Business Activities

Industrial Automation and Control Business

Energy & Sustainability Business

Our business contributes to realizing a resilient and sustainable society by supporting safe and optimal operations throughout the entire value chain of production, delivery, use, disposal, and recycling for energy diversification.

Koji Nakaoka
Head of Energy & Sustainability Business Headquarters

We provide optimal and timely solutions by understanding the needs and trends of changing customers and industries, and by utilizing our own products as well as collaboration with third-party and M&A.

Fiscal Year 2022 Review

Orders received in fiscal year 2022 grew substantially by 25.3% year on year.

We believe that this growth was primarily due to the stronger relationships of trust we built with our customers through the tenacious value proposition activities even throughout the COVID-19 pandemic period. This resulted in immediate orders awarded by our customers as soon as economic activity resumed. It is also attributable to our proactive efforts to propose solutions that contribute to enhancing DX and reducing environmental impact, by capturing customers' revitalized investment sentiment and business diversification needs thanks to the stabilizing high prices of crude oil and natural gas.

Highlights in each industry included great number of DX solutions through "co-creation" with customers in both the Upstream and Downstream sectors. For example, we have offered the real-time data acquisition of operating status and the revenue maximization in the petroleum refining process through KBC's simulation technology, as well as accident prevention and labor savings through the prior detection of abnormalities at individual oil wells scattered across a vast area and the automation of recovery operations procedure. These solutions also make a significant contribution to reducing environmental impact.

In the Power/Renewable Energy sectors , we have collaborated with other companies to make a proposal and secure orders for a variety of new solutions such as boiler condition monitoring and turbine control technologies. We also received a great number of inquiries concerning our new acquisitions, PXiSE and Dublix. We are progressively responding to these with priority and at same time are expanding our sales network by conducting training in our overseas offices.

In addition, for hydrogen, starting from the iconic award of "Holland Hydrogen I" in the Netherlands, we are co-creating for the condition monitoring methods, storage and transportation, etc., and are participating in a various Proof of Concept activities in order to be recognized as a leading vendor in the emerging hydrogen business.

Fiscal Year 2023 Outlook

Orders in the Energy & Sustainability subsegment are expected to decline by 5.3% year on year in fiscal year 2023.

This is mainly due to a peaking-out in demand for large capital investment projects in fiscal year 2022. Moreover, customers have allocated substantial human resources to projects implementation over the past two years, and concerns about deteriorating profit margins for new projects due to the progress of global inflation, as well as doubts about the ability to execute projects due to labor shortages, have led them to adopt a somewhat cautious attitude towards further large investments.

A large number of projects are expected in India and China, where the market is expected to grow strongly, but price competition is intensifying. Therefore, we will strategically advance our activities to achieve growth in medium- to long-term while striving to securing a reasonable level of profit.

Despite these concerns ahead, the Energy & Sustainability Business Headquarters aims to achieve the targets of AG2023 by deepening four major strategies.

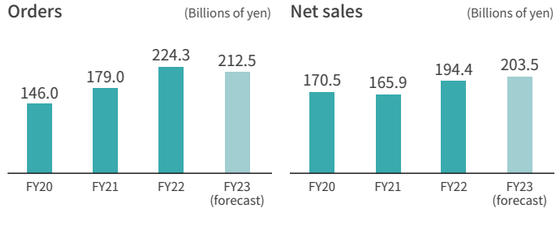
(1) "Co-creation" with customers — Through cross-industry collaboration on carbon neutrality and more diverse proposals using our IA2IA concept, we will lead the way with schemes for reducing environmental impact not only from plant operations, but throughout the energy supply chain.

(2) Expand the recurring revenue business model — We will capture maintenance costs across the asset lifecycle by collecting customers' plant maintenance data, then providing integrated remote monitoring and data analysis , and advising and delivering appropriate maintenance and solutions.

(3) Enhance Business portfolio through collaboration, M&A, and alliances — We will focus on the renewable energy industry, where we will address diverse applications, and on the oil and gas industry, one of our strengths, to broaden our business portfolio and drive further differentiation.

(4) Regional/Account strategy — The needs of our customers are becoming increasingly diverse in each region and industry, and we are engaged in a growing number of joint venture projects with our powerful local customers, including international oil companies. We will strive to establish partnerships allowing us open opinions exchange, not only through the local management but also with Yokogawa's top management, especially in regions such as the Middle East, India, and South America, where the will of the customers' top management is strongly reflected in the activities of government-owned or semi-government companies.

Trend in Orders and Net Sales



AG2023 CAGR

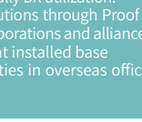
(Reference) Order growth*2			Sales growth*2		
CAGR (FY20-22)	CAGR (FY20-23)		CAGR (FY20-22)	CAGR (FY20-23)	
Result	Forecast*1	AG2023 target	Result	Forecast*1	AG2023 target
23.9% (14.3%)	13.3% (7.8%)	9% or more	6.8% (-1.6%)	6.1% (0.9%)	4% or more

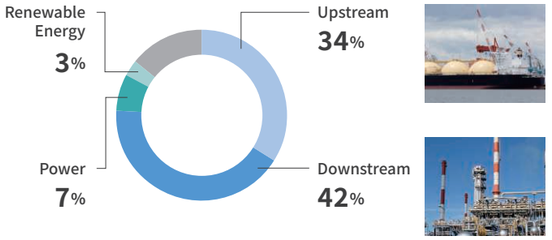
*1 If the FY2023 forecast achieved
*2 The figures in parentheses represent organic growth (excluding the impact of exchange rates)

Business Area

Our business domain encompasses the entire energy supply chain, from the drilling for oil and gas to delivery of "city gas" and optimal control of electricity and renewable energy generation and transmission/distribution networks.

Business Composition (Orders Received in Fiscal Year 2022)





	Upstream / Downstream	Power / Renewable Energy
Strengths	• A global, unbiased and abundant installed base and a relationship of trust with customers that continues after delivery. OPEX business model including services based on the above relationship. • Simultaneous possession of the ability to consult on operational improvements and the solutions to implement . • Total system integration capabilities including third-party products (products re-sold by other companies)	• Extensive experiences in geothermal, Waste-to-Energy, and Biomass applications and further expansion of know-how and solutions through M&A. • Acquisition of transmission system technology know-how through M&A. • A full lineup of environmental load reduction solutions such as emission control and optimal combustion, and real-time temperature control • Our references in Japan for optimal energy management.
Customer Trends	• Investment revitalization on oil & gas businesses due to the impact of the Russia-Ukraine situation (especially on gas) • Diversification of businesses and selective investment into core businesses in parallel, responding to energy transition. • Proof of Concept activities to commercialize cross-industry consortia for CCUS, hydrogen, and ammonia, etc. • Increased investment in DX, including operational efficiencies, unmanned and remote operation, etc. • Concerns about worsening breakeven point caused by inflation (of both construction material and wages). Project postponement or suspension due to such concern.	• Diversification of renewable energy. Key investment applications vary by region and customer. • Return of investments in gas-fired and nuclear power plants to compensate for power shortages • Strengthening the self-sufficiency capability with domestic resources due to the emergence of energy security risks, and Continuation of investments in coal-fired power generation, etc., corresponding to that
Competitive Environment	• Severe price competition involving local vendors (China and India) • Active M&A by IA leading vendors for vertical integration. • Active promotional activities centered on carbon neutrality	• The entry of new players outside of the traditional IA domain, such as consulting firms, IT vendors and local integrators, etc. • Aggressive introduction of new solutions and case studies through the active use of social media or webinars, etc.

