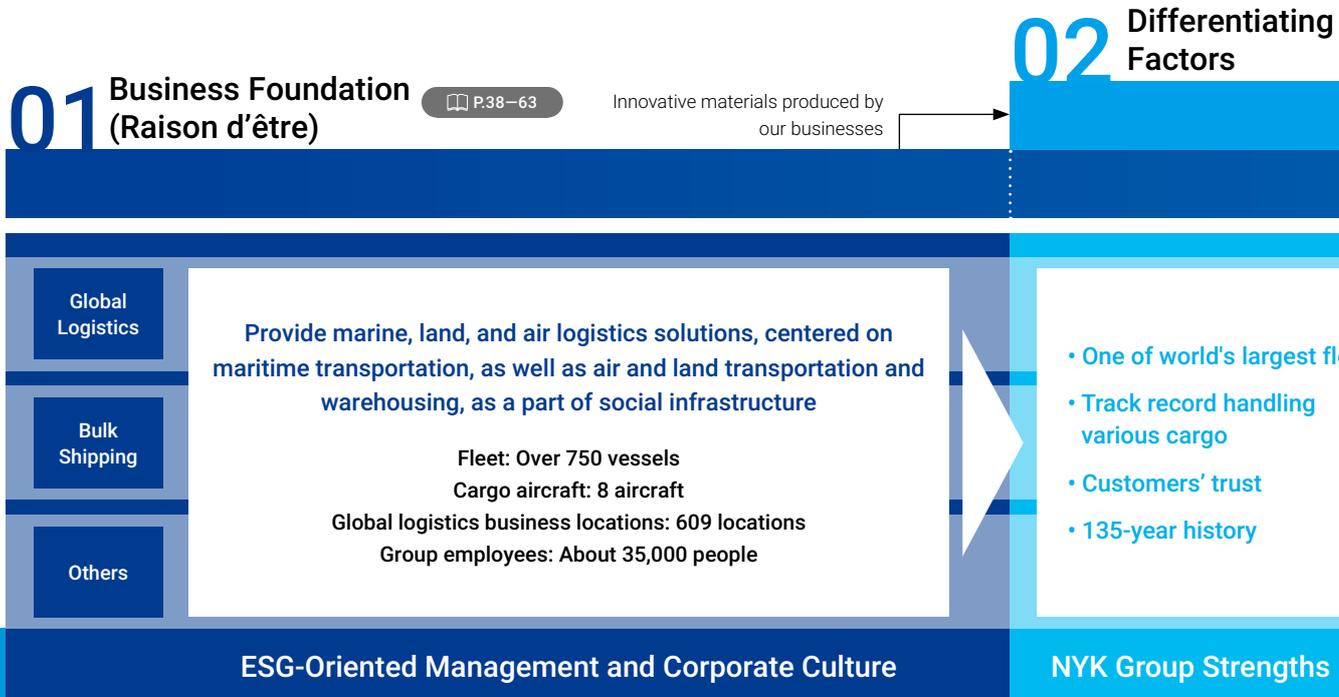


ESG Management at the NYK Group

From its founding to this day, the NYK Group has underpinned society and industry by satisfying the needs of society and its customers for transporting goods.

At our roots is an innovation-oriented corporate culture that is constantly pursuing new value creation. This corporate culture has been lovingly passed down from our predecessors. In its aim to be a sustainable solution provider essential to society and industry, the Group is keen to increase corporate value through Total Innovation while co-creating with its various stakeholders and focusing on ESG initiatives in its management.

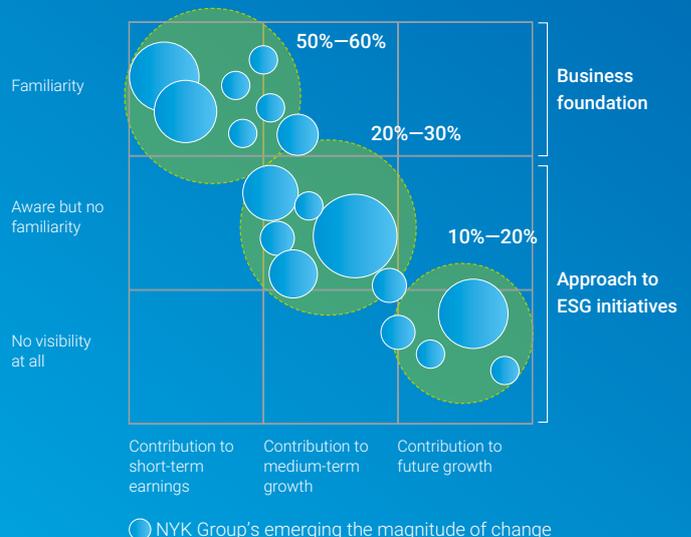


☑ The NYK Group's Long-Term Approach to Management

Initiatives

1 | Challenge Growth Fields

Through existing business activities, the NYK Group supports the development of society and industry. At the same time, we are plotting a growth strategy for the future by identifying social and environmental issues that could become business opportunities for the Group. The NYK Group's approach to ESG management is all about investing business resources in growth fields. In an era of volatility, uncertainty, complexity, and ambiguity (VUCA), we are promoting ESG management to remain a sustainable Corporate Group.



03 Approach to ESG Initiatives (growth strategy)

P.20-37

The SDGs

P.55

(Business foundation + technological capabilities) × ESG perspective

- Global network
- Development of advanced technologies
- Strategic partnerships
- Corporate culture that respects diversity

Fuel conversion

P.24

Digital technology

P.26

Open collaboration

P.28

Green business

P.30

Development of in-house innovation leaders

P.32

Total Innovation (Co-Creation with Stakeholders)

Technology

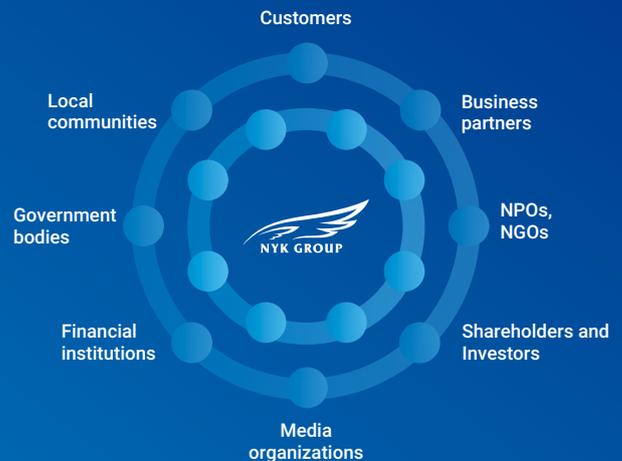
2 | Compete with “Technological Capabilities × Co-Creation”

The technological capabilities that the NYK Group has accumulated over the 135 years since its founding have been cultivated through collaborative creation with stakeholders, such as the understanding of customers, the cooperation of business partners, and the support of local communities.

To take on challenges in new fields, we need to increase the potential of our technological capabilities by combining them with co-creation. Co-creation is the driving force for promoting innovation.

We will continue to promote ESG management, which the Group is aiming for, and work to create new value through co-creation with world-class partners.

Co-Creation with Various Stakeholders

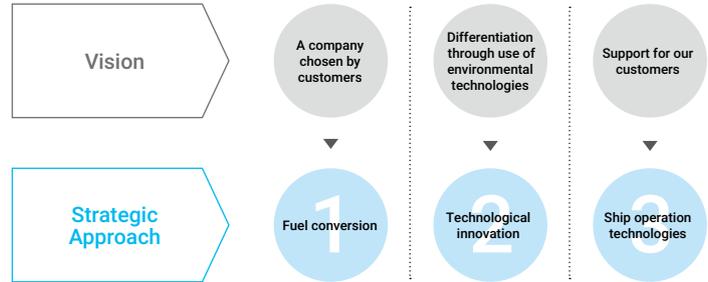


The NYK Group's Innovation for Solving Issues in Maritime Shipping

In ESG management, the NYK Group views the growing concern about environmental issues as an opportunity and aims for a world with blue oceans by spurring innovation in maritime shipping, using the Group's technological capabilities as a wellspring for differentiation.

