Feb. 18, 2016

A Big Data Roadmap for Oceans & Fisheries

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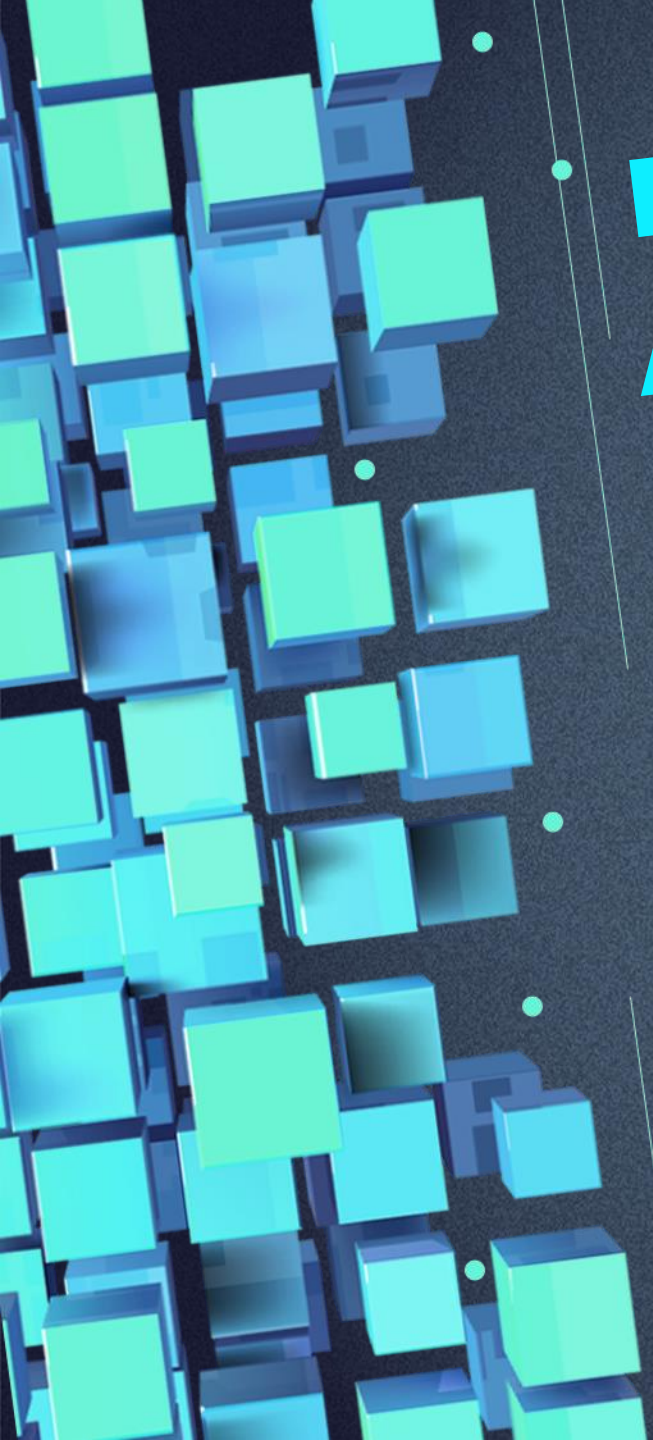


해양수산부
MINISTRY OF OCEANS AND FISHERIES

I. Social Issues in Maritime Affairs and Fisheries

II. Status on Data and its Services for Maritime Affairs and Fisheries

III. Goal and Strategy

IV. Status on Implementing Projects Utilizing Big Data

» Solutions to social problems

News article/ Date/ Media source	Pending issues	Solutions
Article contents: Ship capsizing Reported article: The capsizing of Dolgorae caused widespread alarm to monitor and manage fishing boats Date: Dec. 5, 2015 Media source: YONHAP NEWS	• Information not provided on the areas of high accident risk or safer areas according to marine climate conditions • Lack of information provided for safety lane setup between sea routes	• Support decision making for safety lane setup by providing information on maritime safety map
Article contents: Ship capsizing Reported article: A ferry carrying 471passengers sinking off in the sea off Jindo Date: April 16, 2014 Media source: YTN		
Article contents: Hazardous materials management Reported article: Poor management of ports reminded of the explosion in Tianjin, China Date: Oct. 4, 2015 Media source: NEWS 1	• Poor management of places for storing harmful chemical substances	• Prevent accidents occurring through integrated management of containers storing dangerous substances in ports
Article contents: Damages caused by red tide Reported article: A widespread high-density damage caused by red tide this year that amounts to KRW 5.6 billion Date: Dec. 11, 2015 Media source: KBS NEWS	• Material damages of fish farms caused by red tide • Occurrence of widespread high-density red tide	• Prevent damages with real-time monitoring and occurrence and area prediction of red tide based on big data
Article contents: Eutrophication effects of fish farms Reported article: Find out the cause of red tide Date: Aug. 8, 2013 Media source: Hwankyung Ilbo	• Occurrence of red tide due to eutrophication every summer • Mass mortality of farmed fishes due to red tide	• Prevent red tide occurring through predicting trophic state index based on big data