Key Measures

Upstream / Downstream

- Helping customers increase profits by improving equipment operating efficiency and by maximizing uptime through fully DX utilization.
- Horizontal development of "ready-to-use" solutions through Proof of Concept with customers. Proactive use of collaborations and alliances.
- Expand the OPEX business based on abundant installed base
- Enhance own solution development capabilities in overseas offices and share the successful cases globally.

Power / Renewable Energy

- Strengthen vertically integrated portfolio including acquiring of facilities management solutions to expand MGC*2/DERMS*3 business. Pursue other M&A, collaborations and equity investment.
- Expand business scope by combined proposal of existing solutions using active inquiries to acquired companies
- Accelerate research on hydrogen business potential by in-house cross-section task force.

*1 PoC: Proof of Concept
*2 MGC: Micro Grid Control
*3 DERMS: Distributed Energy Resource Management System

Industrial Automation and Control Business

Energy & Sustainability Business

Maximization of the efficiency of power generation through IoT systems

(Olkaria Geothermal Complex)

Project Name: Olkaria Geothermal Complex (Republic of Kenya)

Customers: The Kenya Electricity Generating Company PLC (KenGen)

Olkaria II Power Station

Overview

Electricity consumption in the Republic of Kenya tripled*1 between 2000 and 2021 due to the rising population and economic development, and securing a stable supply of electricity has become an issue for the country. Kenya has some of the richest geothermal resources in the world. Geothermal power generation is gaining attention as a stable source of electricity with extremely low CO_2 emissions.

The Olkaria Geothermal Complex*2 is the largest geothermal power generation capacity in Africa. It consists of five geothermal power stations (Olkaria I, I Additional Unit, II, IV, and V) operated by KenGen. Olkaria IV is the furthest away from the central control office, at a distance of 20km by road. Previously, the operations of each scattered power stations had been separately managed, and the power complex lacked an effective operations management system capable of overseeing all power stations.

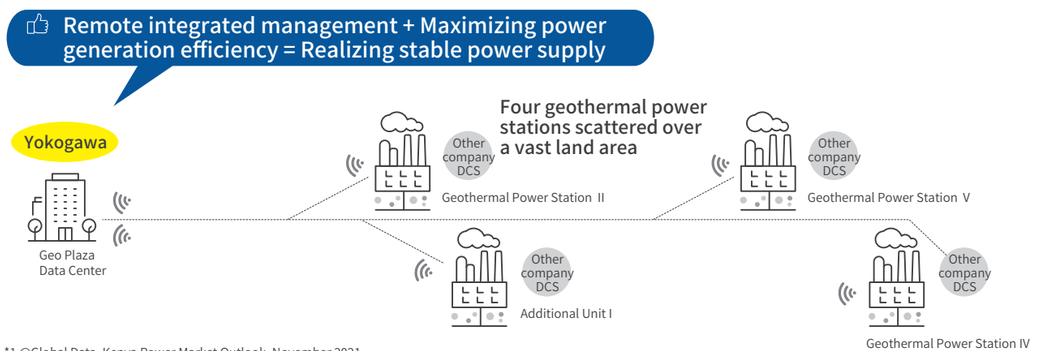
Yokogawa proposed the establishment, installation, and training of an IoT-based, integrated, remote management system using telecommunications and other networks to collect data from the four scattered geothermal power stations above (Olkaria I Additional Unit, II, IV, and V). This system enables the integrated management of the performance of each generating unit's and the maintenance status of the associated equipment. If there is a decline in the efficiency of power generation, it automatically analyzes the causes, and implement appropriate maintenance accordingly.

Achievements

Maximization of the efficiency of power generation:
In the past, when the efficiency of power generation declined, the plant would be coped by increasing the production volume of steam: the "fuel" that runs the generators. However, steam is also a limited natural resource. The depletion of the "fuel" due to an increase in production volume leads to the risk of shortening the operating life of the power plant. This project enabled the plant to use the fuel more efficiently over a longer period.

Realize integrated remote management and ensure human safety
The Olkaria Geothermal Complex is located in a vast, verdant national park, large enough to accommodate approximately 1,450 units of Tokyo Domes. It is therefore necessary to patrol the Complex's undeveloped roads by off-road vehicle. The maintenance work itself was dangerous, and there were concerns over air pollution in the park from vehicle exhaust fumes. This project has drastically reduced the need for staff to travel to the power plants and steam escaping wells scattered throughout the park to check the conditions of equipment there.

The project was implemented on an extremely tight schedule in the midst of the COVID-19 pandemic, but experts from the Yokogawa Headquarters rushed to the site, which requires on-site verification test, and successfully able to complete delivery on schedule. Our customers applauded Yokogawa's project execution capabilities.



*1 @Global Data, Kenya Power Market Outlook, November 2021
*2 The Olkaria Geothermal Complex consist of geothermal power stations I, I Additional Unit, II, III, IV, and V, and currently has a power generation capacity of approximately 930 MW. The oldest power station, Olkaria I, started operation in 1981.

As a leading integrator in the world of the System of Systems, we will provide solutions that create value for society and the entire supply chain

(Holland Hydrogen I Project)

Project Name: Holland Hydrogen I (the Netherlands)

Customers: Shell

Holland Hydrogen I (Part of the facilities *Image)

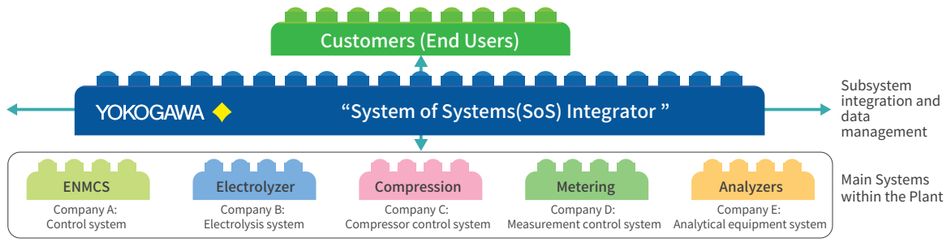
Overview

Hydrogen is highlighted as a promising energy source in the energy transition towards a decarbonized society. The Netherlands is already the hub of Europe's natural gas pipelines, and the prices of gas transactions in Europe are determined through trading at this hub. For a next generation energy source, efforts are being made to maintain this status as a part of the Netherlands' national strategy.

As the name suggests, this project is one of the Netherlands' national strategies to become the leader of the hydrogen supply in Europe. Hence, the country's top politicians attended the inauguration ceremony. The project is positioned as a crucial one by both Shell and the Netherlands government. Yokogawa has been selected as the MAC (main automation contractor) for this project. We will organically integrate plant control and equipment for optimized plant operation.

Our Vision for the System of Systems (SoS)

Yokogawa aims to lead the world in which society as a whole becomes a System of Systems (SoS), where systems are organically connected to each other. The same is true in the hydrogen supply chain, where supply vendors differ for various functions such as production, pipeline transportation, storage, and supply, and a high level of integration capability is required to integrate and operate these subsystems. In this project, Yokogawa was selected as the MAC (Main Automation Contractor) based on its long-standing relationship of trust with the client and its proven track record. Yokogawa will contribute to this project by creating value through SoS optimization.



