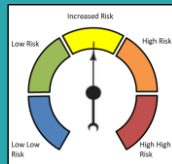


Real-Time Risk Modelling and Software

Real-Time Risk Case Example

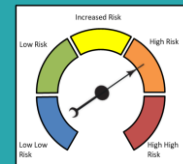
Case 1

Navigation System ... OK
 Propulsion System ... OK
 Communication System ... OK
 ⋮

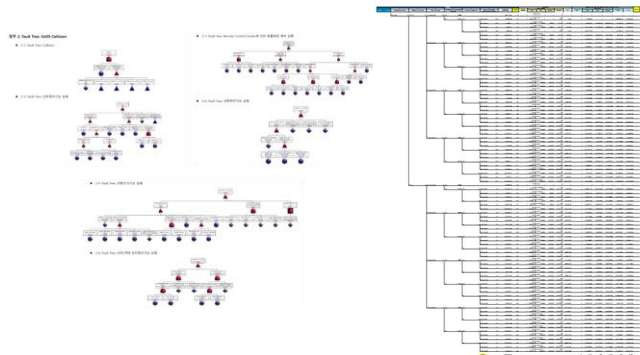


Case 2

Propulsion System ... Partial Failure
 Communication System ... Complete Failure
 Visibility Condition ... Bad
 ⋮



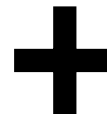
Input for Real-Time Risk Model



HAZID & FTA & ETA by Korea Register

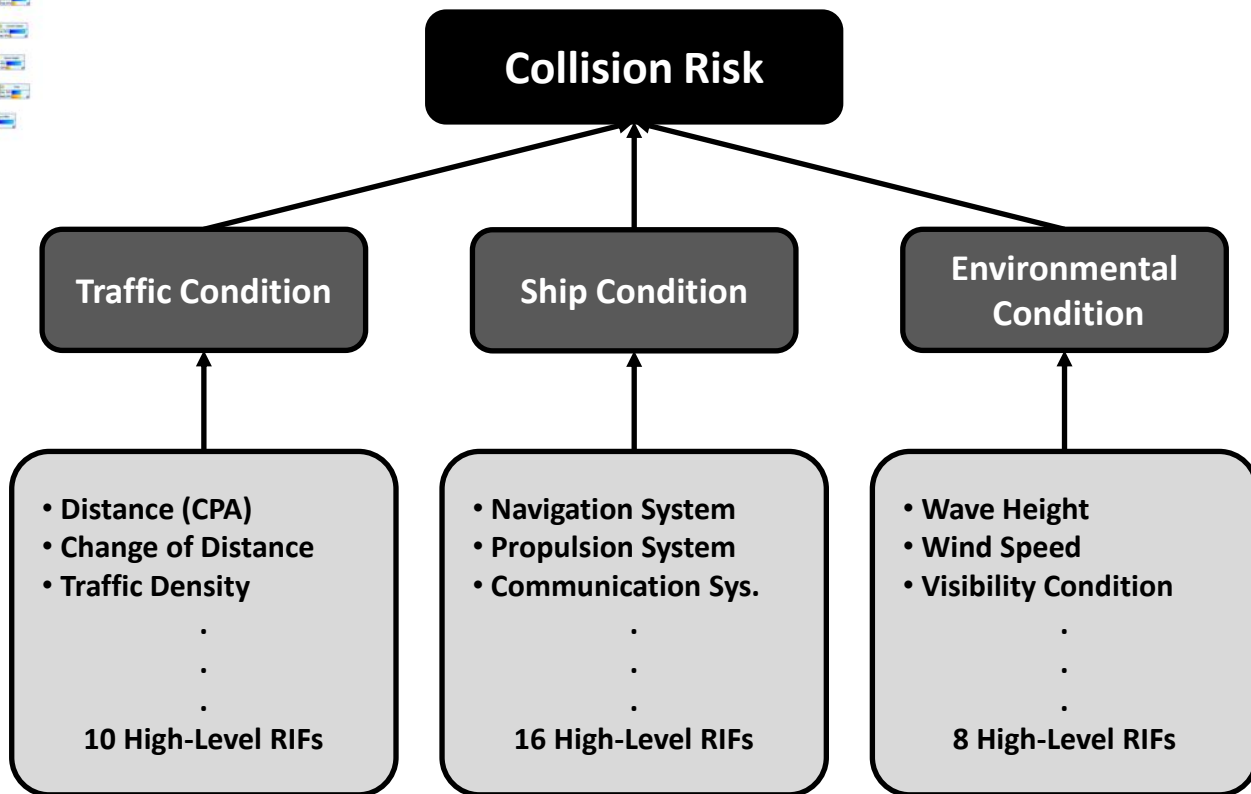
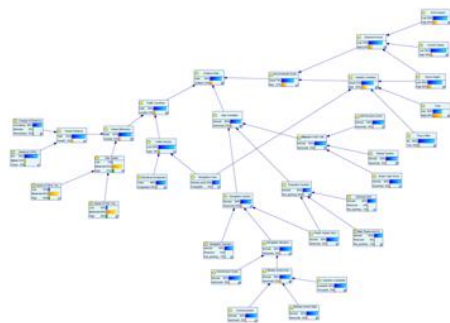


