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YASKAWA Electric Corporation
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Director, Managing Executive Officer
General Manager, Corporate Technology Div.

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1. Yaskawa Electric as a Company Founded on Technology

Company Motto “A Company Founded on Technology,” Embodying the Founder’s Passion
History of Value Creation through Technology
Strengths of Technologies Cultivated
Presence
Company Motto “A Company Founded on Technology," Embodying the Founder’s Passion

At the time of the establishment of the company, Daigoro put up the company motto of “being a company founded on technology” in order to conduct business with the company’s own technology, rather than imitating the leading Western technologies. The culture of “being a company founded on technology” nurtured at the early stage of the entrepreneurial process has been passed down to the present day.

[Description of the calligraphy]
“A company founded on technology” was the top priority phrase in the policy put up by Shinichi Hashimoto, the sixth president of Yaskawa, when he became president in 1996. Later, when he visited China in 1998, he asked the chief priest of Kansan Temple in Suzhou to write it. This phrase conveys the passion that we will provide products that meet customer needs with world-class technologies. In order to achieve this, it is essential to have a strong commitment and love for product development, in addition to a sincere commitment to technological development.”
History of Value Creation through Technology

Determining **electric motors and their applications** as major pillars of our business, we have supported the cutting-edge industries of each age with our proprietary technologies and products.

**Development of industry and society**

**Startup period (Early 1900s)**
- Coal mining equipment shifted from steam engines to electricity (motor).

**1950s**
- Energy shifted from coal to oil, and the heavy and chemical industries developed.

**1970s**
- Expansion of mass production of automobiles, home appliances, etc. during Japan’s high economic growth

**1990s**
- Popularization of personal computers and progress in computerization

**2000s**
- Spread of the Internet and smartphones

**2010~**
- Transition to a data-driven society through the use of IoT and AI

**2015~**
- Transition to a decarbonized society

**Changes in Yaskawa Technologies and Businesses**

**Started to manufacture** **electrical equipment for coal mines** which were mostly imported at that time.

- Development of highly reliable motors and controllers necessary for **steel plant control**
  - Proposed concept of **“Mechatronics”** ahead of the world (1969)
  - Accelerated business expansion from conventional process automation to **factory automation**

**Japan’s first all-electric industrial robot** MOTOMAN was born (1977)

- High-speed, high-precision **AC servo drive** became essential for the manufacture of large quantities of electronic components

- Launched **“i3-Mechatronics,”** a new solution concept (2017)
# Strengths of Technologies Cultivated

We have promoted development aiming at world’s first and world’s best for the core technologies of **motion control, robotics technology, and power conversion.**

<table>
<thead>
<tr>
<th>Expansion into core products</th>
<th>point of differentiation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motion Control</strong></td>
<td></td>
</tr>
<tr>
<td>AC servo drive</td>
<td></td>
</tr>
<tr>
<td>Robot</td>
<td></td>
</tr>
<tr>
<td>Controller</td>
<td></td>
</tr>
<tr>
<td>• Developed minertia motor which became the basis for the servo motor available today <em>for the first time in the world</em> (1958)</td>
<td></td>
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<tr>
<td>• World-class basic performance such as rotational speed, resolution and speed frequency response</td>
<td></td>
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<tr>
<td>• Sensing and data utilization function (Σ-Link *1)</td>
<td></td>
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<tr>
<td>• Optimal control of cells (processes combining equipment and robots)</td>
<td></td>
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<tr>
<td><strong>Robotics Technology</strong></td>
<td></td>
</tr>
<tr>
<td>Robot</td>
<td></td>
</tr>
<tr>
<td>• Developed <strong>Japan’s first</strong> all-electric articulated robot (1977)</td>
<td></td>
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<tr>
<td>• In-house production of key components (servo motors)</td>
<td></td>
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<tr>
<td>• <strong>World’s best</strong> product lineup and application response</td>
<td></td>
</tr>
<tr>
<td>• Response to new business areas (Food &amp; Agri, Biomedical)</td>
<td></td>
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<tr>
<td><strong>Power Conversion</strong></td>
<td></td>
</tr>
<tr>
<td>AC drive</td>
<td></td>
</tr>
<tr>
<td>Converter</td>
<td></td>
</tr>
<tr>
<td>• Developed <strong>world’s first</strong> PWM controll model *2 transistor AC drive (1974)</td>
<td></td>
</tr>
<tr>
<td>• Application know-how of various machines and equipment</td>
<td></td>
</tr>
<tr>
<td>• Energy-saving and high-efficiency performance (application of WBG device *3)</td>
<td></td>
</tr>
<tr>
<td>• Control technology and sensing technology based on motor drive</td>
<td></td>
</tr>
</tbody>
</table>