✓ Differentiation Strategy in ESG Management

We are advancing a differentiation strategy in ESG management, based on the "Digitalization and Green" theme in our medium-term management plan. From a "Green" standpoint, we are taking on the challenge of achieving zero emissions in ship operations, by converting ship fuels and participating in the hydrogen and ammonia business. In order to increase the safety of ship operations, we intend to make advances in the "Digitalization" of technologies for ship operations and manned autonomous ships. From the standpoint of addressing climate change, an issue that affects all industries, the Group is working to reduce environmental burden in line with its medium- and long-term environmental targets, which have been verified by Science Based Targets (SBT). By providing customers with environmentally friendly modes of transportation, we can help our customers solve their own environmental issues. To this end, the Group is marshalling all its technological capabilities.



Group Medium- to Long-Term Environmental Targets (GHG Reduction Targets)

	2016	2017	2018	2019	2030 (Target)	2050 (Target)
Ships Aircraft	-0.5%	-1.6%	-2.4%	-2.8%	-30%	-50%

* CO₂ emissions per ton-kilometer (base year fiscal 2015)

CSR (Corporate Social Responsibility) > Environment > Environmental Regulation

✓ Environmental Regulations for International Shipping

The International Maritime Organization (IMO) is leading discussions to strengthen regulations of international shipping in order to address various environmental problems.

Category	Regulations	International conventions and regulations	Sea area	2014	2015	2016	2017	2018	2019	2020	2021	2025
GHG	EEDI (Energy Efficiency Design Index)	Appendix VI to the MARPOL Convention	Open sea areas	Ph 0 0%	Ph 1 10%					Ph 2 20%		Ph 3 tbn
	SEEMP (Ship Energy Efficiency Management Plan)	Appendix VI to the MARPOL Convention	Open sea areas	Mandatory	→							
	DCS (Data Collection System)	Appendix VI to the MARPOL Convention	Open sea areas					Adoption	→			
SOx · PM	SOx	Appendix VI to the MARPOL Convention	ECA	1.0%	0.1%							
			Open sea areas	3.5%					0.5%			
NOx	NOx	Appendix VI to the MARPOL Convention	ECA	Tier II regulations		Tier III regulations (U.S. and Canada coastlines)					(Adding North Sea and Baltic Sea)	
			Open sea areas	Tier II regulations								
Biodiversity	Ballast water	Ballast Water Management Convention	Open sea areas				Effective					
	Fouling (Organisms that attach to vessels)	—	—	Formulation of guidelines in 2011 for managing attached organisms (unenforced)								
Demolition	Ship recycling	Ship Recycling Convention (still pending)	Open sea areas	Adopted in 2009 and shall be applicable to all vessels upon becoming effective								

GHG : Greenhouse gases (GHGs) including carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF₆), etc.
 EEDI : The Energy Efficiency Design Index is a formula for measuring a ship's CO₂ emissions per ton-mile, based on the design of the ship being built, incorporating various parameters.
 SEEMP : The Ship Energy Efficiency Management Plan (SEEMP) is an operational plan for improving energy efficiency on a voyage-specific basis.
 DCS : Shipping firms use a data collection system (DCS) to report to the IMO on fuel consumption, distance traveled, and time spent at sea for all vessels of 5,000 gross tonnage or above operating internationally.
 SOx regulations : Regulations for the percentage of sulfur content in fuel oil, in order to reduce SOx volume in exhaust gas
 NOx regulations : Staged regulations for NOx volume in engine exhaust gas
 Tier I regulations: Regulations for emissions based on rated speed of engines for ships constructed between 2000 and 2010.
 Tier II regulations: Mandates 20% reductions from Tier I regulations for ships constructed after 2011. Tier III regulations: The start year for these regulations differs by covered sea area and they come into effect in two stages, the first in 2016 and the second in 2021.
 Ballast Convention: After it came into effect in September 2017, this convention mandated that ballast water-processing equipment should be installed on ships by a certain deadline, depending on the type of ship, to prevent the spread of living organisms and some pathogenic bacteria from one region to another.
 Ship recycling : This convention aims to control labor accidents and environmental pollution when ships are dismantled (scrapped). It is effective 24 months after conditions are met.

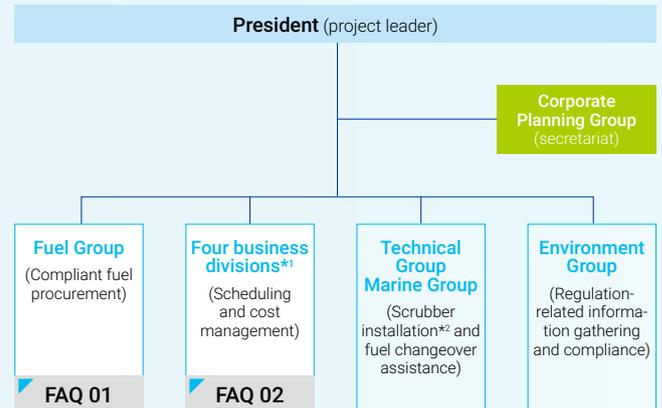
Column

Organizational Power of the NYK Group to Comply with Regulations

To prevent atmospheric pollution, the IMO instituted a regulation on January 1, 2020 (The 2020 Global Sulphur Cap), in order to limit the concentration of sulfur oxide (SOx) in vessel fuel oil to 0.5%. The NYK Group commenced the IMO 2020 project in April 2019 to take on the challenge of complying with this regulation as a top management priority.

☑ Outline of the IMO 2020 Project

To bring existing vessels into compliance with SOx regulations, it is necessary to either switch to low-sulfur content fuel oil (compliant fuels) or install exhaust gas cleaning systems (scrubbers) on ships. Each measure comes with its own problems that must be solved. Compliant fuel impacts ship machinery in the context of supply systems to ships and fuel changes. Installing scrubbers, meanwhile, requires a shipyard to do the construction work and finding a place where the equipment can be installed on the ship. The Group started a cross-divisional internal promotion project with the president as the project leader, gathered information from numerous related departments within NYK, made adjustments with involved parties, and finished bringing the Group's entire fleet up to compliance with SOx global cap regulations, allowing full compliance with the regulation from January 1, 2020.



*1 Four business divisions: Global Logistics, Car Transportation, Dry Bulk, and Energy

*2 No. of vessels with scrubbers: Decision already made to install scrubbers on about 80 vessels in operation as of March 31, 2020

FAQ: How did NYK achieve its mission? 01

● Fuel Group Initiatives

The Fuel Group is responsible for procuring ship fuel. For this project, the Group made its best effort to gather information about compliant fuels and secured enough in advance. For the start of the regulation instituted by the IMO in January 2020, bunker suppliers proceeded with preparations such as adjusting the content of the new fuel. On the other hand, one of the major concerns was whether the supply of the compliant fuels would be adequate to meet world demand. NYK planned to start bunkering with compliant fuels from around October 2019 and commenced negotiations with bunker suppliers in April 2019 in order to procure enough thereof. To make sure we could procure and switch over to compliant fuels, we held individual briefings with staff in the ship operating divisions many times, sharing our switch-over plans to systematically change over to compliant fuels by the end of 2019, thereby enabling us to execute these plans.

We also built a system to purchase the optimal amount of compliant fuels and visualized the demand forecast. Furthermore, we realized cost savings by working with the ship operations divisions.

FAQ: How did NYK achieve its mission? 02

● Dry Bulk Division Initiatives

The fuel consumption of dry bulkers varies depending on the type of vessel and routes taken. In order to ensure a smooth switch to compliant fuels before the end of 2019, a system for visualizing the remaining oil inside fuel tanks used by other divisions was deployed on the dry bulker fleet. The amount of remaining fuel was verified on each vessel and, if the amount was higher than anticipated, the division head and all relevant employees shared information and sent out alert emails. Twice a week, each vessel that had triggered an alert email was analyzed carefully, and the person in charge of ship operations coordinated with relevant departments to reverify conditions.

To smoothly switch over to compliant fuels, IBIS TWO Plus, an internal organization that engages in activities to conserve fuel, was designated the secretariat, and it held study sessions for all persons in charge of ship operations to learn about the switch to compliant fuels and related contracts. Around 100 people participated per study session, spreading awareness across the entire Group.



Innovation Roadmap

—Promoting Safe Operations and Decarbonization—

Achieving zero emissions in oceangoing shipping will require enormous effort to overcome thorny issues. Our duty to ensure safe operations also means protecting the ecosystems in the ocean, a precious resource. The NYK Group has created a Vessel Technology and Innovation Road Map, identified issues to tackle from a long-term perspective, and is making steady progress on the development of technologies for the future.