II. Status on Data Generator Types and Services for Maritime Affairs and Fisheries

Name of the Institution	Data Acquisition/ Generator Types	Information Portal	Information Center	Services
Korea Hydrographic and Oceanographic Agency	• Information on oceanographic observation (water temperature, wave height, wind speed…) • Information on nautical charts, maps and current charts • Navigational information • Coastal hazard vulnerability map • Depth information • Geomagnetic charts • Information on coastlines and harbor limits	• Real-time oceanographic observation information portal • Internet broadcast portal of marine information • Grid-type marine information management system • Total oceanographic information system	• National Marine Data & Information Service Center	• Grid-type marine information service • Notice/ warning to mariners • Marine forecasts, application forecasts • Information delivery service
Fisheries Management Service	• Information on fishing, illegal fishing and fishery inspection boats	-	• Fisheries Monitoring Center (FMC)	• Fishing operation map
Regional Office of Oceans and Fisheries	• Information on oceanic environment • Information on nautical marks • Integrated information on particular ships	• Port Management Information System (PORT-MIS)	• Vessel Traffic Service Center • Shipping & Port Integrated Data Center	• Nautical mark • Marine accident forecast • Maritime education
National Institute of Fisheries Science	• Information on oceanographic observation and research • Information on red tide • Information on satellite oceanography • Information on fishery resources • Information on aquaculture research • Information on life resources • Real-time fisheries information	• NIFS • Ocean science and fisheries information system • Real-time fisheries information portal • Red tide information system	• National Aquatic Organisms Genome Information Center • Fish Disease Control Center • Korea Oceanographic Data Center (KODC)	• Forecasting on oceanographic and fishing conditions • Breaking news for red tide, shellfish toxin and jellyfish • Radioactive monitoring • Breaking news for abnormality
Port Authority	• Container schedule information • Information on ship's entry/ departure • Control information • Information on receiving dangerous goods • Current status on cargo volume	• IPUS Incheon Port Portal	-	• Terminal congestion service • Statistical information service • Earthquake monitoring
Korean Register	• Information on ship's technical data • Information on specialized suppliers • Information on ship technology	-	-	• Ship technology inspection • Technical support service • Inspection service on behalf of government
Korea Coast Guard (Ministry of Public Safety and Security)	• Disaster safety information • Statistics of crackdowns on illegal fishing • Statistics of occurrences of maritime crimes	• Total water sports information	-	• Busan safety broadcasting • Emergency disaster SMS

III. Goal and Strategy (Big Data)

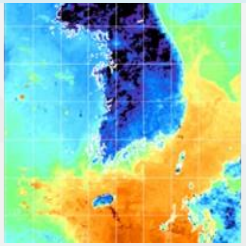
Goal

Aiming to become the Ministry of Oceans & Fisheries that predicts changes

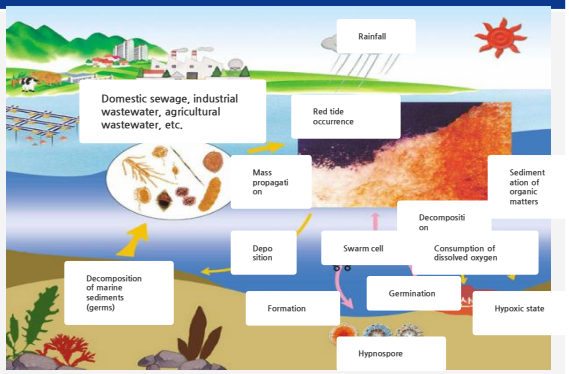
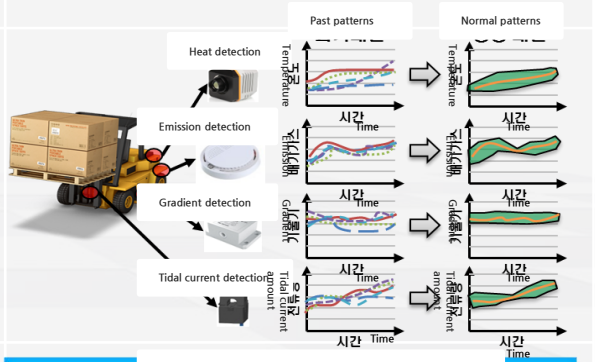
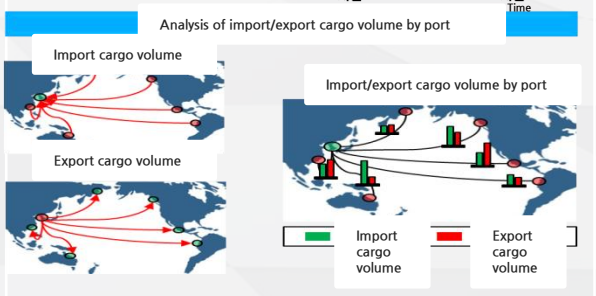
Strategy