Literatures

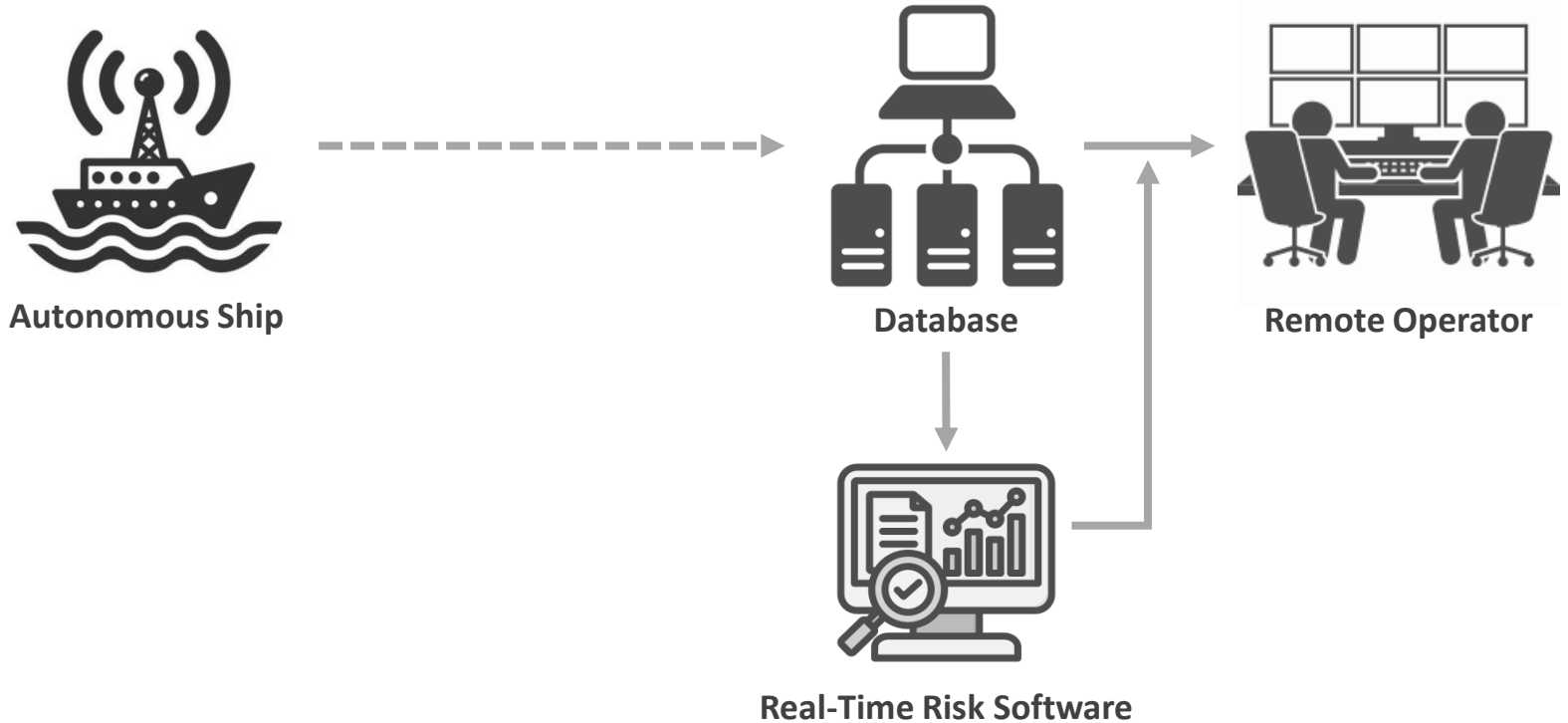


Expert Opinion