*1 A communication system developed by Yaskawa Electric that can receive multiple sensor signals between servo amplifiers and encoders

*2 PWM (Pulse Width Modulation) control is a method for controlling power through high-speed switching.

*3 A new type of power converter that can operate at much higher voltages, frequencies, and temperatures than conventional semiconductor materials.
Presence

Since the invention of the world’s first minertia motor in 1958, a total of 20 million servo motors have been shipped.

No. 1 market share in the world at 17% (Company’s own estimation)

Since the commercialization of Japan’s first all-electric vertical articulated industrial robot in 1977, a total of 500,000 units have been shipped.

One of the world’s top 4 industrial robot manufacturers

Since the commercialization of the world’s first general purpose transistor AC drive in 1974, a total of 30 million AC drives have been shipped.

As an energy-saving equipment, Yaskawa AC drive reduces global annual electric power consumption by approximately 4% (Company’s own estimation)
2. Toward the Realization of Vision 2025

Development of Core Technologies for Value Creation in Vision 2025

i³-Mechatronics Concept

Factory Automation/Optimization Based on i³-Mechatronics

Application of Mechatronics for Sustainable Development of Society
Development of Core Technologies for Value Creation in Vision 2025

Contribute to solving customers’ management issues in addition to creating new added value to society, through evolution of core businesses, and expansion into new fields by applying mechatronics technology.

Automation and optimization of factories through i³-Mechatronics*

New fields of mechatronics application for sustainable social development

i³ - Mechatronics Concept

Evolution of mechatronics through the use of data

Realization of new industrial automation revolution

integrated
intelligent
innovative
Factory Automation/Optimization Based on i³-Mechatronics

ERP/SCM management control resource control
MES manufacturing execution control

Cloud/FOG IoT/AI

Data Center/Cloud

modeling and learning
know-how accumulation
Utilization and analysis of big data

Run analytical model in real time
- defect monitoring model
- predictive maintenance model
- recovery decision model

YASKAWA Cockpit*2

Controller

digital data management

Area of collaboration with partners

FA(Edge*1)
Areas that we demonstrate our unique strengths

digital data management

turning into a movement

Parts input

Cell system (assembly, processing, etc.)

Parts input

Shipping

data distribution

data collection

Analysis

Monitor

*1: Areas for real-time data analysis and Information processing for providing feedback (Areas close to production sites, such as plants and production sites)
*2: Software that can collect, store, and analyze data on equipment at production sites in real time
Application of Mechatronics for Sustainable Development of Society

Contributing to a sustainable society by applying mechatronics

Energy Saving
- Eco PM motor flat type and AC drive

Food & Agriculture
- Vegetable factory

Clean Power
- PV inverter for solar power generation and electric appliances for wind turbines

Humatronics
- Biomedical robot
3. Technology Development Centered on YASKAWA Technology Center (YTC)

Aims and Results of "Technology Integration"

YASKAWA Technology Center Overview

YASKAWA Technology Center Concept

Integration of Development Processes (integrated)

Consolidation and Creation of Intelligence (intelligent)

Creation of Innovative Technologies (innovative)

Specific Examples of Open Innovation
Aims and Results of "Technology Integration"

Integrated development functions which had been dispersed in each business unit into YASKAWA Technology Center in the headquarters in Kitakyusyu, and established the system that meet various customers’ needs rapidly.