For the Future

Through our participation in this project, we expect to gain operational expertise for large-scale commercial plant in highly promising hydrogen business. With many electrolysis-based hydrogen production projects in the sales pipeline, Yokogawa will accelerate our activities and expose more our industry presence through our achievements. In fiscal year 2022, Yokogawa was also selected for Australia's largest commercial green hydrogen project (the Yuri project).

The Energy & Sustainability Business Headquarters will continuously contribute to a resilient and sustainable society.

Industrial Automation and Control Business

Materials Business

The Materials Business contributes to the realization of a convenient and comfortable material society and a recycling-oriented society that can coexist with the global environment by speedily implementing four key measures to address issues such as improving customer productivity, reducing environmental impact, and using energy efficiently.

Takeshi Taniguchi
Head of Materials Business Headquarters

In addition to growth in the Process Automation (PA) area, which is our forte, centered on chemicals, we aim to further expand our business in new areas centered on the mobility supply chain (semiconductors, mining, etc.), which is expected to grow against a backdrop of decarbonization and other factors.

Fiscal Year 2022 Review

Looking back on the second year of the Materials Business Division, which was newly established in April 2021, it was a year of solid results in establishing a business base and accelerating growth in the industrial axis.

In fiscal 2022, orders received were especially strong at 202.0 billion yen (+28.3%), including the effect of exchange rates, mainly in Japan, which accounts for about half of the orders.

Although some orders were frontloaded due to the impact of global inflation, we recognize that we are making steady progress toward achieving the AG02023 target.

In the mainstay chemical industry, the need for environmentally friendly materials (business opportunities) is increasing as the movement toward carbon neutrality and a circular economy accelerates. Against the background of CO_2 reduction in the mobility supply chain, our company's strength in technology, especially in the field of Specialty Chemicals, and experience in various manufacturing processes, including the needs for new raw materials for rechargeable batteries for electric vehicles (EVs) and power semiconductors, is contributing to an increase in orders.

Also, in the mining industry, which is our focus industry, continuous demand growth for copper and lithium, including global expansion through comprehensive initiatives with major overseas customers, has led to an increase in orders.

Mindset Transformation (MX) activities, including the industry-plant process training that has been promoted mainly in Singapore to strengthen solution-oriented proposal capabilities, have contributed to the growth of problem-solving orders globally, as well as to the improvement of organizational capabilities in the industrial segment. In addition, as part of our efforts in new areas, we have also improved the content of our Battery Website and released a promotional movie for Carbon Management Solutions. We received overwhelming responses and have been approached by customers in various industries where GHG emissions are a management issue, as well as new partners with whom we have not previously had a relationship, to work with us to decarbonize their businesses.

Fiscal Year 2023 Outlook

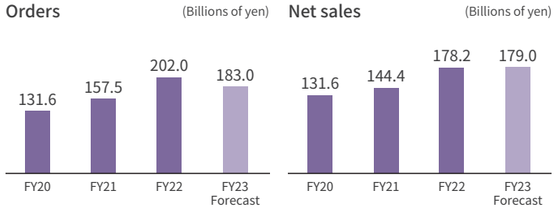
Material Business Division Orders for FY2023 are expected to decrease 9.4% YoY, mainly in the first half of the fiscal year, due to an expected slowdown in investment by customers, mainly in the materials industry. Despite a temporary decline in a single fiscal year, the Materials Business Division recognizes that it is making steady progress toward its AG2023 targets of 6% CAGR for orders and 3% for sales, excluding the impact of foreign exchange rates. We will not change our policy significantly but will further accelerate our priority measures to achieve the AG2023 target.

In addition, with an eye on the future, we will focus our activities from the three perspectives of "Focus Industries," "Sales Strategy," and "Solutions."

First, in "Focus Industries," in addition to the chemical, mining, and mobility supply chains, we will focus on the agrochemical and fertilizer areas, which are essential for daily life and for which demand is relatively stable.

Second, in "Sales Strategy," we will devote resources to developing new sales channels while optimizing global allocation and strengthening conventional channels beyond the framework of regional strategies. Next, from a "Solutions" perspective, priority will be given to strengthening "Carbon Management," "batch solutions" in the Specialty Chemical fields, and "Battery Solutions." In both cases, in addition to growth in existing fields, we will place "Mobility Supply Chain" at the center of our strategy to achieve our business goals, support the creation of earth-friendly materials of the future, and contribute to the realization of a recycling-oriented society.

Trend in Orders and Net Sales



AG2023 CAGR

(Reference) Order growth*2			Sales growth*2		
CAGR (FY20-22)	CAGR (FY20-FY23)		CAGR (FY20-22)	CAGR (FY20-FY23)	
Actual	Forecast*1	AG2023 Target	Actual	Forecast*1	AG2023 Target
23.9% (16.9%)	11.6% (8.1%)	6% or more	16.4% (9.6%)	10.8% (7.4%)	3% or more

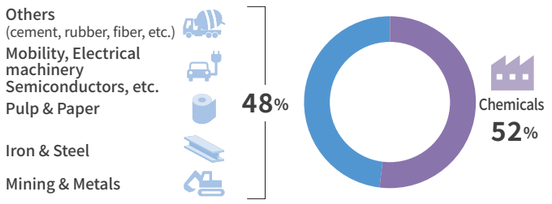
*1 If the FY2023 forecast is achieved
*2 The figures in parentheses represent organic growth (excluding the impact of exchange rates)

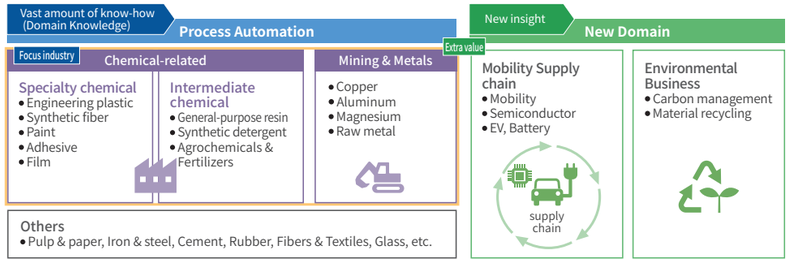
Business Area

In a wide range of materials industries, we are developing our business in two main areas.

The first is the "PA domain" which includes mining, metals, etc., with a focus on chemistry, which has always been our forte. The second is the "New domain" which includes mobility supply chain, which is a new growth area, and carbon management, etc.

Business Composition (Orders Received in Fiscal year FY2022)

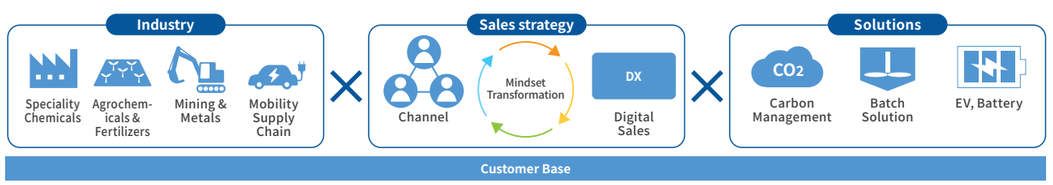




	Chemicals	Mining & Metals
Strengths	• High share of DCS in the basic chemical field and large installed base • Extensive experience and know-how accumulated through long-term partnerships with customers of world-leading Japanese companies	• It has a strong affinity with the PA area, which Yokogawa specializes in. Safety and reliability match our customers' needs. • Experience and know-how accumulated through long-term partnerships with customers mainly in Australia, South America and Africa
Customer Trends	• High-mix low-volume production • Increasing global demand for semiconductors and efforts for stable supply • New raw material for EVs, raw material development needs with low environmental impact • Promoting efficient use of energy, such as reducing CO_2 emissions toward carbon neutrality	• Increasing need for optimal and autonomous operations throughout the mine • Issues such as environmental (decarbonization) safety, advanced control, advanced maintenance, and remote operation
Competitive Environment	• The continuous process is centered on DCS vendors, and the batch process has many players including PLC vendors as well as DCS vendors. Industry knowledge is a differentiating factor	• Mainstream of major vendors traditionally strong in the heavy electric field

Growth Strategy

Utilizing our customer base, we will develop our business by focusing on industries, sales strategies (expansion of sales channels/utilization of digital sales), and development of new solutions. We will take three approaches.