✓ Vessel Technology / Innovation Road Map (abridged version, updated August 2020)

● Digitalization ● Hardware innovations



* Full version available in NYK Report 2018

P.24-25

▶ 01: Advanced predictive maintenance

Establishment of the Remote Diagnostic Center

The NYK Group monitors the operations of approximately 200 ships equipped with SIMS. Since engine plant anomaly detection system and data quality management systems have been well developed, the Remote Diagnostic Center (RDC) was established at NYK Fil Maritime E-Training, Inc. in the Philippines as an organization of digital shipmanagement in order to monitor NYK fleet intensively and effectively. The RDC's mission is to maintain and provide reliable and high-quality logistics by preventing serious accidents and reducing CO₂ emissions, thereby contributing to ESG management at the Group and its customers (see page 29 for details).



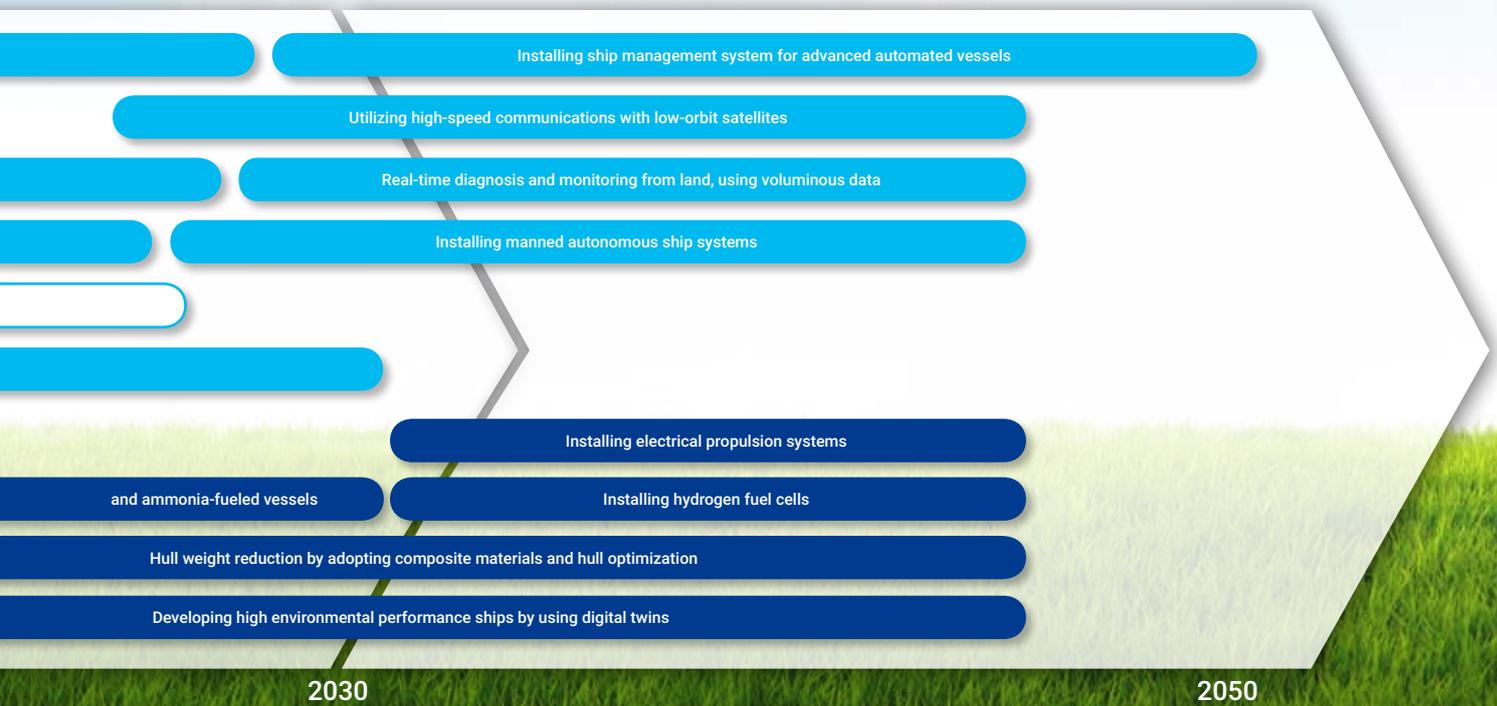
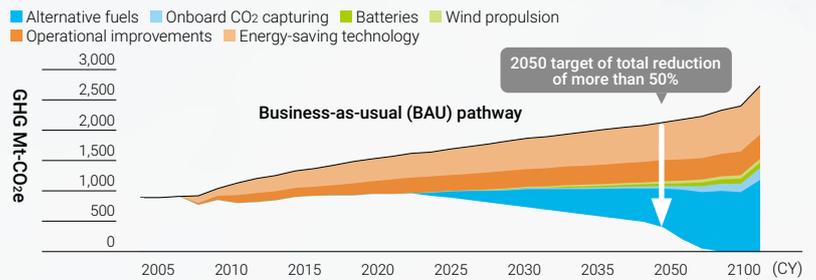
Remote Diagnostic Center

► Reductions in GHG Emissions in International Shipping

The International Maritime Organization (IMO) has come up with a scenario for achieving zero GHG emissions from international shipping during this century. The IMO expects that the 2030 target will be achieved mainly by operational and technical energy efficiency measures, and beyond 2030, the introduction of zero-carbon fuels will be main options to reduce GHG emissions.

Source: MTI Co., Ltd. based on data from the Japan Ship Technology Research Association

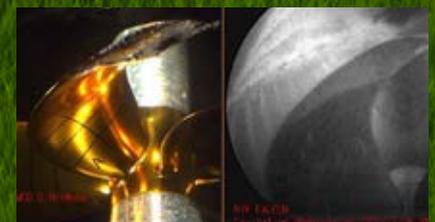
Pathway toward Zero Emission



► 02: Ship design using full-scale simulation

Designing with Full-scale Simulations Using Data from Cutting-Edge Sensors

NYK, together with MTI Co., Ltd. and Furuno Electric Co., Ltd., has developed sensors to measure the flow of water around ship in operation. The collected data is shared with Japan Marine United Corporation for analysis and utilization. Using the simulations reflecting actual ship, we have designed a more efficient propeller that reduces CO₂ emissions by about 2%. Plans call for performing the same measurements on a large crude oil tanker built in 2020, and then deploying the technology to other types of vessels. We will utilize this full-scale simulation technology to designing hull forms as lower resistance toward 2050.



Propeller (model and actual ship)

Next Innovation for Zero

—A Further Step toward Decarbonization—

Decarbonization is an issue faced by every industry. In response, while promoting a shift to low-carbon and decarbonization with regard to modes of transportation, the NYK Group has commenced efforts to create a value chain for the carbon-free society of the future.

✓ LNG Fuel Promotion of LNG-Fueled Vessels

✓ Delivery of Japan's First LNG Bunkering Vessel

Joint venture company Central LNG Shipping Japan Corporation (CLS) established by NYK, Kawasaki Kisen Kaisha Ltd., JERA Co., Inc., and Toyota Tsusho Corporation concluded a ship-building contract with Kawasaki Heavy Industries Ltd., which is building an LNG bunkering vessel.

The vessel will be delivered around the fall of 2020 and will be the first of its kind in Japan. To prepare for the start of an LNG fuel supply/sales business for vessels in Japan's Chubu region, the four companies also established CLS and Central LNG Marine Fuel Japan Corporation (CLMF) in May 2018. CLS will own and provide ship management services for the LNG bunkering vessel currently under construction, while CLMF will be responsible for the LNG fuel supply/sales business.



✓ Building of Japan's First LNG-Fueled Pure Car and Truck Carrier

NYK placed an order for one of the world's largest pure car and truck carriers fueled by LNG, the construction of which started in September 2019. It is the first large-scale LNG-fueled vessel to be built in Japan, with its completion scheduled for around fall 2020.

The vessel will be equipped with large LNG fuel tanks. To minimize a reduction in vehicle loading capacity due to accommodating the tanks, principal particulars have been optimized, such as the breadth of the vessel, and designs for maximizing vehicle loading space have been implemented to enable transportation of approximately 7,000 vehicles (standard vehicle equivalent). In addition, in terms of environmental performance, the vessel will be about 40% more energy efficient than conventional vessels in terms of reducing CO₂ emissions per unit of transport, far exceeding the International Maritime Organization's Energy Efficiency Design Index Phase 3 requirements, entailing a 30% improvement in energy efficiency, which will become effective in 2025. The vessel is additionally expected to reduce sulfur oxide emissions by approximately 99% and nitrogen oxide emissions by roughly 86% compared with conventional heavy oil-fired engines.