- Acquisition of accurate big data
- Analysis of scientific big data
- Forecasting services utilizing big data
- Provision of an integrated system for big data

IV. Status on Implementing Projects Utilizing Big Data

Name of the implementing project	Data elements	Applicability	Note
Tourism service for beacon-based smart fishing villages (tourism)	• Gender, age and residence of the floating population • Weather information • Location information on tourists' movements • Personal identification	• Service of acquiring and providing information for scientific and systematic analysis of visitors to fishing villages • Able to provide an advanced tourism service by utilizing it in policies for attracting tourists • Increase incomes through revitalizing tourism in fishing villages	
Development of diagnostic and forecasting system for vessel failures through analysis of ship's motion patterns (maritime safety)	• Engine movement data • Ambient temperature/ humidity data • Weather data including wind direction, wind speed, wave height, etc. • Tidal current data including current direction, current speed, variation in current speed, etc. • Ship location data	• Able to prevent ship accidents and minimize damages by detecting and predicting accidents based on past sensor data analysis • Utilized in improving weakness of each institution by providing failure patterns by institution	Engine movement sensor Temperature/ humidity sensor Water sensor Smoke sensor GPS sensor Electronic power flow sensor Gradient sensor Motion detection sensor
Pattern analysis of wave heights according to marine weather and development of a system for maritime safety map construction (maritime safety)	• Ship data including ship types, length, width, etc. • Weather data including wind direction, wind speed, wave height, etc. • Ship gradient data • Tidal current data including current direction, current speed, variation in current speed, etc.	• Utilized in preventing ship accidents and setting up Korea Coast Guard's patrol plans by providing maritime safety map • Utilized in preventing ship accidents through ship moving route recommendation service	Generation of safety lane information
Development of monitoring and forecasting system for changes in water temperature according to the season (fisheries)	• Oceanographic observation data including trophic state index, ocean current, etc. • Water temperature/ surface water temperature data • Degree of clearness data • Weather data including sunshine amount, sunshine time, etc. • Observation location data	• Utilized in minimizing damages caused by abnormality through abnormality alert service based on monitoring changes in water temperature • Utilized in setting up management plans for farming fishery through water temperature forecasting service according to the season	Monitoring and forecasting of Temperatures sea water 

IV. Status on Implementing Projects Utilizing Big Data

Name of the implementing project	Data elements	Applicability	Note
Development of a system for monitoring red tide occurrence and forecasting damages (Fisheries)	• Red tide creature data • Red tide history data including date, place, etc. of red tide occurrence • Weather data including sunshine amount, wind direction, wind speed, etc. • Oceanographic observation data including water temperature, ocean current, etc.	• Utilized in minimizing red tide damages through forecasting service on diffusion range based on red tide history data analysis • Utilized in minimizing red tide occurrence and prevention through forecasting service for red tide occurrence	
A system for inspecting and analyzing smart port's safety efficiency based on big data (port)	• Specification data of unloading equipment including types, load capacity, etc. • Electric power flow data of unloading equipment • Emission data of unloading equipment • Gradient data of unloading equipment • Heat generation data of unloading equipment	• Utilized in managing unloading equipment and preventing accidents through diagnosis service for failures of unloading equipment based on data pattern analysis by sensor • Utilized in operating high-efficient unloading equipment through diagnosis service for energy efficiency of unloading equipment	
A system for forecasting and analyzing containers' cargo volume demand (logistic)	• Departure/ arrival data of cargo volume by port • Route data by ship • Logistics carrying capacity data by ship • Facility status data by port • Road traffic data of surrounding areas of ports	• Utilized in easing traffic congestions through forecasting service for road traffic congestions near the port • Utilized in setting up ship operation plans through forecasting service for transit shipment cargo volume by port	

1. Setting Up Tourism Service for Beacon-based Smart Fishing Villages (Tourism)

A concept map of system for analyzing the floating population

Public data
Fishing village
Weather, holiday, map, etc.
Private big data
Communication data

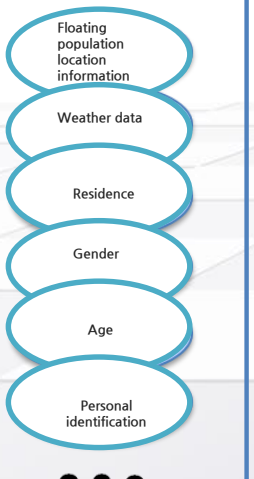
→

Big data of the floating population
Handling/ analysis/ statistics/ processing
Basic information of fishing villages