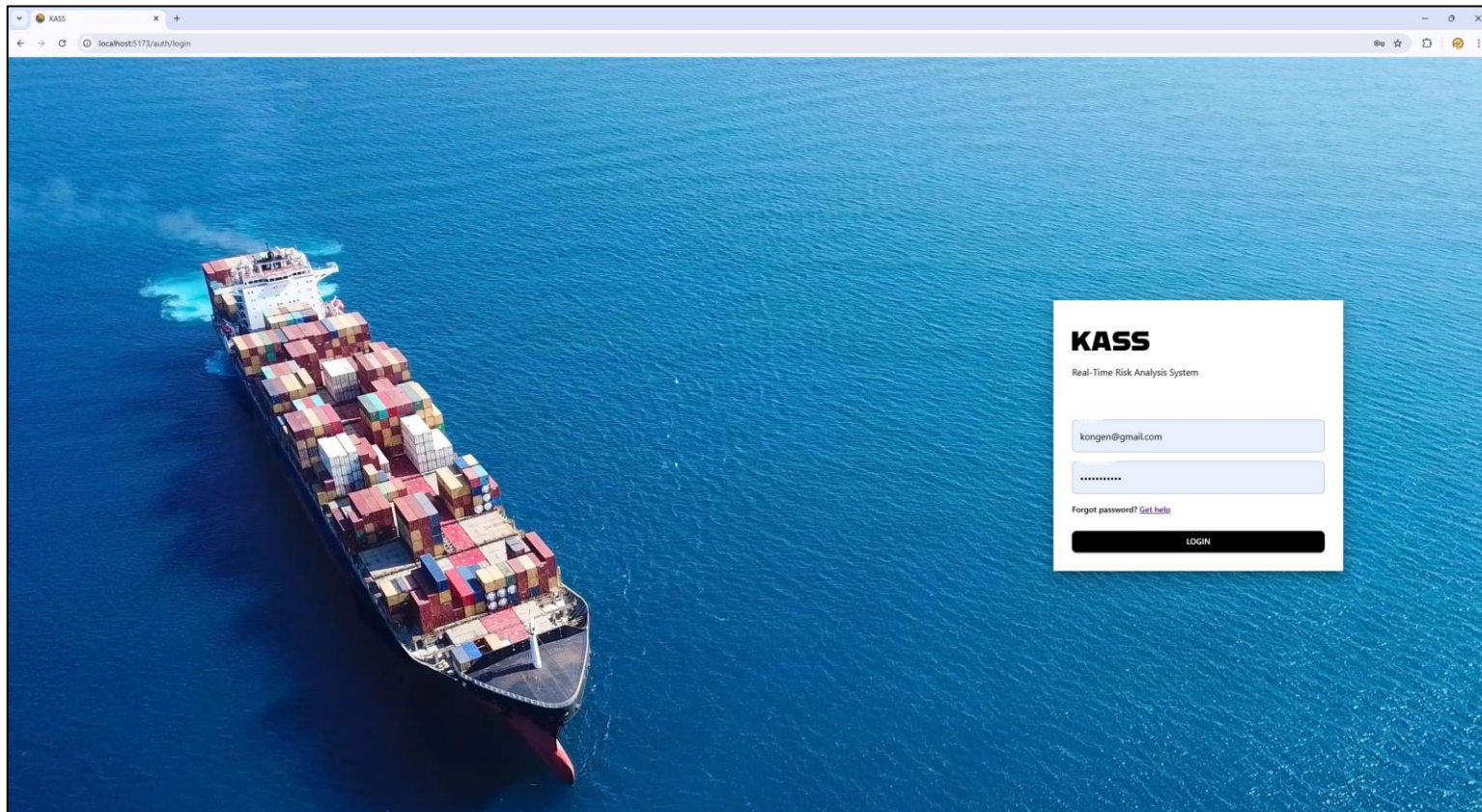
Real-Time Risk Modelling using Bayesian Network