Industrial Automation and Control Business

Materials Business

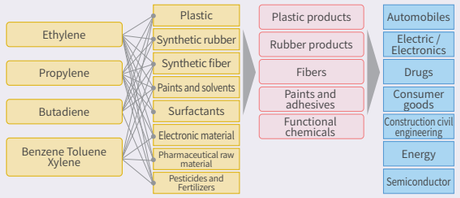
Chemicals

The chemical industry has a broad base, encompassing various sectors, from producing basic chemicals such as ethylene to providing raw materials widely useful to society, such as materials for electric vehicles and semiconductors. Due to the complexity of the system, the number of control points, and the importance of integration, the chemical plant process can take advantage of Yokogawa's strengths such as reliable and high-quality products, high project execution ability, solution proposal capability, and timely and detailed service. In particular, we hold a dominant share of the chemical industry in Japan.

In the manufacturing process of the chemical industry, the upstream of the supply chain is predominantly a continuous process, while the downstream is batch processes. In the future, as raw materials diversify and materials become more functional, Yokogawa will strengthen batch (process-oriented) solutions in addition to continuous processes, which is its forte, and will accelerate its efforts to establish a firm foothold in the chemical industry.

Globally, the chemical industry is expected to grow at a high rate over the medium to long term, although there will be temporary increases and decreases due to continued market expansion in semiconductors, EVs, and other mobility-related markets. By leveraging the extensive experience and know-how accumulated in Japan and expanding overseas, Yokogawa aims to achieve steady growth.

■ Supply Chain of Chemical Industry



Source: Ministry of Economy, Trade and Industry, "Current Situation and Issues in the Chemical Industry"

■ Classification of Manufacturing Processes

Flow process
Mass production
React the fluid continuously

Batch process
Manufacturing process for a small number of many products, produced by the same equipment and facilities.

Oil, LNG (liquefaction, regasification)
Petrochemical, Refinery

Chemical, Bulk chemical, Specialty chemical

Source: Ministry of Economy, Trade and Industry, "Role and Expectations of Innovation in the Materials Industry," January 2018

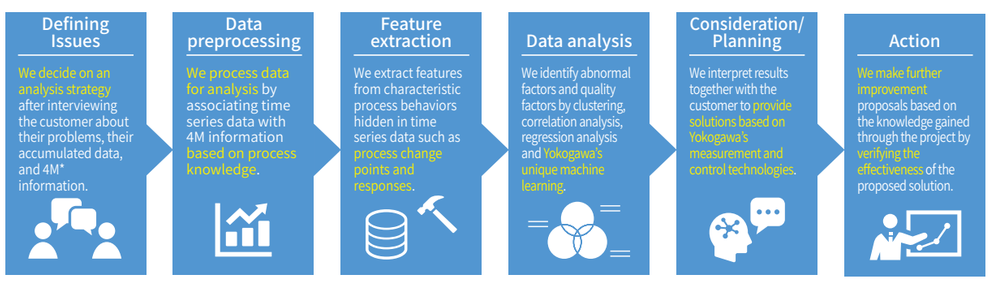
Case Study

Improving and Stabilizing Product Quality Using Big Data

Customer Industry: Fine Chemicals
Solution: Process Data Analytics

- **Customer Background:** Due to the aging production facilities and the retirement of veteran operators, quality stabilization, efficiency improvement, and transmission and sharing of operating know-how have become major issues at many plants. In recent years, more stringent quality targets have been required for products, and further improvements in operations have been required.
- **Achievement:** Yokogawa provides a big data analysis IoT solution to solve these challenges. In the analysis project, we analyze various data, including process data, in cooperation with people in the manufacturing field, and unravel the factors. By engaging people in the field with a variety of knowledge and experience in thinking together, discussing throughout the analysis, and implementing improvement actions, we provide not only tangible value, such as stabilizing quality, but also intangible value, such as formalizing tacit knowledge, improving communication across departments and roles, and improving problem-solving skills.

As a result, we have identified several factors that affect product quality. We have improved and stabilized product quality by improving the accuracy of sensors in required areas, adding new quality control points, and modifying control sequences.



*4M: Man, Machine, Material, Method

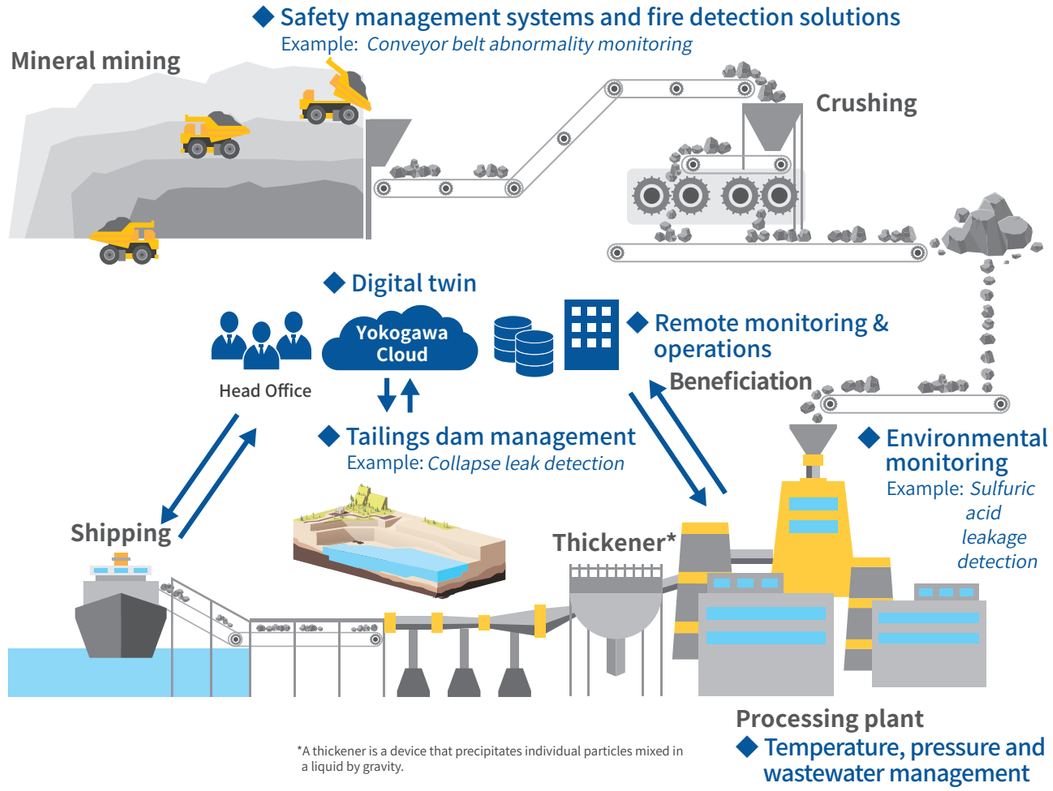
Mining

Recently, as the world increasingly adopts renewable energy, electric vehicles (EVs), storage batteries, fuel cells, etc., toward decarbonization, the demand for mineral resources such as copper and rare metals has increased. The mining & metal market is booming and the market size is expanding. Against this backdrop, the need for optimal and autonomous operation of the entire mine is increasing, as the site is required to respond to environmental (decarbonization) considerations, safety, advanced control and maintenance, and remote operation.