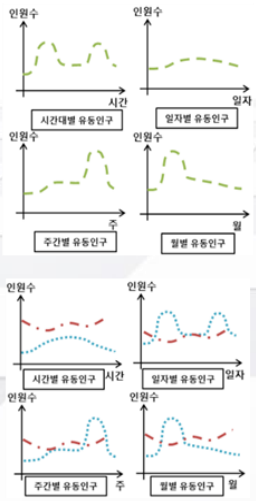
→

Analysis services
Reports
Map based
Charts, graphs
User input inquiry

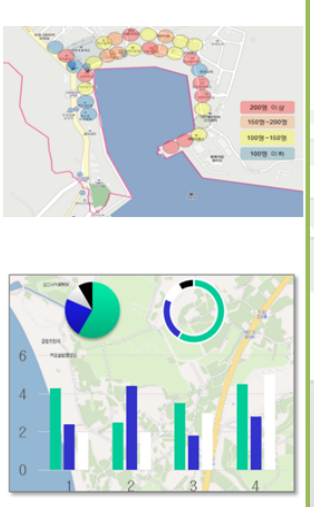
Collected Data of the floating population



Floating population location information



Visualization of analysis/ forecasting results



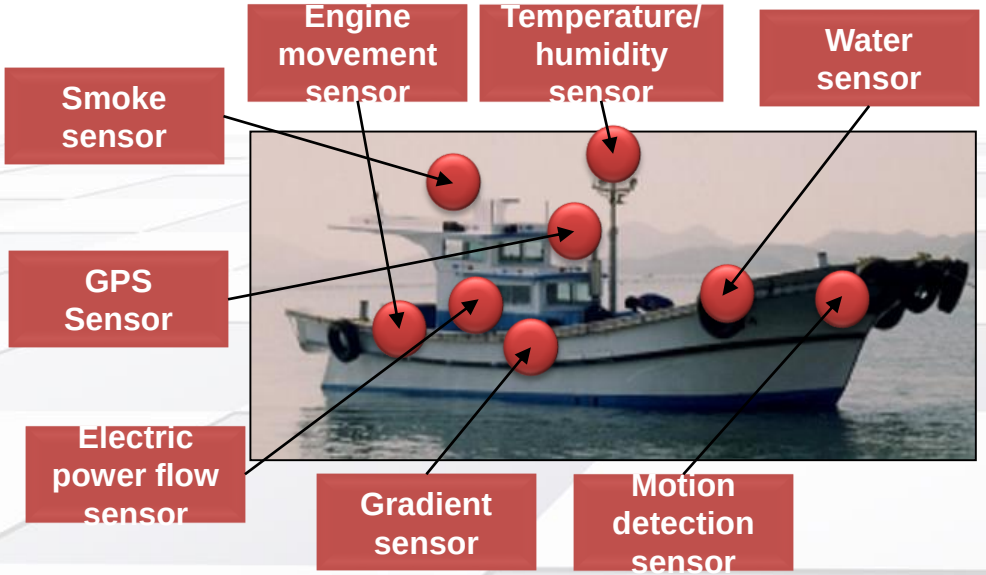
2. Diagnosis and Forecasting of Ship Failures by Analyzing Movement Patterns of Ships (Maritime Safety)

⦿ Problems of ship accidents

1. Secondary accidents caused by drifting ships due to engine troubles
2. Accidents due to obsolete critical parts of ships

⦿ **Solutions**

1. Sensor data acquisition including electric power flow, smoke, water, gradient, motion detection, temperature/ humidity, engine movement, GPS, etc.
2. Detection and forecasting of engine troubles by analyzing past engine movement patterns
3. Calculation of maintenance period by analyzing long-term sensor data patterns



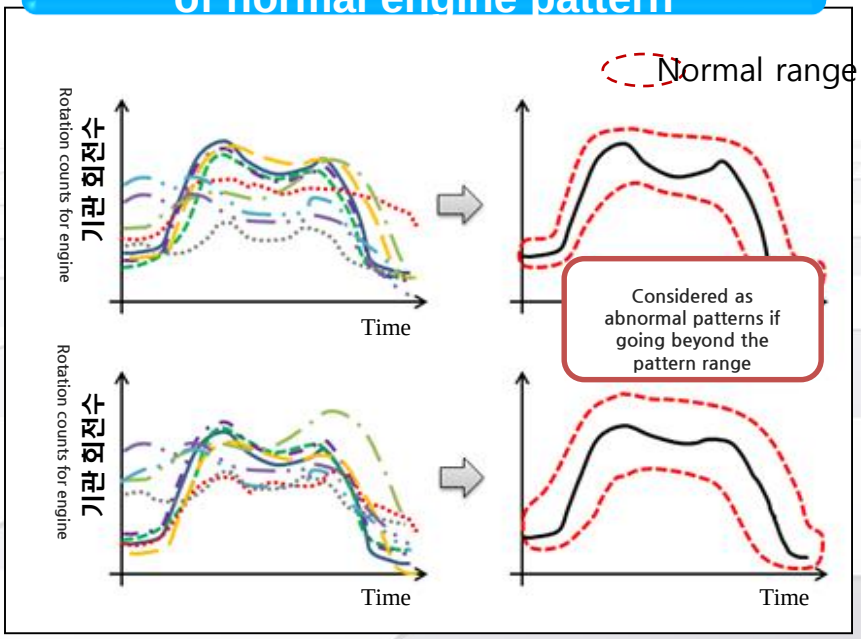
Detection and forecasting of accidents based on past sensor data analysis