➤ Road Map for Vessel Fuel Change

2015

Japan's first LNG-fueled tugboat, Sakigake, delivered



2016

World's first LNG-fueled pure car and truck carrier, AUTO Eco, delivered



2017

World's first purpose-built LNG bunkering vessel, Engie Zeebrugge, delivered



2019

Methanol-fueled vessel Takarao Sun delivered



2020

- Scheduled delivery of the first LNG-fueled pure car and truck carrier, Sakura Leader, built in Japan
- Scheduled delivery of Japan's first LNG bunkering vessel

2022

- Scheduled delivery of LNG-fueled pure car and truck carrier

2023

- Scheduled delivery of LNG-fueled large coal carrier

✓ Low-carbon fuels: LNG, LPG, methanol

Heavy oil

2015

2020

☑ **Hydrogen and Ammonia** Establishment of a Value Chain for Decarbonization



The World's First Global Hydrogen Transportation Demonstration Project Starts in Earnest

NYK, Chiyoda Corporation, Mitsubishi Corporation, and Mitsui & Co., Ltd. have established the Advanced Hydrogen Energy Chain Association for Technology Development (AHEAD), which has started the world's first global hydrogen transportation demonstration project in earnest. After methylcyclohexane produced in Brunei is transported to Japan by ship, the hydrogen is separated out at a dehydrogenation plant in Kawasaki City and supplied to a gas turbine at the Mizue power station owned by Toa Oil Co., Ltd. In June 2020, toluene produced by the separation process at the dehydrogenation plant was shipped to Brunei to start a process of chemical combination once again with hydrogen to create a circular supply chain.



Transportation by ISO tank container



Participation in Joint Research on the World's First Ammonia-Fueled Ammonia Gas Carrier and Ammonia Floating Storage and Regasification Barge

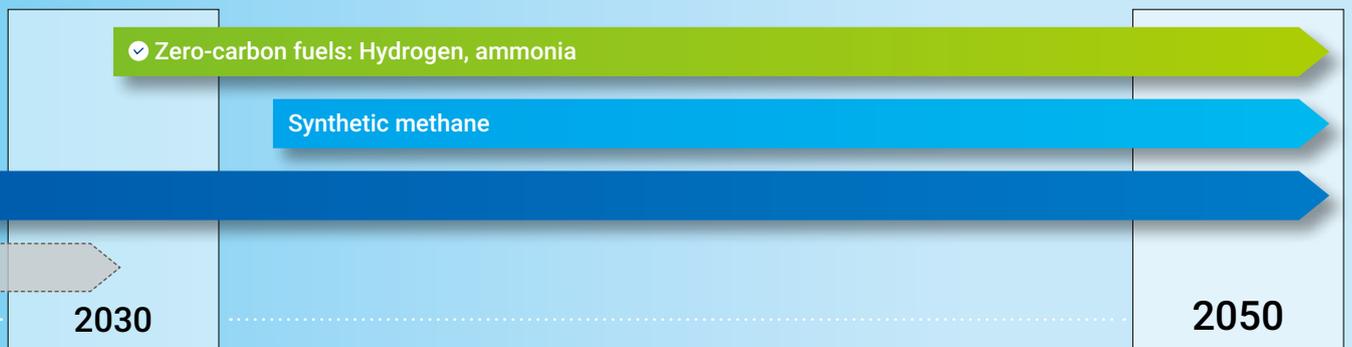
In August 2020, NYK, Japan Marine United Corporation, and Nippon Kaiji Kyokai signed a joint R&D agreement for the commercialization of an ammonia-fueled ammonia gas carrier (AFAGC), which would use ammonia as the main fuel, as well as of an ammonia floating storage and regasification barge (A-FSRB). Both the AFAGC and the A-FSRB are world R&D firsts. Since ammonia does not emit CO₂ when used as fuel, it is expected to see increasing demand as a next-generation fuel. The project aims to contribute to the decarbonization of not only the maritime shipping industry but also the energy industry by realizing the transportation of ammonia by large-scale vessels and providing various logistics solutions, including providing storage on the A-FSRB, for electric power companies in Japan seeking to introduce mixed combustion of ammonia at coal-fired thermal power stations.



Image of AFAGC exterior



Concept Ship
NYK SUPER ECO SHIP 2050



2030

2050

A Group of Technical Experts for Creating New Value

The NYK Group is constantly working to resolve the various issues that arise in the business and operation fields.

By combining our rich experience and strong technological expertise built through operations with cutting-edge digital technologies starting with the Internet of Things (IoT) and big data, we intend to build and implement the maritime industry's leading advanced system for optimizing vessel design and their operations. We are creating new value with a variety of global partners both within and without the maritime cluster.

It is the group of technical experts that will lead the way to this new value.

✓ **A Track Record of Taking On Challenges to Create Value**

Value creation that contributes to ESG Initiatives
(zero-emission vessels, manned autonomous ships and others)

2000s

STEP / 1

Operational Knowledge

Marine and Engineering as Basic

- Energy-saving operations (Saving bunker)
- Quality management for cargo transport
- Vessel performance analysis
- Water-emulsified fuel boilers
- Solar cells with onboard rechargeable batteries
- Hybrid turbochargers

2010s

STEP / 2

Big Data and the IoT

Data Analysis and Visualization

- Ship voyage and machinery data collection via the Ship Information Management System (SIMS)
- Fuel-saving activities called IBIS TWO Plus
- Optimized fleet allocation
- Optimized container box transport

Big Data × Design

- **Energy-saving vessel devices**
- **Energy-saving governor controller for main engine**
- **Air-lubrication system**
- **High voltage shore connection**
- **Energy-saving hull modification**
- **Selection of anti-fouling paints for hull bottoms**

2020s New Challenges

STEP / 3

System Integration

Advanced Automation and Integration

- Advanced ship management system using digitalization
- Environmental solutions for customer supply chains
- Alternative fuels (LNG, hydrogen, ammonia, etc.) and renewable energy

Operational Knowledge × System Integration

- **Advanced environment-friendly vessels**
- **Safe maneuvering technology**
- **Remote Diagnostic Center**
- **Optimal ship design based on operational profile**
- **Accident analysis system KISEKI**
- **Cybersecurity measures for ships**

STEP / 1 × 2 × 3

- Vessel performance analysis based on actual navigation data
- Condition-based maintenance (CBM)
- Ship navigation support tool J-Marine NeCST
- Ship management data sharing platform NiBiKi
- Internet of Ships (IoS) open platform data sharing
- NYK data lake

STEP / 1 × 2

Message

Integrating the Power of Our Technical Headquarters to Accelerate Value Creation

Tomoyuki Koyama

Senior Managing Executive Officer
Chief Safety Officer (Marine)
Chief Information Officer
Chairman of Group IT Strategy Committee
Chief Executive of Technical Headquarters
(Executive Chief of Environmental Management,
Chairman of Technology Strategy Committee)



At the NYK Group, safety and the environment are the most important challenges when it comes to promoting ESG management. I believe the key to addressing these challenges lies in how much of the power of our Technical Headquarters we can integrate. We have formulated a Vessel Technology and Innovation Road Map (see pages 22 and 23 for details), which shows various time frames and research domains toward 2050. This road map includes the NYK SUPER ECO SHIP 2050, a concept ship, factoring in the environment in ESG. In addition, we are progressing R&D to realize safe operations and to develop carbon-free vessels.

Further, we have set medium- to long-term environmental targets that anticipate the reduction of CO₂ emissions from vessels and the ripple effect down to the supply chain (see page 20 for details). As a first step toward reaching these targets, we are investigating the introduction of LNG-fueled vessels in line with our new building plan. However, LNG fuel is considered as a bridging solution for reducing our carbon footprint, we are extremely keen in developing zero-emission vessels by switching fuels to either Ammonia or hydrogen, which we plan to introduce around 2030. On top of fuel changes, we continue to pursue innovative hull and machinery design to curtail CO₂ emissions. Having said so, dramatic improvements in operational efficiency are needed as the contribution of hardware innovation to decarbonization is limited at least before the zero-emission vessels era. We are confident that through the cooperation of our customers together with our digital transformation, we will be achieve our goals.