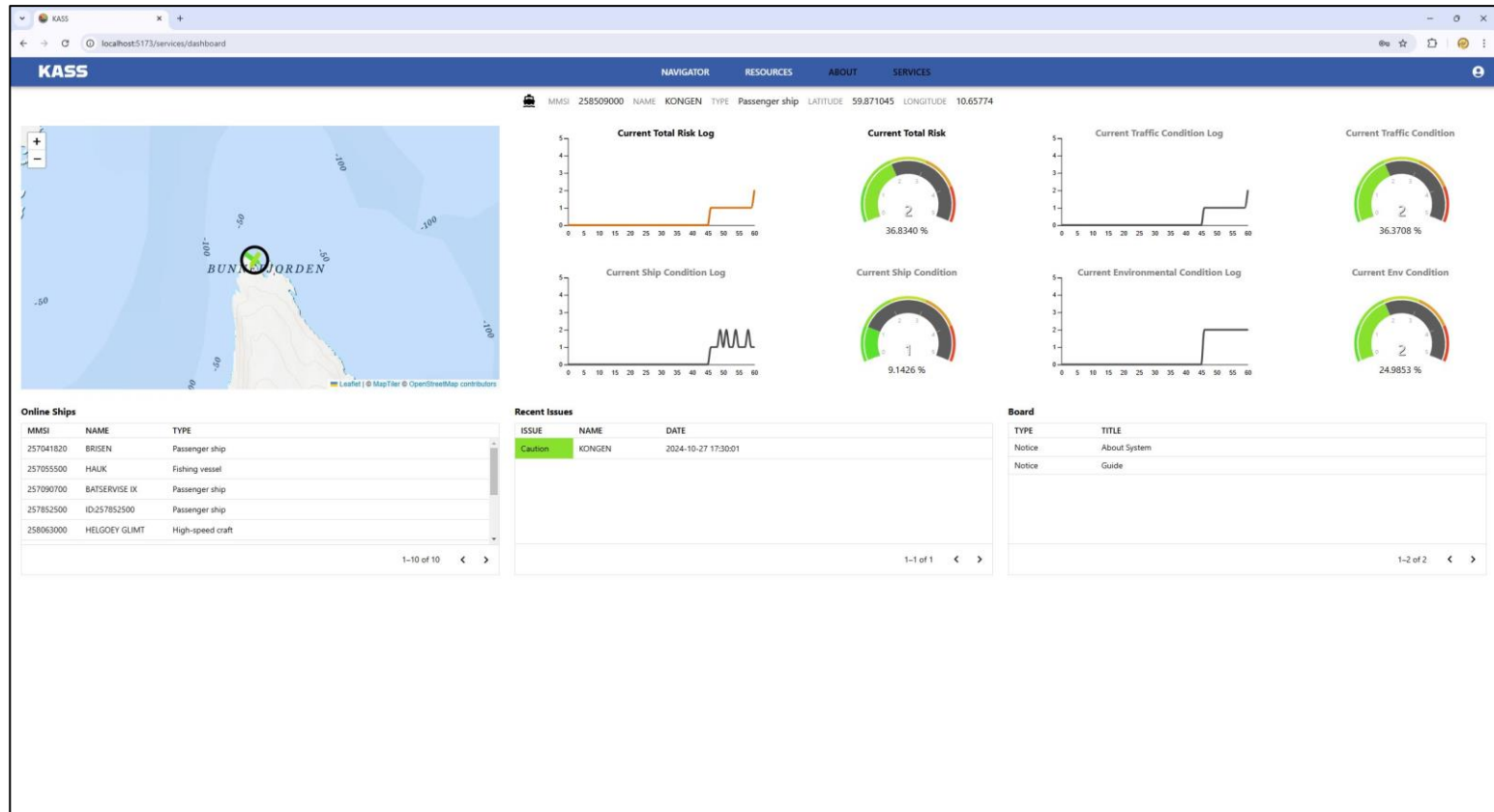
Development of Real-Time Risk Software



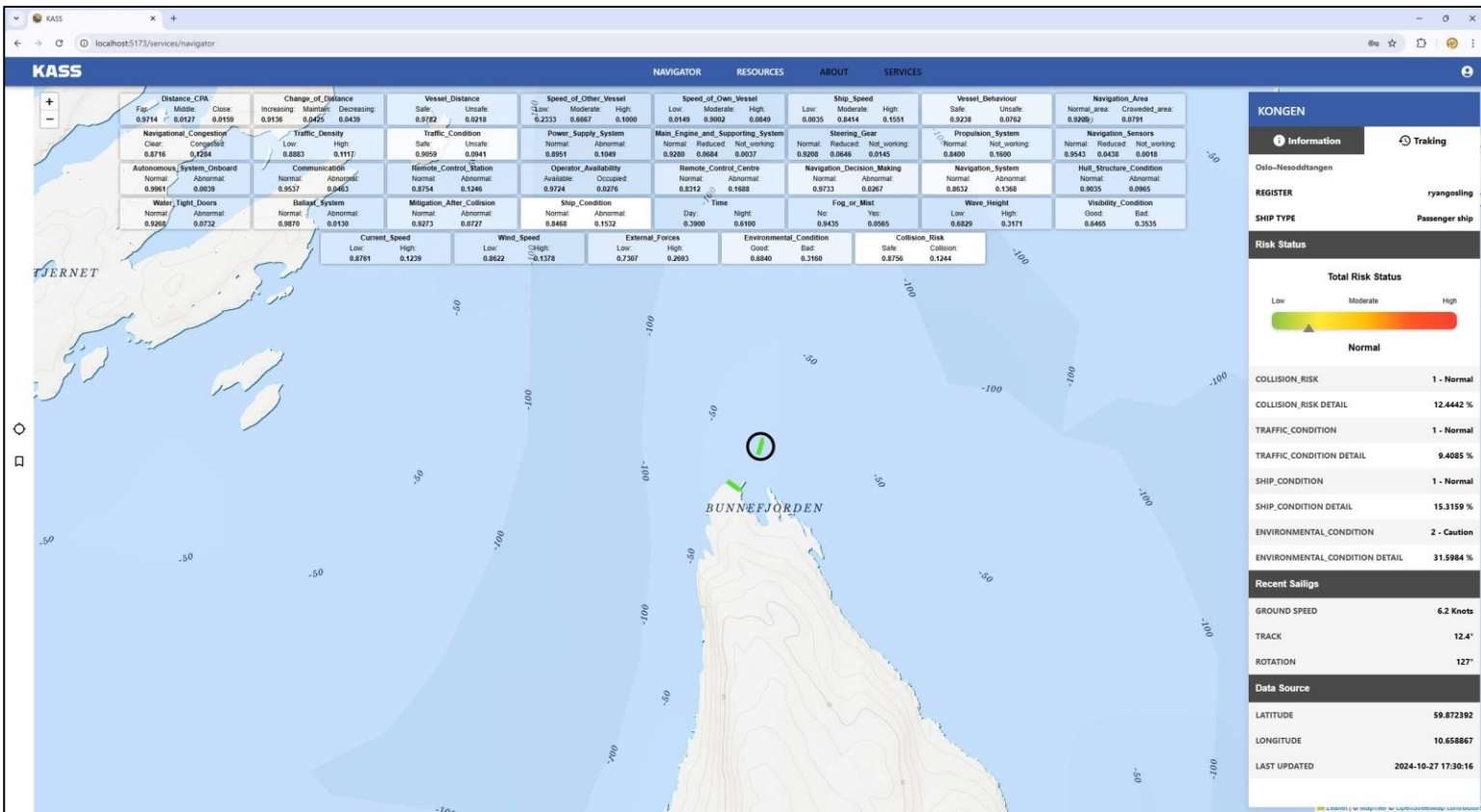
Web Application