2. Diagnosis and Forecasting of Ship Failures by Analyzing Movement Patterns of Ships (Maritime Safety)

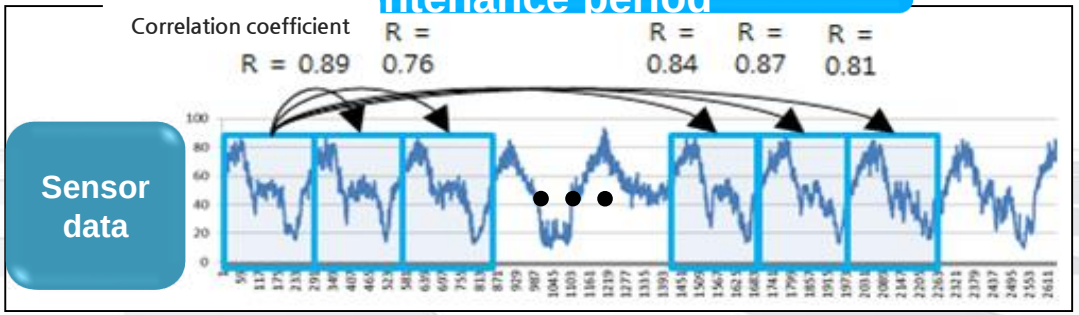
⦿ Diagnosis and forecasting of engine malfunctioning and failures
- ✓ Define the normal movement pattern of engine by analyzing past data
- ✓ Determine normality by comparing present engine movement with derived patterns

⦿ Forecasting of maintenance period by critical part
- ✓ Distinguishing initial motion and similarity by using correlation coefficient to sense movements by part
- ✓ Deciding to change parts if there is a huge gap in similarity

Definition and abnormality diagnosis of normal engine pattern



Calculation of appropriate maintenance period



3. Pattern Analysis of Wave Heights According to Marine Weather and Development of a System for Maritime Safety Map Construction (Maritime Safety)

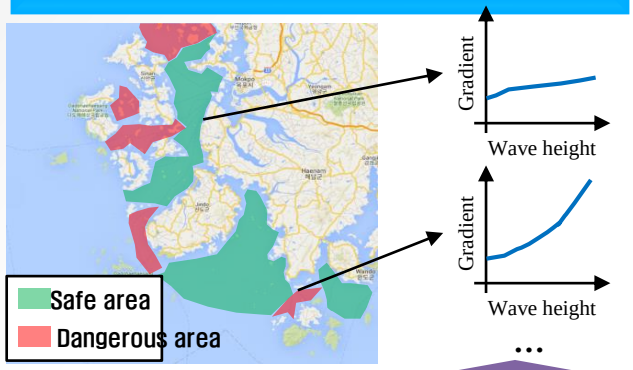
» A system that derives areas of high accident risk by analyzing changes in gradient according to marine weather (wave heights) and collecting gradient information of ships, thereby preventing accidents from occurring due to deteriorating ocean weather conditions with a map of safe areas for ships to travel.

Services

- Service of analyzing sea areas of high risk and safe areas
- Real-time maritime safety map service
- Real-time ship movement route recommendation service

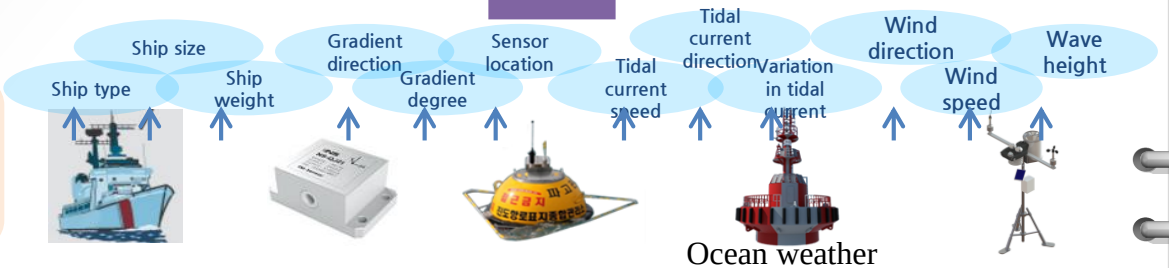
Analysis

Analysis of areas of high accident risk by wave height



Generation of safety lane information

Source data



Ship information Gradient sensor | Tidal current information | Ocean weather information (KHOA) | Weather information (KMA)