The function of Technical headquarters includes New Building, Fleet Safety, Environment, ICT, Digitalization and 130 employees are working for those. NYK also has four R&D arms—MTI Co., Ltd, Japan Marine Science Inc., NYK Business

Systems Co., Ltd., and Symphony Creative Solutions Pte. Ltd.—which makes the NYK Group unique and strong. It is because of this organizational strength and our solid track record that we are able to engage in open collaboration with marine equipment manufacturers, shipyards, and companies outside the maritime cluster. Moreover, in June 2020 we made the decision to become a founding member of the Maersk Mc-Kinney Moller Center for Zero Carbon Shipping, a research center dedicated to promoting decarbonization within the maritime industry by converting to alternative fuels.

The Technical Headquarters has two major areas of focus: infrastructure technology to support business and cutting-edge technology aimed at differentiating the Group from others. The former refers to technology that supports the foundation of the Group's business, such as new buildings, ship management, and IT infrastructure, including cybersecurity. Without this technology, operations would not continue even for a day. The latter refers to technology directed toward the future, keeping us a half-step ahead of the competition. SIMS, a ship information management system introduced in 2008, is one of our trailblazers in cutting-edge technology. This system accumulates voyage data and weather and sea conditions as big data, provides engine performance analysis and condition-based maintenance (CBM),* among other functions, and is leading to the development of manned autonomous ships. The ship management data sharing platform NiBiKi, which went into full-scale operation from 2019, has made it possible to convert the human element of onboard operations into big data as well. I believe that the ability to analyze the data collected by SIMS and NiBiKi by the Group's engineers is what differentiates us and will lead to future business returns.

* CBM is preventative action that continually monitors the status of equipment anomaly on board so that maintenance can be performed before breakdown. As a result, advanced engine plant operations can be expected.

Taking On the Challenge of Maritime Autonomous Ships through Open Collaboration

Advanced system integration, exemplified by autonomous ships, is essential for improving the safety and efficiency of ship operations while reducing crew workloads. NYK and Group companies Monohakobi Technology Institute Co., Ltd. (MTI) and Japan Marine Science Inc. (JMS), which are taking the lead on technological development, aim to develop autonomous ships with crews that uses systems capable of advanced data processing, developed through open collaboration with global players supporting the maritime shipping industry and with system vendors and companies from other sectors.

Autonomous ships

2016

Participation in i-Shipping, a Japanese Government R&D Project

NYK, MTI, and JMS have joined four projects, including collision avoidance and autonomous operations, as part of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT)'s Maritime Productivity Revolution project, or i-Shipping. These five-year projects launched in 2016.

2019

Participation in One Sea, Asia's First Autonomous Ship Alliance

From its base in Europe, MTI joined the international One Sea ship alliance, which aims to make autonomous ships a reality.

2020

Maritime Test of Remote Navigation of Tugboat

A consortium of 16 companies, including NYK, MTI, Keihin Dock Co., Ltd., and JMS, was formed in 2018 to participate in the MLIT project to test autonomous ships. Maritime tests are conducted using tugboats in Tokyo Bay (route between Yokohama and Yokosuka) for the purpose of identifying issues in the operating environment, such as for the drafting of safety requirements.



https://www.youtube.com/watch?time_continue=1&v=YGn-2ifYvY&feature=emb_logo

AiP* Certification Obtained from Nippon Kaiji Kyokai (Class NK) for APEX Autonomous Ship Concept Framework

* AiP = Approval in Principle (basic certification)

Core technologies

2008

2008 Development of Ship Information Management System (SIMS)

SIMS enables the collection of more granular data on actual sea conditions. By installing SIMS on our ships, the operational and fuel-related data of each ship can be shared among land and sea locales in a timely manner.

2018

IoT Open Platform and Creation of International Standards

NYK became a core member of the Internet of Ships Open Platform (IoS-OP) operated by Ship Data Center Co., Ltd. (ShipDC), a subsidiary of Class NK, with the aim of spurring innovation in the maritime shipping industry. The Japan Ship Machinery and Equipment Association (JSMEA)'s Smart Ship Application Platform (SSAP) Group drew up the ISO 19847 and ISO 19848 international standards for shipboard data servers to share field data at sea and land standard data for shipboard machinery and equipment, used in ship data collection systems developed by MTI, with cooperation from ship equipment makers and the Japan Ship Technology Research Association (JSTRA).

2012

Launch of IBIS Project for Optimal Economic Operations

The IBIS Project was launched with the objective of achieving optimal economic operations for container ships. The project aims to reduce CO₂ and fuel consumption across the entire fleet through information sharing on land and at sea, business process reforms, and data utilization. Its impact is on the scale of several billion yen per year. In 2013, IBIS-TWO was launched to find the most optimal economic operations for vessels other than container ships. In 2019, IBIS-TWO was renamed IBIS TWO Plus and given a broader scope.

2017

Joint Development of J-Marine NeCST Ship Navigation Support Tool

NYK and MTI, along with Japan Radio Co., Ltd., developed J-Marine NeCST as a ship navigation support tool for managing and sharing data, including digital nautical charts, on a large display.

2019

Commencement of Joint Research with Dualog on Cyber Risk Management System for Ships

The Cepa Shield project was launched to develop cybersecurity management systems for ships—using a grant received from the Norwegian government fund Innovation Norway—along with Dualog, a maritime IT system developer in Norway. Development is proceeding on a two-year time frame with the system being installed and tested on 50 NYK vessels.

Acquisition of Certification for Cybersecurity Management System for Ships

Group company NYK LNG Shipmanagement Ltd. obtained certification for its cybersecurity management system from Class NK (its first such accreditation). The system will be installed on ships due for their first annual inspection after January 2021, and manuals for crew and onshore personnel will be updated with descriptions of the system. The NYK Group is making preparations to rapidly comply with this schedule.



2020

Participation in MEGURI 2040 Crewless Maritime Autonomous Surface Ship Trial Project

This project aims to make crewless maritime autonomous ships a reality on coastal routes around Japan. The project, which is being jointly carried out by NYK and the Japan Foundation, is to conduct maritime tests in 2021 for the development of the world's first crewless maritime autonomous ship. The consortium of 26 domestic firms (as of October 2020) includes NYK, JMS, MTI, and Kinkai Yusen Kaisha Ltd.



2019

NYK received the Grand Prize at the IT Japan Award 2019, organized by Nikkei Computer magazine, for its initiative to use the IoT for detecting anomalies in the engine rooms of ships.



2020

Establishment of Remote Diagnostic Center (RDC)

As a part of efforts to digitally manage ships, in August 2020 the Remote Diagnostic Center (RDC) was established inside NYK-FIL Maritime E-Training, Inc. Seafarer Training Center in the Philippines. From onshore, the RDC monitors the engine plants of approximately 200 vessels equipped with SIMS.

The RDC will contribute to fuel conservation and the prevention of incidents of serious engine troubles for NYK fleet. The RDC is also looking to develop into a remote control center for the autonomous ship in the future (see page 22 for details).



Messages

Co-Creation of Maritime Autonomous Ships from a User's Perspective

The NYK Group is developing manned autonomous ships with its know-how of field operations at shipping companies. Key features of this initiative are the open collaboration with manufacturers and service providers with advanced technological capabilities and development that focuses on crews, the users of the ships. All processes, ranging from concept formulation to design, risk assessment, development, verification, installation, and operation, are openly conducted with partners and stakeholders. Leveraging the fields of expertise of major players in the maritime shipping industry, we aim to be the first in the world to develop autonomous ships as an industry.

Hideyuki Ando

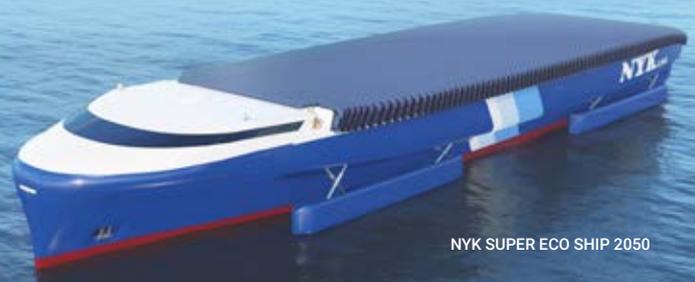
Director of Monohakobi Technology Institute Co., Ltd.

Creation of Value by Pursuing Technologies Staying Half a Step Ahead

As suggested by the words "Creating the future with on-site knowledge and practice," the NYK Group's initiatives in manned autonomous ships are unique in that they are being advanced in collaboration with numerous partners both inside and outside the Company, with a focus on navigation officers and engineers, to identify and solve issues related to safe and efficient ship operations that navigation officers and engineers in charge of ships face every day. The people involved in this initiative have come to understand that we are always aiming, with our partners, for technologies that are almost within reach. Without being bound to the technologies we develop, going forward we strive to create new value in our businesses by standardizing technology and spreading it around the world. We aim to create the future demanded by users, based on the relationships of trust we have built with our partners.