The "dig, crush, heat or pressure, refine, and drain safely" process at the mine is highly compatible with solutions for oil and gas, and it is an industry where our strength in "measurement" and "control" can be utilized.

In addition to measurement and control solutions for scattered worksites, Yokogawa provides solutions such as cloud-based integrated operations, as well as environmental load reduction, safety and operational improvement. Our company is working to solve our customers' problems by utilizing the know-how we have accumulated through many projects, mainly in Australia, South America, and Africa.

Examples of Solutions Provided



*A thickener is a device that precipitates individual particles mixed in a liquid by gravity.

■ Challenge to Improve Useful Mineral Collection Using AI

Yokogawa is working to solve problems by conducting a series of demonstrations with our customers to realize control technologies that maximize mineral recovery in the flotation* process through image analysis using AI instead of operators.

*A type of beneficiation in which minerals and chemicals such as surfactants are injected into a water tank, and useful minerals are collected by separating them into those that float and those that sink with the bubbling air blown into the tank.

Industrial Automation and Control Business

Life Business

The life business provides solutions that support people's lives and protect their health and safety. We contribute to the supply of pharmaceuticals that save people's lives and health, and safe food and water everyone can eat and drink with peace of mind.

Hiroshi Nakao
Head of Life Business Headquarters

We will lead the world in advancing "Bio Industrial Autonomy (BIA)" and contribute to a future embracing global harmony.

Fiscal Year 2022 Review

Orders received in FY2022 were ¥59.1 billion, up ¥4.5 billion, or 8.3%, from the previous year.

In the Life Sciences business, sales of the "CSU-W1 SoRa", which enables super-resolution live cell imaging, increased. We were able to obtain an order for High Content Analysis that can seamlessly realize everything from cell imaging to analysis from a major account in Europe and the United States. In addition, the activities to expand the service business that we have been promoting since the past have been successful. As a result, the Life Sciences business achieved record-high orders and sales. We launched the Subcellular Sampling System SS2000 in February 2022, and in FY2022, we received an order for the first unit from GSK plc.

In the Pharmaceuticals and Food markets in Japan, we have achieved record-breaking orders for not only existing businesses such as control equipment, but also DX/smart factory solutions to resolve customer issues.

In the Water business, besides steadily increasing orders in Japan, we actively worked to create new businesses such as water leakage/distribution management and sewage/reclaimed water.

Furthermore, continuing from previous year, we vigorously worked for M&A and alliance activities for the purpose of expanding the Life business. For HIROTSU Bioscience Co., Ltd. (HBS), with which we concluded a capital and business alliance agreement in December 2020, we were in charge of designing and manufacturing inspection equipments. HBS and Yokogawa have adopted a revenue-sharing system (*1) and we will continue to work together in the future. Yokogawa Insilico Biotechnology, which joined the Yokogawa Group in November 2021, has been developing digital twin technology for bioprocesses, used to improve the efficiency of operating condition searches through bioprocess simulations, stabilize production of biopharmaceuticals, and reduce production losses. We will provide customers with unprecedented new value. In addition, in April 2022, we launched "Pharmira Co., Ltd.," a joint venture that conducts contract development and manufacturing of continuous manufacturing technology for pharmaceutical active ingredients and intermediates.

We will continue to energetically work to provide customers with new value and cutting-edge technology.

*1: A system that distributes a certain amount of revenue according to the number of samples to be measured

Fiscal Year 2023 Outlook

In the Pharmaceuticals, Food and Water industries, we continue to see strong investment appetite for process advancement, including safety, productivity and quality improvements. Aiming for 4.9% growth in orders received in FY2023, we will strengthen our overseas development of products and solutions that have traditionally been strengths in the Japanese market.

In Life Sciences, we are currently focusing on single-cell analysis solutions. We will develop applications such as genome editing (CRISPR-Cas9 (*2)) and utilize demonstration sites, academic conferences, exhibitions, etc., for accelerating global activities to receive orders.

In Pharmaceuticals, Food, and Bio, we will work with regional headquarters to capture target customers such as GMA (Global Major Accounts) by training overseas members and strengthening support for overseas bases from Japan. As a new solution, in June 2023, we announced an integrated information management system (OpreX Informatics Manager) that connects not only laboratories but also departments such as production and quality assurance.

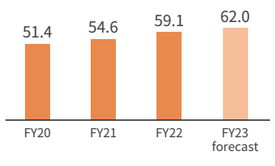
In the existing Water business, we aim to acquire new business opportunities for water supply, sewage, water distribution businesses and ODA (*3) projects. In the new Water business, we aim to commercialize the water distribution and leakage management, land-based aquaculture, reclaimed water, and water circulation cloud businesses.

We will continue M&A and alliance activities. In FY2023, we will continue to work actively to achieve the plan of AG2023.

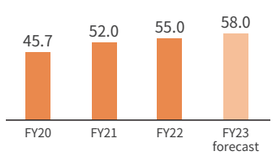
*2: CRISPR-Cas9: A genome-editing technology that enables simpler, more efficient, and more flexible rewriting of genetic information than conventional genome-editing methods
*3: ODA: Official Development Assistance

Trend in Orders and Net Sales

Orders (Billions of yen)



Net sales (Billions of yen)



AG2023 CAGR

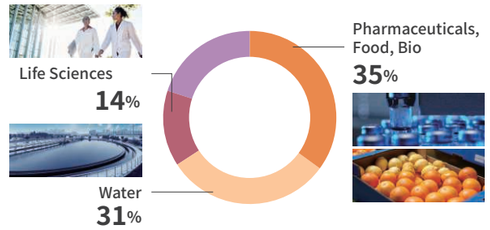
(Reference) Order growth*5			Sales growth *5		
CAGR (FY20-22)	CAGR (FY20-FY23)		CAGR (FY20-22)	CAGR (FY20-FY23)	
Actual	Forecast*4	AG2023 Target	Actual	Forecast*4	AG2023 Target
7.2% (4.0%)	**6.4%** (4.8%)	**16%** or more	**9.7%** (6.0%)	**8.3%** (6.5%)	**16%** or more

*4: If the FY2023 forecast is achieved
*5: The figures in parentheses represent organic growth (excluding the impact of exchange rates)

Business Area

In the Life business, we improve the productivity of the entire customer value chain, from basic research to logistics and services, in the Life Science, Pharmaceutical, Food, Bio, and Water industries, and contribute to the well-being of all people.