Core Components

- ✓ **Service formation**
  - Analysis of sea areas of high risk and safe areas
  - Derive real-time maritime safety map
  - Derive routes recommended for ships in real time
- ✓ **Data analysis**
  - Analysis of changes in ship gradient according to wave heights by sea area
  - Analysis of areas of high accident risk by ship gradient
- ✓ **Source data acquisition**
  - Ship information including types, length, width, etc.
  - Collection and storage of weather information including wind direction, wind speed, wave height, tidal current, etc.
  - Collection and storage of ship gradient information
  - Collection and storage of tidal current information including current direction, current speed and variation in current speed

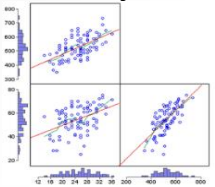
» A system that minimizes damages caused by sudden changes in water temperature due to red tide and cold pool by monitoring and forecasting changes in ocean water temperature

Services

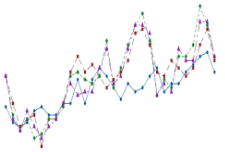
- Monitoring service for changes in water temperature according to the season
- Forecasting service for water temperature according to the season
- Abnormality alert service

Analysis

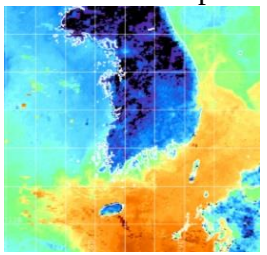
Multiple regression analysis



+ Analysis of time series



→ Monitoring and forecasting of ocean water temperature



Source data

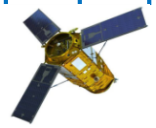
Water quality, Ocean current, Latitude/ longitude, Tide, TSI, Tempera ture, Humidity, Water temper ature, Surface water temperature

Eutrophic measurement

Water quality measurement

Oceanographic Observation buoy

Temperature/ humidity sensor



Satellite

Core Components

✓ **Service formation**

- Monitoring of changes in water temperature according to the season
- Forecasting of water temperature according to the season
- Alert service for abnormality caused by red tide, cold pool, etc.

✓ **Data analysis**

- Multiple regression analysis based on data related to past water temperature
- Analysis of time series based on past time series data for water temperature

✓ **Source data acquisition**

- Unit of time and space during observation
  - · Time unit: 6 hours
  - · Space unit: points by sea
- Collection and storage of ocean information
- Collection and storage of surface water temperature information
- Collection and storage of the degree of clearness information
- Collection and storage of weather information

5. Development of Red Tide Occurrence Monitoring and Damage Prediction System (Fisheries)

» A system that predicts red tide occurrence areas and diffusion range and forecasts damages that might occur through relational analysis of fishing activities, fishing species, production and supplied amount related to diffusion range.

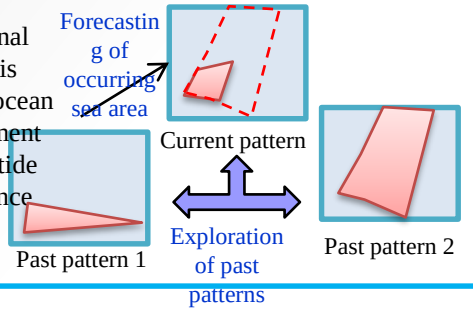
Services

- Forecasting service of red tide diffusion range
- Red tide control and prevention service
- Red tide occurrence prediction service