Satoru Kuwahara

General Manager
Maritime Technical Group, Japan Marine Science Inc.
(ship captain from NYK)



NYK SUPER ECO SHIP 2050

NYK ×

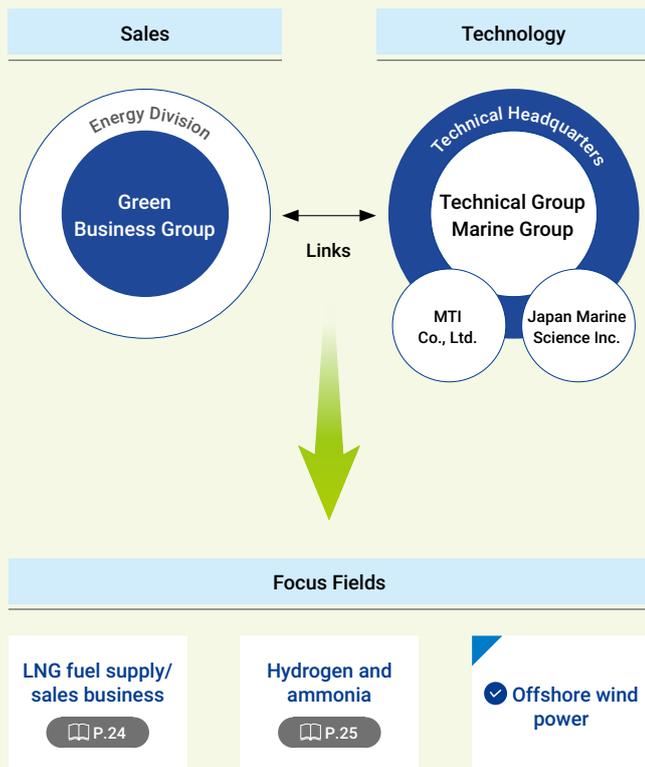


Aiming to Create New Value Based on the Theme of Renewable Energy

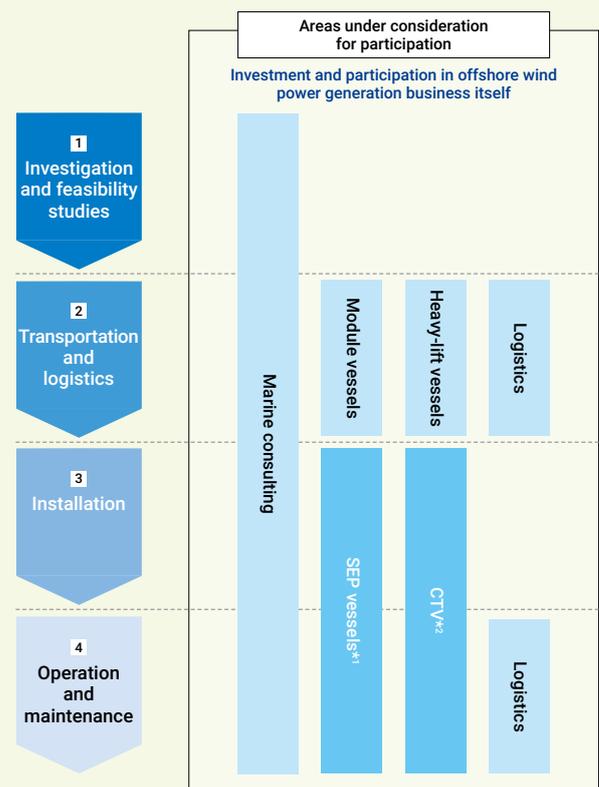
The NYK Group established the Green Business Group in April 2019 to accelerate business development in environmental fields. In 2017, the Group launched fuel supply service for LNG-fueled vessel in Europe using the world's first purpose-built LNG bunkering vessel. In 2020, we started operations with Japan's first LNG bunkering vessel. We are also promoting specific projects in fields such as offshore wind power.

▶ Striving to Create Businesses Using Both Sales and Technologies

The Green Business Group is leading our efforts to reform our traditional business models. Accordingly, we have mobilized the NYK Group's engineers under the concept of Green to develop technology-oriented sales.



Offshore wind power value chain



■ Newly participated businesses

*1 SEP vessel: Self-elevated platform. A vessel required for offshore wind turbine and foundation installation operations
 *2 CTV: Crew transfer vessel. A vessel for transporting crews for offshore wind turbine and foundation installation and maintenance after power generation commences



The Role of Green Business in Our Becoming a Sustainable Company



Toshi Nakamura

Senior General Manager, Green Business Group



The NYK Group faces two major trends of this era. Consequently, it is under great pressure to make changes on an unprecedented scale. The first major trend is decarbonization. As a maritime shipping and logistics company, the Group operates the business of transporting fossil fuels while consuming a large quantity of heavy fuel oil. To continue its existing businesses, the Group needs to take action on pivoting completely to a low-carbon model, with the ultimate goal of decarbonization. The other major trend is slow trade associated with protectionism and the shift to local production for local consumption. Businesses have a life span, just like living organisms. The Group's sustainable growth thus requires bold initiatives in the green business field, which is also a requirement of the times.

The Green Business Team was launched in April 2018. In 2019, the Green Business Group was established as a dedicated department, and it is now in its third year in a row since the establishment. Although this is only the third year, there are numerous needs within society, and the group is handling a rapidly increasing number of projects (see page 55 for details). The Green Business Group's basic strategy is a value chain strategy, similar to the Energy Division, which aims to be involved across all stages, from upstream to downstream. For example, in the offshore wind power business, we envisage being involved at every stage, from feasibility studies through to the transportation of materials, wind turbine installation, and, after completion, maintenance and electricity sales. Furthermore, this business is one where the Group can apply the expertise of its existing businesses in constructing and operating vessels, and we expect to assist with offshore wind turbine and foundation installation vessels (SEP vessels) at the

construction stage of an offshore wind farm and with crew transfer vessel (CTV) operations at the maintenance stage. Moreover, in developing the hydrogen and ammonia business, we plan to participate from both the demand and supply sides. First, we have been gradually creating hydrogen and ammonia demand while starting initiatives to build a supply network for these gases. In July 2017, the Company established the Advanced Hydrogen Energy Chain Association for Technology Development (AHEAD) with external partners and started the world's first demonstration project of an international hydrogen supply chain in June 2020 (see page 25 for details). Building a hydrogen supply chain is likely to take over 10 years from now to complete. Nonetheless, we will proceed with technological development in collaboration with external partners.

The medium- to long-term vision of the Green Business Group is to "develop and establish a business that contributes to reducing the environmental burden of activities involving transportation and power generation as one of the NYK Group's earnings foundations, thereby making the Group's overall business operations sustainable." To make this vision a reality, we are carrying out initiatives in four areas of innovation: product innovation to provide the necessary services for offshore wind power; market innovation to open new markets for the supply of hydrogen and ammonia; open innovation for building win-win relationships with partners in Japan and overseas that have specialist knowledge; and organizational innovation for developing new businesses through unified efforts with technical divisions, such as the Technical and Marine Groups, MTI Co., Ltd., and Japan Marine Science Inc. Through these initiatives, we will realize our vision to build a business division that can generate several billions of yen in profits per fiscal year after a decade.

NYK ×

Digital



Cultivating Business Leaders Who Will Perceive Customers' True Needs and Work Proactively in Innovation

We have established the NYK Digital Academy to develop human resources who will lead the Group in the future. We are currently running the second semester of the program for young managers in the NYK Group.

▶ Types of Human Resources We Aim to Cultivate

- Business leaders who will lead the Group by opening new markets, creating new businesses, and inspiring internal transformation
- Project leaders who will drive internal reforms and innovation

Column: NYK Digital Academy Is a Great Long-Term Investment



Katsuhiko Nishinari
Professor,
Research Center for Advanced Science and
Technology,
The University of Tokyo
Outside Guest Lecturer,
NYK Digital Academy

The next generation of innovation leaders will need to be aware of overall optimization in their activities. One of the issues in international logistics is how to seamlessly integrate marine and land transportation. The solution requires people who are able to think beyond ordinary operational frameworks. To achieve such a mindset, it is important that they acquire a wide range of knowledge and experience from an early stage. I think it is excellent that NYK has an internal organization for developing such human resources with a long-term perspective. It is without doubt that the NYK Digital Academy is a great long-term investment.