Development of Autonomous Ship Technology Outline



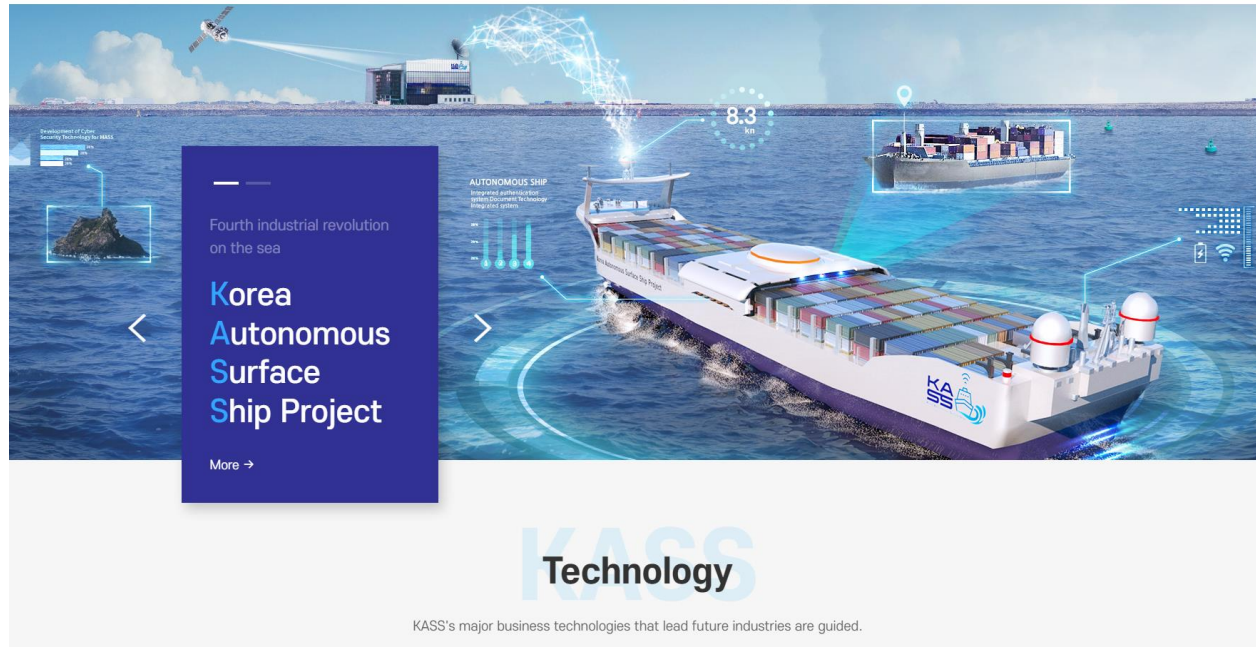
Development of Autonomous Ship Technology Outline



Concluding Remarks

FOR A SAFER WORLD





Acknowledgement

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*Thank
you!*

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