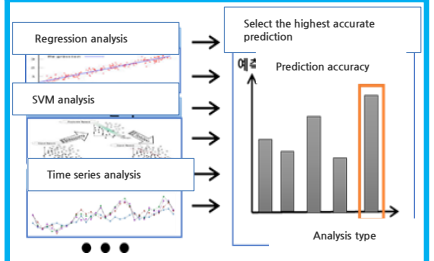
Analysis

Forecasting of red tide diffusion range

Relational analysis between ocean environment and red tide occurrence

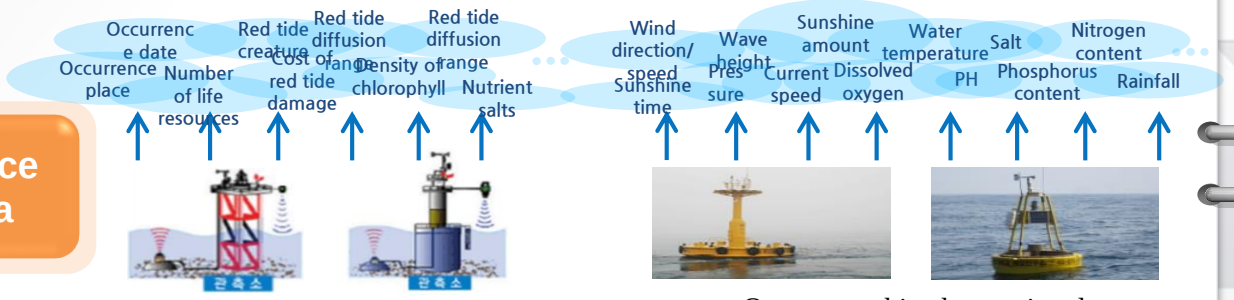


Red tide prediction



Prediction based on various data analysis

Source data



Red tide history/ monitoring data

Oceanographic observation data

Core

- ✓ **Service formation**
  - Monitoring of red tide occurrence based on red tide monitoring data
  - Forecasting of red tide diffusion range based on red tide diffusion patterns
  - Prediction of red tide occurrence based on data analysis
- ✓ **Data analysis**
  - Relational and group analysis between past ocean environments and red tide occurrence history
  - Pattern analysis of red tide diffusion patterns based on red tide history data
  - Selection of the highest accurate analysis method out of various methods including regression analysis, SVM analysis, etc.
- ✓ **Source data acquisition**
  - Collection and storage of red tide monitoring information
  - Collection and storage of oceanographic observation information
  - Collection and storage of past red tide damage history
  - Collection and storage of red tide creature data
  - Collection and storage of generated fishing species and production volume information by sea

*Support Vector Machine(SVM): Method of analyzing nonlinear prediction model based on pattern recognition

6. Diagnosis and Analysis of Smart Port Safety Efficiency Based on Big Data (Port/ Logistic)

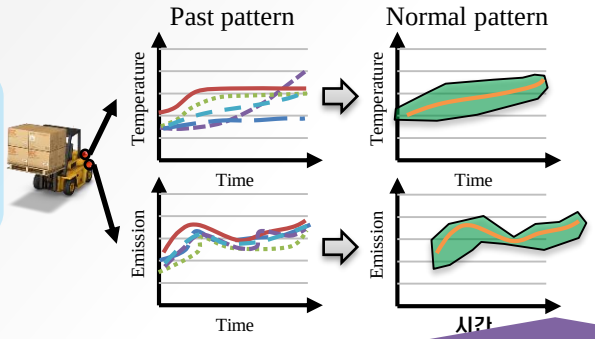
» A system that diagnoses energy efficiency and normal operation of unloading equipment by analyzing data collected from electric power, heat detection, emission and gradient sensors installed in unloading equipment.

Services

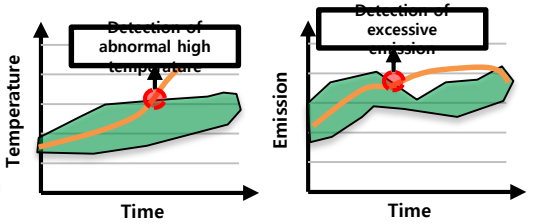
- Energy efficiency diagnosis service for unloading equipment
- Repair diagnosis service for unloading equipment
- Operational status information service for unloading equipment

Analysis

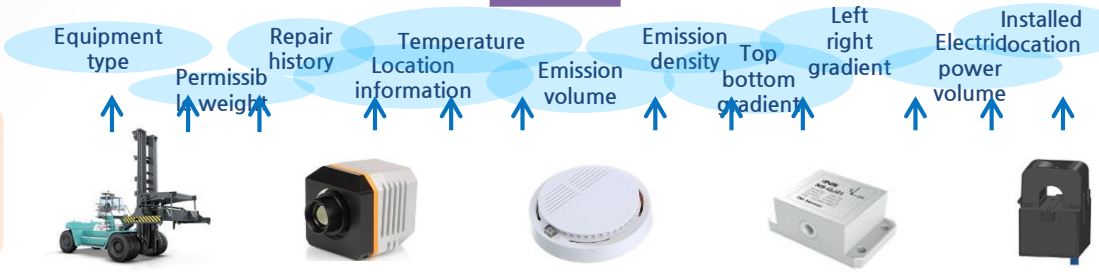
Data pattern analysis by sensor



Abnormality detection based on normal patterns



Source data



Unloading equipment information | Heat detection information | Emission information | Gradient information | Electric power information

Core Components

✓ **Service formation**

- Energy efficiency service for unloading equipment
- Repair diagnosis service for failures of unloading equipment
- Operational status information service for unloading equipment

✓ **Data analysis**

- Derive normal patterns and analyze past data patterns by unloading equipment sensor
- Detect abnormality based on normal patterns

✓ **Source data acquisition**

- Collection and storage of unloading equipment information including types, carrying capacity, etc.
- Collection and storage of electric power information for unloading equipment
- Collection and storage of emission information for unloading equipment
- Collection and storage of gradient information for unloading equipment
- Collection and storage of heat generation information for unloading equipment

7. Forecasting and Analysis of Container Cargo Volume Demands (Port/ Logistic)

» A service that supports ship route setup, forecasts traffic congestion near the port and predicts transit shipment demands for each port by analyzing transit shipment volumes, import cargo volumes and export cargo volumes, so that the port can fulfill its role as an international port.