My role in the academy is to provide knowledge about the universal mathematics that lies behind everything. I hope to contribute to developing human resources who are able to see beyond conventional patterns of thought and action to reveal their essential nature.

▶ Course Content

- In foundational studies, participants acquire innovation techniques for design thinking and analysis techniques using data science, such as machine learning, using real examples from maritime shipping and other industries. In the practicum, the participants are tasked with enacting internal reforms or creating new businesses based on themes that they select themselves.
 - Internal and external experts are invited to give lectures.
 - During the practicum, mentors are assigned to each team.
 - In the final session, the participants give a presentation to the Group's senior management.
- Upon graduating from the program, participants receive a completion certificate and an internal qualification.

Lectures: One two-hour lecture/week (total lecture time: 124 hours/participant)

Schedule: Foundational studies (two months), practicum (four months)

Follow-up: Six months after the program



Web conference



Short-term intensive practicum in the Philippines

▶ After Graduation

Coordinate with the Digitalization Group to promote internal reforms or create businesses together with relevant internal departments, with the goal of carrying out the proposal presented during the course



Developing the Next Generation of Human Resources Who Will Lead the Organization to Create New Value and Achieve Transformation



Naotaka Ishizawa

Dean of the NYK Digital Academy
Digitalization Group

Invited as an outside lecturer to the School of Engineering,
The University of Tokyo, on "Theory of Advanced Logistics Science I"



Human resources are the most important driver of sustainable growth in a company. The NYK Group's business environment is experiencing major changes, such as the advancement of digital technologies, requiring us to radically revise our conventional business models. With a sense of crisis over the rising level of future uncertainty, we decided that we needed a training program that would take employees' thinking and our business processes to a completely new level. With that in mind, the NYK Digital Academy was launched in September 2019.

There are three unique aspects to the academy's establishment. The first is that the employees themselves designed the training program, rather than outsourcing this task. In addition to inviting highly esteemed outside lecturers, a large number of employees serve as lecturers. Among such employees are those involved in starting new businesses at overseas locations and achieving unprecedented transformations, as well as those who have acquired expertise in cutting-edge innovation at educational and research institutes in Japan and overseas. These employees are thereby able to give guidance related directly to the Group's businesses. The second aspect is the creation of a business story that resonates with many people, which is an essential element for forging business leaders. The academy takes innovation as its primary theme. To discover seeds that have not been fully recognized or realized inside the Company, the academy uses approaches for searching and creating new value, such as listening to people from a wide range of industries, creating a hypothesis for a business story, and then repeatedly verifying it. The third aspect is an emphasis on learning the latest approaches for creating new businesses from the perspective that innovation is not created by accident.

The academy's goal is not to train specialist engineers and digital technicians; rather, it is to nurture business leaders who can create new businesses, lead organizations, and realize their ideas. The first two months of the six-month training program are spent acquiring a thorough understanding of foundational content. This part of the program focuses on universal elements, such as mathematical science, that will be needed in any era, on the Group's history and principles, and on other learning, such as liberal arts, required for business leaders. The participants also learn about the latest technologies underpinning mathematical analysis, such as machine learning and programming languages, which will be essential skills for business going forward. In addition, the program includes a short practicum with overseas Group company employees to hone participants' skills in cross-cultural communication and ability to adapt to different environments. In the remaining four months of the program, the participants work together proactively on planning and proposing a new business or promoting internal reforms in line with their chosen theme. The final session is allocated to presenting a proposal to the president. However, to ensure that the proposal in question does not end there, but carries on to fruition, there is a biannual follow-up after the training program, which is conducted in coordination with the relevant internal parties.

The mission of a company is to provide value to its customers and meet the expectations of society. I hope that it will become normal within the Group to see graduates of the academy challenging and supporting each other as they autonomously undertake projects. As a cutting-edge educational institution, the academy will make maximum use of the knowledge resources within the Group to cultivate human resources who will create new value by working across Group, industry, and regional boundaries.

Considering New Possibilities and Innovation That Contribute to Solving Social Issues through Business

In its medium-term management plan, “Staying Ahead 2022 with Digitalization and Green,” the NYK Group is promoting initiatives to contribute to resolving environmental, social, and governance (ESG) issues and achieving the Sustainable Development Goals (SDGs), with the aim of solving social issues through business. In this section, we asked Representative Director Eiji Oishi of Minna-denryoku, Inc., who has generated a stream of successful examples in the fields of innovation and entrepreneurship, to talk to the Group’s young employees—who will take up the baton for the future—about social issues, innovation, and work ethic.

Minna-denryoku, Inc.’s First Meeting with the NYK Group

President Oishi, could you begin by talking about what kind of company you have created in Minna-denryoku, Inc.?

Oishi: Minna-denryoku, Inc. was founded in 2011 and has 83 employees (as of April 2020). Many of our diverse employees have had very different careers, and we value their individuality and respect their opinions. We manage the business with an emphasis on solving social issues while creating

corporate value. Our two guiding principles are “have fun” and “make a profit.” We pursue projects that are fun for ourselves, the public, and our customers and which generate profit for society as well as the company. One of our recent business activities is “Zero-Carbon Yokohama,” a decarbonization initiative promoted by Yokohama City in Kanagawa Prefecture. It is an inter-regional collaboration project in which renewable energy from Yokohama Town in Aomori Prefecture will be supplied to operators in Yokohama City. Minna-denryoku, Inc. is providing its proprietary blockchain technology, while NYK agreed to participate, and the two companies became acquainted by

jointly supplying renewable energy to Hikawa Maru.

Viewing the Corporate Culture of the NYK Group from Outside and Inside

What kind of company is the NYK Group?

Oishi: Over these past few years, especially, I feel there has been an increase in companies showing a strong interest in renewable energy, with the NYK Group

Profile

Eiji Oishi

Representative Director and President
Minna-denryoku, Inc.

After graduating from university, Eiji Oishi worked at an advertising production company before taking a job at a major printing company and then subsequently starting up numerous new businesses. In 2011, he founded Minna-denryoku, Inc., and was involved in a project with Setagaya Ward, Tokyo, to raise awareness regarding renewable energy. In 2016, he developed an electricity retailing service centered on renewable energy, with the concept of “Power supply with traceability,” which enables consumers to identify their electricity producers. This original service uses blockchain technology to allow electricity consumers to freely choose their producer, and its earnings have grown. With one of Japan’s leading renewable energy rates, the service has electricity supply contracts with approximately 3,000 contracts. Currently, the company is working to expand the “Power supply with traceability” concept outside the electricity sector by realizing “Lifestyle with knowing where the product came from.”



among their number. As I soon realized after collaborating with the Group, although many companies become slower in their decision-making and more inflexible as they expand in size, the NYK Group has a wonderful corporate culture that is actually flexible and supportive of adopting new ideas. An institutional investor with whom I am acquainted said that the Group's level of sincerity in its approach to addressing ESG issues and the Sustainable Development Goals (SDGs) supersedes that of the majority of companies in Japan. The president of the NYK Group himself, Hitoshi Nagasawa, leads the way in promoting ESG management. While the Group naturally has a firm stance on achieving profitability, I feel that it is ahead of other companies in terms of the sincerity it shows in promoting business from new perspectives, such as social issues.

Hashimoto: The NYK Group really does have a large number of talented human resources. In keeping with its history and corporate culture of operating its business on the wide oceans, the Group has an outstanding, open organizational culture.

That being said, I do not mean that we are at all indulged; if I make a mistake, I have senior colleagues and coworkers who will point it out to me directly, in addition to drawing my attention to things from different perspectives.

The cargoes handled by the NYK Group are many and varied, including food, living essentials, coal, and crude oil. The story that is shared throughout the Group is one of delivering the cargo that is required to carefully meet various needs. Although we may have different approaches, I feel that we are united in our goal. Over 10 years ago, shipping was focused primarily on speed. Today, however, fuel economy is emphasized with a view to saving energy, and we are called to create even more value based on the theme of "Digitalization and Green." I believe that the Group has worked to meet the needs and expectations of the changing times.

Oishi: When I listened to you speaking just now, I felt that the NYK Group's business is truly broad, from marine transportation to green business. The amount of trust needed to create a global network cannot

be built overnight. It is because the Group and other entities were there to ensure the continued flow of logistics that society and industry were able to continue functioning even amid the COVID-19 crisis. However, I think that it can be difficult for people in general to see the importance of your role. Would it not be a good idea to tangibly demonstrate your social and industrial impact so that more people could understand the important role of the NYK Group?