Industry Composition (Orders Received in Fiscal Year 2022)



	Life Sciences	Pharmaceuticals, Food, Bio	Water
Strengths	● High market share and brand value in high-end CSU ● Unique and innovative technologies and advanced development capabilities in live cell imaging ● Knowledge and expertise in the cell field	● Providing wide variety of solutions to support from on-site to the management level ● Global sales and service network and extensive implementation track record ● Measurement and control technologies for the biomaterial manufacturing process ● Digital twin technology	● Extensive track record of deliveries in the Japanese water and sewage market ● Total project execution capability for integration includes electric instrumentation
Customer Trends	● Increase in personalized medicine studies ● Increasing needs for sophistication and automation in the laboratory experiment ● Accelerating open innovation ● Growing demand in the live cell imaging field	● Progress in biotechnology ● Advances in technologies such as genome analysis/manipulation and cell processing ● Implementation of automation and autonomy through smartification and digitization ● Increasing the penetration rate of digital twins	● Increasing water demand due to population growth ● Active development of water sources for stable supply ● Increased investment in monitoring control, and DATA fields ● Provide diversified solutions to meet regional and country-specific needs
	Common: ● Enhance portfolio and product lineup through M&A and alliances		
Competitive Environment	● Severe competition with industry giants	● Aggressive entry from the IA industry	● Many competitors exist in each region and country
	Common: ● New entry from IT and software companies		

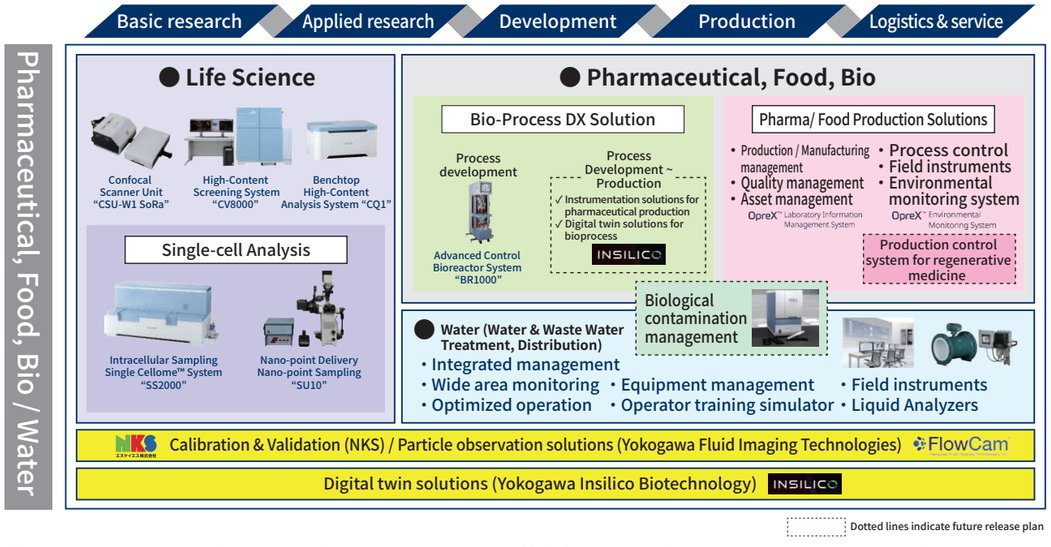
Key Measures

Life Sciences	Pharmaceuticals, Food, Bio	Water
Common: ● Strengthen cooperation with regional headquarters and expand global business ● Create new projects and expand orders using digital marketing, exhibitions, and webinars ● Continuation of M&A, capital and business alliance activities		
● Expansion of imaging equipment functions ● Research and develop technologies for next-generation microscopes ● Strengthening bio lab automation ● Providing remote support services ● Expansion of single-cell analysis solutions	● Realization of next-generation smart factories ● Expansion of production control system for regenerative medicine ● Unmanned or labor-saving operations through Robotics ● Providing Bioprocess DX(BDX) Solutions	● Automation of water and sewage facilities ● Official Development Assistance (ODA) in emerging countries ● Water distribution and leakage management / Land-based aquaculture / Reclaimed water / Water cycle cloud

Industrial Automation and Control Business

Life Business

Solution Portfolio of the Life business



Dotted lines indicate future release plan

Contribution to Digital Transformation(DX) in the Biopharmaceutical Industry (Ajinomoto Co., Inc.)

■ Overview

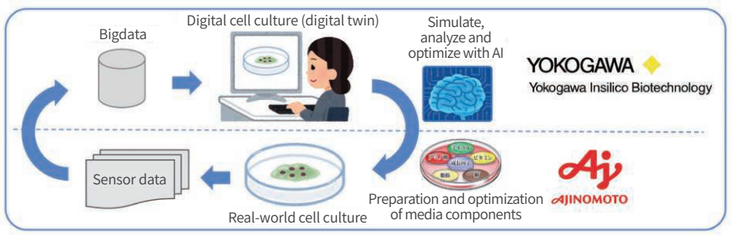
In recent years, demand has continued to grow for biopharmaceuticals that have fewer side effects and can be used to treat patients with rare and intractable conditions. In contrast to the production of chemically synthesized small molecule pharmaceuticals, the overall cost of biopharmaceuticals is higher, and the complex cell cultivation process required to efficiently and stably obtain the target proteins demands rigorous quality control measures that pose significant challenges to mass production.

By leveraging the digital twin technology provided by Yokogawa Insilico Biotechnology GmbH (YIB), a member of the Yokogawa Group since November 2021, we can help develop processes to achieve stable quality and efficient mass production in the field of biopharmaceuticals development and production.

YIB is working in collaboration with Ajinomoto Co., Inc., which develops, manufactures, and sells cell culture media under the CELLiST™ brand, for development and production of biopharmaceuticals. Ajinomoto Co., Inc. develops advanced culture media based on their expertise in amino science such as amino acid nutrition, pharmaceuticals R&D, and fermentation production technology, and provides culture media to the global market as well as Japan and Asia. Ajinomoto Co., Inc. uses YIB's digital twin technology to develop and supply high-quality, high-performance media promptly and stably.

■ Achievement

In the production of mammalian cell culture for biopharmaceuticals, we propose the optimal adjustment of culture media components to Ajinomoto Co., Inc. by using YIB's digital twin technology with modeling and AI to simulate and optimize data collected from various sensors. Subsequently, based on suggestions with YIB technology, Ajinomoto Co., Inc. can confirm the improvement of culture medium performance through real cell-culture. As a result, Ajinomoto Co., Inc. can greatly reduce the time required to search for optimized conditions through repeated experiments. YIB technology contributes to the development of rapid optimization mechanisms for medium composition and culture conditions and to the efficient scale-up of antibody-production by controlling the response. Yokogawa and YIB will continue to accelerate digital transformation(DX) in the bioprocess field, contributing to the industrialization of bioprocesses and the improvement of productivity and quality in the biopharmaceuticals field.



Yokogawa Insilico Biotechnology GmbH

Established: 2001 (Joined Life Business Headquarters as a subsidiary in November 2021)
Location: Stuttgart, Germany
CEO: Koichi Oya
Number of employees: 30
Business: Development of digital twin-based software and provision of services for bioprocesses

Building Next-Generation Smart Factories that Pursue Optimal Safety and Security (NISSIN FOOD PRODUCTS CO., LTD.)