Services

- Traffic congestion forecasting service for roads near the port
- Forecasting service for ship demands based on import/ export cargo volumes
- Forecasting service for cargo volumes by port

Analysis

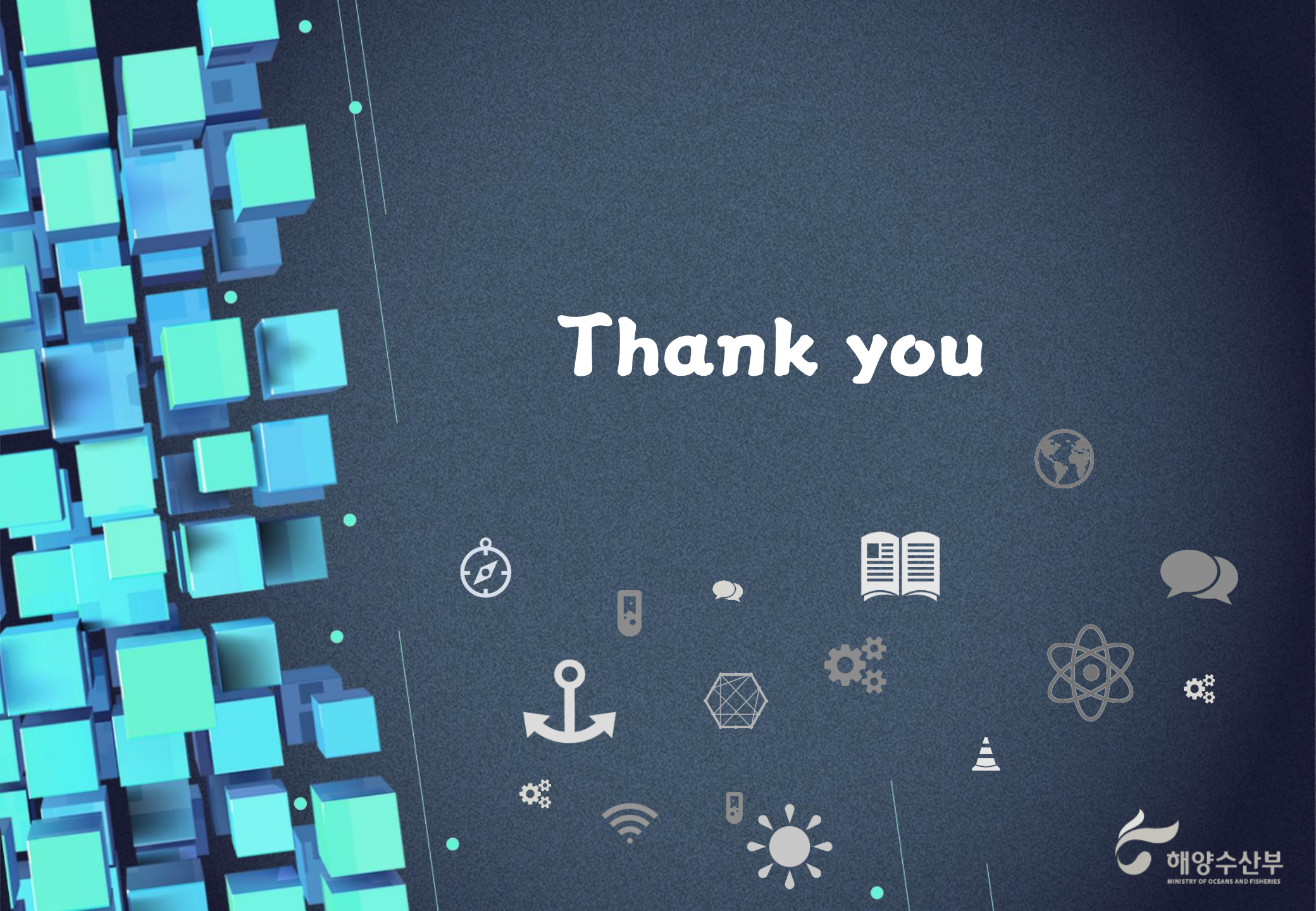
- OD Analysis and traffic integration analysis for import/ export cargo volumes
  - Import cargo volumes
  - Road traffic congestion near the port
  - Analysis of changes in traffic congestion according to the import cargo volume
  - Traffic congestion / Import volumes
- Transit shipment OD analysis
  - Past pattern
  - Derive characteristics of changes
  - Transit shipment volumes

Source data

- Route information: Current location, Departure, Arrival
- Ship carrying capacity information: Ship size, Total weight, Container
- Port information: Warehouse, Unloading status equipment status, Dock status
- Traffic information: Road ID, Traffic volume, Traffic speed

Core Components

- ✓ **Service formation**
  - Forecasting service for traffic congestion near the port
  - Forecasting service for ship demands based on import/ export cargo volumes
  - Forecasting service for transit shipment volumes by port
- ✓ **Data analysis**
  - Import/ export cargo volume OD analysis and traffic integration analysis
  - Transit shipment OD analysis
- ✓ **Source data acquisition**
  - Departure/ arrival information of cargo volumes by port
  - Route information by ship
  - Carrying capacity information of cargoes by ship
  - Facility status information by port
  - Road traffic information of ports


Thank you
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