Kurakado: In the Dry Bulk Division, I belong to a team whose mission it is to dig up and launch new dry bulk businesses, and I am in charge of sales. Moreover, I am also working on resolving the issue of ocean plastic waste in parallel with my main duties. Even as we continue a business with a long history, the Group has a corporate culture that enables people to take on the challenge of new businesses.

President Oishi, what aspects do you focus on when seeking new business opportunities?

Oishi: I believe I can best answer this question by describing my track record of starting businesses. In 2007, I happened to

Profile

Wataru Kurakado

Project Team
Global Mineral Resources Group

Wataru Kurakado joined NYK as an onshore office worker in 2011. Following his involvement in on-site training regarding pure car and truck carriers and container ships, he was assigned to the LNG Group. Subsequently, Mr. Kurakado worked on overseas finance in the Finance Group before assuming his current role working on new business development in the dry bulk business while tackling the problem of ocean plastic waste.

Profile

Ayako Hashimoto

Technical Team and Green
Technology Team,
Technical Group

Ayako Hashimoto joined NYK as an engineer in 2005, where she worked in the Technology Division on new shipbuilding and in-service vessels. She also carried out research and development at MTI Co., Ltd., during which time she took childcare leave. Currently, Ms. Hashimoto is involved in building vessels that use alternative fuels, such as hydrogen and ammonia, to help achieve the Group's aim of reducing its greenhouse gas emissions and working on verification testing.



| **Our Approach** |
Feature: Round table Discussion

see a young woman walking with a solar-powered cell phone battery charger on a subway car and, as my own cell phone battery was on the verge of running flat, I wondered whether I would be able to purchase electricity from her. That experience provided me with a flash of inspiration that I might be able to create electricity and sell it to other people, and so I started Minna-denryoku, Inc. The added value of traceability of your electricity producer has become a major point of differentiation from our industry peers. When issues become too big, we may lose the motivation to solve them. Who specifically will benefit from our solving a particular issue? Ocean plastic waste, as an example, is an extremely grave issue facing the world. However, rather than thinking about it from the broad perspective of the whole world, we might think about it on a personal level and just want to feed our children fish that is safe to eat, for example, or let them play

in a clean ocean. When we visualize issues in such a manner, the more specific and clear they are in our minds, the more readily solutions and ideas should emerge. In addition, the closer your motivations are aligned to your goals, the more able you are to be determined and passionate, no matter what difficulties you face. Even with a social business, it is not so easy that you can succeed via superficial means. It is because I have had such experiences that I find it valuable to rely on my own instincts.



of my supervisor. In March 2020, I began promoting an open sea sampling survey of microplastics in collaboration with Yutaka Kameda, an associate professor at the Chiba Institute of Technology (CIT), which has extensive knowledge regarding microplastic research. The NYK Group operates various vessels in oceans around the world, and we started a trial collecting samples of plastic waste during voyages of three dry bulk vessels carrying coal, iron ore, chips, etc., over a wide range of ocean. Since then, the number of target vessels and samples have steadily increased, and we are aiming for 100 samples by the end of this year. These samples are then analyzed by the CIT to create a worldwide microplastic map that comprises data such as waste size, distribution concentration, etc. We also associate the sample date, location information, and weather and ocean condition data. Promoting this project has made me keenly

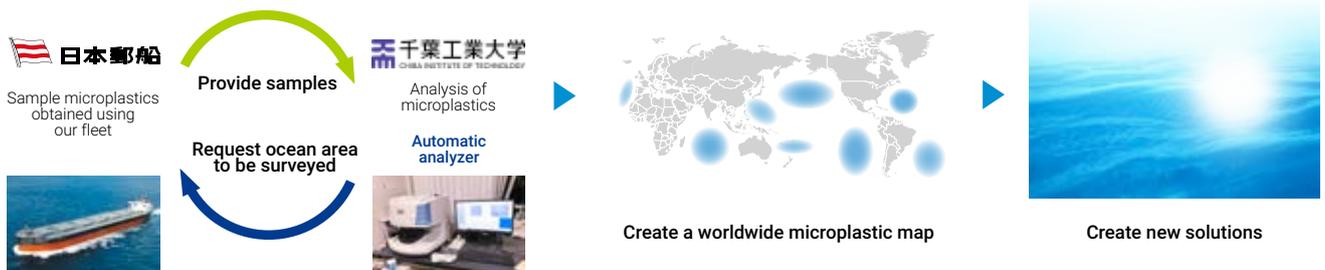
**Taking on the Challenge of
 Creating New Value**

Please tell us about your initiatives concerning ocean plastic waste.

Kurakado: Because the NYK Group's main business is the maritime shipping industry, I was interested in social issues related to the oceans, and ultimately I have a strong desire to use our vessels to make a social contribution. This desire inspired me to launch a project in this regard by visiting individual ocean research laboratories, universities, among others, when not performing my main duties, after obtaining the permission



Microplastic Sampling Analysis Flow



aware of the importance of cooperating with relevant internal departments. Now, we have started up a task force comprising members from each relevant department to promote activities with the Environment Group.

Oishi: That is a really great project, something which only the NYK Group could do. When considering commercializing the project, we incorporated blockchain technology to create a totally new kind of value. In the case of ocean plastic waste, you need to think about how to attach meaning to that value and also what kind of consideration it merits. For example, when you eat sushi, even if a particular sushi restaurant is a little more expensive than others, if eating there helps reduce ocean plastic waste, I would be happy to do so, because

I would see it as being connected to my children's future. When I started an Internet business at a major printing company, as it was at the dawn of the Internet era and the notion of public infrastructure was not well established, I was told that, even if we distributed news and articles digitally, we would not be able to charge a fee for doing so. When I established Minna-denryoku, Inc., at first everyone said that there was no way I would be able to sell electricity of the same quality for a higher price, even if it were only ¥1 higher. Nonetheless, I think it was my creating a persuasive story about the benefit to the earth that generated demand and enabled us to achieve profitability. You may also find with ocean plastic waste that business opportunities will expand if you can make a clearer story of how it will ultimately create value.

Hashimoto: I believe there must be value in the data collected regarding ocean plastic waste. It is likely that certain people would benefit from utilizing this data. As President Oishi said, if you can create a system that clearly benefits a specific customer demographic, then we can contribute to society as a shipping company.

Finding the Key to Achieving Innovation

President Oishi, what is the secret to creating a group of people who share the same principles?

Oishi: People differ as to what they find interesting. What is most important is to create a corporate culture that enables mutual respect among people and acceptance of their interests. In my experience, I have really felt that the more passionate someone is to make his or her particular business a success, the longer the business will operate, as opposed to running a business born of the interest of your company or supervisor. If I can be really passionate about something, then I can communicate that passion to other people. Moreover, if I can find just one other person who will get fired up about what interests me, then I will be able to give my best, no matter what challenges we face. All work is challenging, yet valuable. As a person who oversees others, one thing I make a point of doing is to encourage my team members to look at problems from a bird's-eye perspective and understand how to find the meaning in their work. Then, I make sure to not only pay attention to employees working on the front lines but also remain aware of those who are doing the steady work behind the scenes. Such an approach inspires even greater passion in individuals and makes them more likely to spark innovation.

Hashimoto: I am one of those who finds it easy to make work interesting. Nevertheless, within the Company there are people with all kinds of opinions. When I listened to what you said, frankly I experienced a kind of culture shock. As I strived to develop more as an engineer, I also had a

constant sense of unease that something was lacking in the status quo and that I was not creating value. This discussion has made me aware of the many ways in which I can still contribute.



Kurakado: I also found a lot to take away from today's discussion. I really felt it is important to go back to my instincts and the feeling I had when I started my project, as well as to ensure my project reaches its goal. From now on, I will boldly take on new challenges without fear.

Oishi: Please do try to take on all kinds of challenges. Many people who have qualifications or specializations shut themselves inside that framework. By building up experience, you may even find that your strengths and expertise can change. Even if people think that they have an area of expertise, they may often find they also have other strengths, and the NYK Group is no exception. It is important not to box yourself in. Rather, it is vital for companies and supervisors to help their employees be aware of the value of being open-minded. I wish all of you the very best with your future endeavors, and I look forward to being able to work with you on initiatives that are "fun and profitable" going forward.