■ Summary

NISSIN FOOD PRODUCTS CO., LTD. has defined the concept of its new factory as a "next-generation smart factory that pursues optimal safety and security." They are studying ways to create safe and secure products, reduce manufacturing costs, and build an optimal supply system. Yokogawa received orders of all five systems for the new factory such as the Manufacturing Execution system, Warehouse Management System and Plant Information Management System.* To realize the new factory, Yokogawa participated not only in the introduction of the new systems, but also in the "Consulting on Basic Concept" phase for drawing up a design plan, and worked with the customer. In the review process, NISSIN FOOD PRODUCTS CO., LTD. stated that "Yokogawa is a company that is highly experienced and knowledgeable about the site, learns about NISSIN, and works from the same perspective as ours. Besides, we often heard about the good reputation of Yokogawa from other food & beverage companies, which was a key factor in our selection of partners."

*Some products and solutions are sold only in Japan.

■ Results

The new factory, which is currently in operation, has established the Centralized Monitoring and Control Office as the center of the world-class quality-control system. Yokogawa's system has contributed to improving food safety and security. This factory is now one of the largest factories in Japan, producing 4 million meals per day, with high productivity as well as quality.

■ Future of Customers and Yokogawa

In the future, NISSIN FOOD PRODUCTS CO., LTD. will continue to collect and analyze data and conduct a variety of research projects, aiming not only to automate facilities but also to realize autonomous operation in the future. In addition to this, NISSIN is aiming to link supply chain data, optimize operations as a company, and further improve efficiency with a view to expanding the system to other factories and divisions.

Yokogawa has a strong determination to bring together its know-how, and will continue to work to sustain the global food & beverage supply with our customers in the food & beverage manufacturing industry with a mission of providing a long-lasting stable supply.

NISSIN FOOD PRODUCTS CO., LTD. KANSAI Factory

Visit the website below for more information.

https://www.yokogawa.com/industries/food-beverage/

Subcellular Sampling System SS2000 - Aiming to Contribute to the Development of Drug Discovery and Medicine - (GSK plc)

■ Overview

Yokogawa began developing the SS2000 prototype in 2014 and completed the prototype in 2017. Since 2017, we have installed a prototype at GSK plc, a global biopharmaceuticals company in the U.K., and have been jointly developing devices and applications. In February 2022, the SS2000 was officially launched, and we received an order for the first unit from GSK plc in FY2022.

■ Achievement

It takes about 30 minutes to collect cell samples manually, but the SS2000 can perform the procedure automatically in about three minutes. Since conventional analysis of intracellular components mainly involves collecting and disrupting cells, positional and morphological information is lost. However, the SS2000 solves these problems.

■ Future of Customers and Yokogawa

GSK plc is currently considering using the SS2000 for individual region analysis of tubercle bacillus-infected cells, macrophages, BCG (anti-tuberculosis vaccine), and bacteria projects. The SS2000 plays an important role in GSK plc's early studies and clinical development pipeline. We will continue to contribute to biopharmaceuticals research through further collaborations. Yokogawa will continue to contribute to the development of drug discovery research, personalized medicine, and regenerative medicine through single-cell analysis solutions to enrich people's lives.

Subcellular Sampling System SS2000

Single Cellome™ System SS2000, a single-cell analysis solution that utilizes high-resolution images captured with a confocal microscope to automatically and accurately collect samples of specific cells and intracellular components.

Measuring Instruments Business

In partnership with our customers, we offer measurement solutions that are helping to realize sustainability and innovation, and pointing the way to a brighter future for all on planet Earth.

As a best-in-class technology solutions company, we are able to deliver solutions that both surprise and delight to our customers.

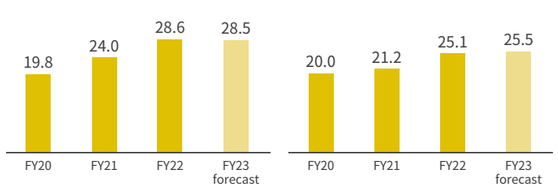
Toshiyuki Suzuki
President of Yokogawa Test & Measurement Corporation

Greetings
The measuring instruments business is the foundation on which Yokogawa was established more than 100 years ago. With the industry-leading accuracy and excellent quality of its measuring instruments, this business has continued to set new milestones throughout its history, keeping pace with advances in technology. Our focus on technology is unwavering, and we will continue to respond to the real challenges of our customers and the true needs of our customers' customers through the delivery of timely solutions. With the aim of being a best-in-class technology solution company with luminous authenticity, we are in the business of delivering solutions that both surprise and delight to our customers.

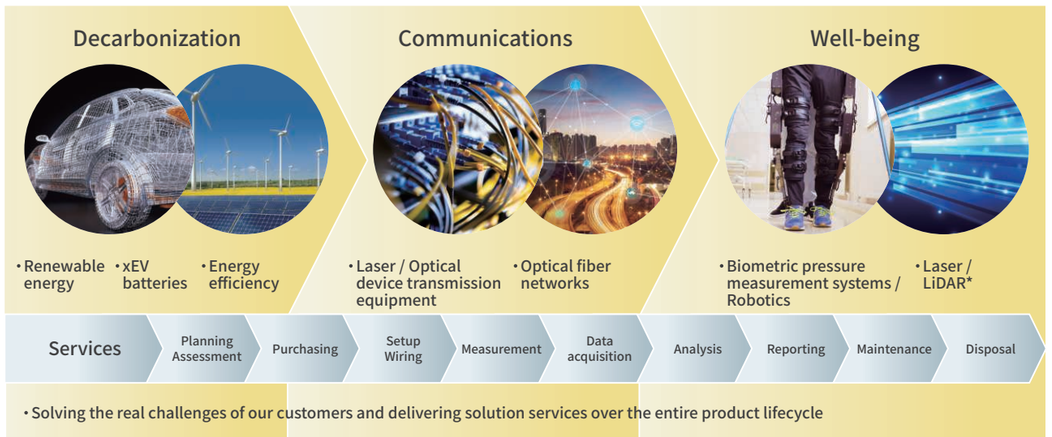
Future Growth Strategies

- **Targeting of growth sectors that contribute to the SDGs**
  Making full use of our expertise, we are focused on the decarbonization, communications and well-being industry sectors, and on the services sector.
- **Making our strong products even stronger**
  Providing our integrated measurement solutions to the energy-conservation and EV markets, based on strong product families such as our market-leading optical spectrum analyzers
- **Expanding our solutions in close cooperation with our customers**
  Solving the real challenges faced by our customers and delivering solution services over the entire product lifecycle

Trend in Orders and Net Sales



Focus Areas —Industrial Sectors that Contribute to Sustainability—

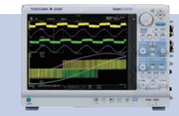


*LiDAR is a method for calculating the distance to a target. This is done by targeting an object with a laser and measuring how long it takes for the light to be reflected to a receiver.

Measurement Solutions for Electric Vehicle (EV) R&D

We are helping to speed up and improve the efficiency of electric vehicle (EV) research and development by offering solutions that enable precise and seamless integrated measurements for the assessment of the powertrains*1, that are a core element in every EV. This includes, the assessment of high-speed inverter*2 switching waveforms and the waveforms of individual units, as well as high precision assessments of electric power efficiency.

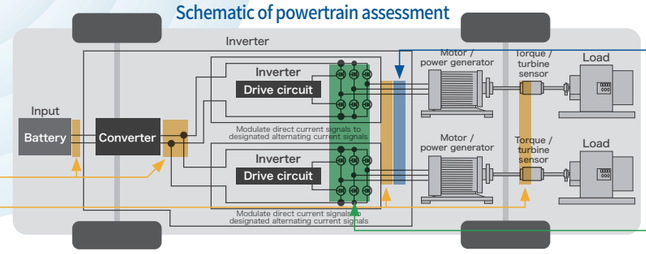
IS8000 integrated software platform
Supports a comprehensive range of measurement operations from the management of multiple types of measuring instruments to data analysis and editing



DL950 scope corder
Capable of real-time, long-term data storage of inverter waveforms (The maximum data transfer rate is an industry-leading 320MB/s)

Streaming of waveform data

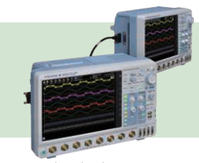
Schematic of powertrain assessment



Electric power / efficiency

WT5000 precision power analyzer
A high-precision instrument capable of detecting even a 0.1% change in efficiency

Switching waveforms

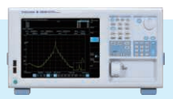


DLM5000 oscilloscope
Capable of multichannel, simultaneous measurement and observation of high-speed (tens of nanoseconds) switching waveforms

*1 In automotive engineering, a general term for the components that transmit mechanical power from a motor to the wheels
*2 A device that converts direct current to alternating current

Measurement Solutions for Optical Networks

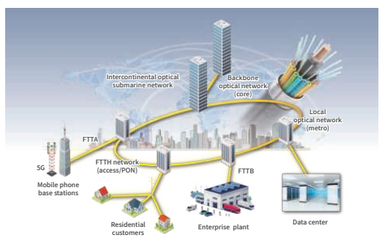
In a world where rapid progress is being achieved in the digitalization of processes, network infrastructure and communication networks play ever more indispensable roles. Yokogawa meets a wide variety of measurement needs, spanning everything from the development of cutting-edge R&D devices to the support of stable mass production operations and the construction and maintenance of optical fiber networks.

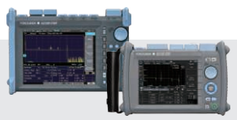


AQ6380 optical spectrum analyzer
Measurement of optical signal wavelength and s/n ratio

Measurement of laser and optical devices
We contribute to the development and production of optical devices that support communications over multiple wavelengths.

AQ2200 modular manufacturing test system
Measurement of optical power, construction of automated assessment lines





Optical time domain reflectometers (optical pulse test equipment) AQ7280, AQ1210
Measurement of optical fiber loss distribution, Detection of fault locations

Measurement of optical fibers and cables
From backbone networks to FTTH*3 and data centers, we respond to a wide range of needs.

*3 "Fiber to the Home," : one of the broadband internet connection architecture

New Businesses and Others

We will make an effort to achieve solid growth and earnings improvement in new businesses, such as the provision of services leveraging IoT and AI, and the production and sales of biomass materials.

amnimo Inc.

amnimo, launched in May 2018, contributes to realizing IoT and AI convergence by providing easy-to-use, highly reliable IoT devices and software services. amnimo flexibly combines its own IoT devices, cloud applications, and partner components to support customers' process transformation and contribute to their value creation.

Yokogawa Bio Frontier Inc.

Yokogawa Bio Frontier Inc. was established in March 2021 to develop, produce, and deliver biomass materials to the world beyond our conventional business of providing solutions for the manufacturing industry.

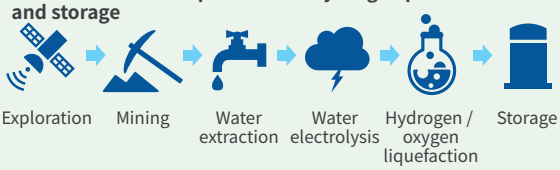
Activities in Areas for Exploration

Space: Participating in Lunar Hydrogen Energy Technology Feasibility Study*1

Yokogawa is participating in a Ministry of Economy, Trade and Industry (METI) project to verify the feasibility of producing hydrogen from lunar water ice and using that to sustain activities on the moon. We are identifying technologies that could be useful in the search for water resources and the production and utilization of hydrogen on the moon, and are jointly developing roadmaps for the future with other participating companies. This is the first-ever study to examine the feasibility of establishing a human habitat and engaging in economic activities on the moon.

As plant operation on the moon requires unmanned, time-lagged, remote monitoring and control, we are undertaking challenges to solve problems by a predictive control approach using digital twin technology. The circulation of resources will be essential on the moon, and we will apply the insights gained to build a circular society on Earth.

From lunar water exploration to hydrogen production and storage



*1 Conducted prior to the launch of a new business, product, or service to assess and verify its practicality based on cost, market, technology, patents, and other considerations.

Disaster Prevention: Successful Deep Sea Observation of Sea Level Fluctuations with Made-in-Japan Silicon Resonant Water Pressure Gauge

The National Research Institute for Earth Science and Disaster Resilience (NIED), the Earthquake Research Institute (ERI) of the University of Tokyo, and Yokogawa Electric Corporation (Yokogawa) have undertaken an evaluation of an innovative water pressure gauge for use in the early detection of tsunamis. The water pressure gauge used in this evaluation was equipped with a new type of silicon resonant pressure sensor*2, and was installed on the seafloor near the Boso Peninsula at a water depth of 3,436 m. In this evaluation, the gauge successfully identified pressure fluctuations of seven hectopascals equivalent to a 7-cm change in sea level. Although it is difficult to obtain data on tsunamis, which are infrequent events, the evaluation allowed the detection of changes in sea level similar to those of a tsunami, and the water pressure gauge is expected to be used in the event of an actual tsunami. The water pressure gauge will be adopted for the Nankai Trough Seafloor Observation Network for Earthquakes and Tsunamis (N-net) to observe water pressure fluctuations on the seafloor caused by tsunamis generated by earthquakes, enabling reliable detection of tsunamis and contributing to damage mitigation. (Announced on May 22, 2023)

A water pressure gauge equipped with a silicon resonant pressure sensor that uses MEMS technology

*2 Yokogawa's silicon resonant pressure sensors employ a sensing method based on the pressure-dependent change in the resonant frequency of single crystal silicon resonators, and are characterized by low power consumption, compact size, high sensitivity, high stability, and high pressure resistance. The resonator is sealed in a clean vacuum cavity using silicon semiconductor manufacturing technology, which prevents foreign particles from adhering to the resonator and degrading its performance. In addition, there is no change in performance due to gas desorption, which occurs with sensors using quartz crystal resonators, and stable measurement can be achieved. Yokogawa has been installing pressure sensors using this sensing method in its industrial differential pressure and pressure transmitters since 1991.

Otsuka Chemical and Yokogawa Electric to Launch SynCrest Inc., a Joint Venture Targeting the CRDMO Business for Middle-molecular Drugs

Otsuka Chemical Co., Ltd. and Yokogawa Electric Corporation announce the establishment of SynCrest Inc., a joint venture that will engage in research, development, and manufacturing in the promising field of middle-molecular pharmaceuticals as a Contract Research, Development and Manufacturing Organization (CRDMO*3). (investment ratio: Otsuka Chemical 51%, Yokogawa Electric 49%) This new joint venture will provide services to meet various challenges and needs across the pharmaceutical industry's drug development value chain, from research through to commercial production.

SynCrest's Naruto Plant

*3 CRDMO: The Research function at SynCrest Inc. will initially focus on library development and library synthesis.