Up to FY2020

- **Product development and product maintenance development**
  - Finishing of product application technology
  - Technology development for product application

- **Elemental technology development**
  - Basic technology development
  - Technology development for product application
  - Technology development for new businesses

Mainly for existing businesses

From FY2021

- **Development of new products and product technologies**
  - Finishing of product application technology
  - Technology development for product application

- **Basic technology development**
  - Basic technology development
  - Technology development for new businesses

Reinforce technology development for new businesses

Integration

September 1, 2021
Full-scale operation started!
# YASKAWA Technology Center Overview

<table>
<thead>
<tr>
<th>Name</th>
<th>YASKAWA Technology Center (YTC)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Address</strong></td>
<td>Within Yaskawa Electric Headquarters</td>
</tr>
<tr>
<td><strong>Construction Cost</strong></td>
<td>15 billion yen</td>
</tr>
<tr>
<td><strong>Personnel</strong></td>
<td>Approx. 650</td>
</tr>
<tr>
<td><strong>Total area</strong></td>
<td>Approx. 25,500 m²</td>
</tr>
<tr>
<td><strong>Operation started</strong></td>
<td>September 2021</td>
</tr>
</tbody>
</table>

**4F** Approx. 8,000 m²  
Technology and product development

**3F** Approx. 7,000 m²  
Production technology development

**2F** Approx. 4,000 m²  
Mass production trial

**1F** Approx. 6,500 m²  
Open Innovation
YASKAWA Technology Center Concept

Technology center for timely development of products that make customers win through open innovation and Yaskawa Group as a whole

- **integrated**
  - Integration of development process

- **intelligent**
  - Consolidation and creation of intelligence

- **innovative**
  - Creation of innovative technologies
Integration of Development Process

Consolidated the development functions of the Yaskawa Group’s technologies, products, and production technologies in one place

Technology and product development members gather in each technology field

Members from development to production preparation gathered

4F
- Motor
- Drive
- Controller
- Robot
- Quality
- Intellectual property
- Technological management
- Technological cooperation

3F
- Production technology
- Trial manufacture
- Procurement
- Production system

4F
- Technological development
- Product development

3F
- Open Innovation
- Production technology development
- Evaluation and analysis

2F
- Production technology development

1F
- Mass production trial
Consolidation and Creation of Intelligence

Evolving value creation by connecting information of the value chain globally

- Customer Support
  - Quality information
  - Customer Information

- Services

- After sales

- Sales
  - Marketing
    - Market trend
    - Customer information

- Logistics

- Market Planning
  - Planning information
  - Management information
  - Resources (people, goods, money)

- Elemental technology development
  - Technological trend
  - New materials and parts
  - Standards and legal information
  - Development progress

- Development and production
  - Development progress
  - Design and test data

- Product planning

- Design development

- Production preparation

- Procurement
  - Production information
  - Product Information

- Manufacturing
  - Production technologies
  - Materials information
Creation of Innovative Technologies

Diverse systems and environments promoting collaboration with external parties and creative activities

**Creation of innovative technologies**

- **Industrial world**
  - Complementary technology

- **Venture**
  - Unique technology

- **Academic World**
  - Cutting-edge research

**Environment that promotes collaboration**

- **Local 5G environment**

**Environment that promotes creative activities**

- **Collaborative development room**

<table>
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<tr>
<th>YASKAWA Strengths</th>
<th>Diverse work styles</th>
<th>Shared space for human interaction</th>
<th>Customers’ equipment to learn by touching physically</th>
</tr>
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</table>

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Specific Examples of Open Innovation

Strengthening the development of new technologies and systems through industry-academia-government collaboration

• Kyushu University
  Conducting exchanges of engineers and human resource development, including joint research in the agricultural field

• Kyushu Institute of Technology (Cabinet Office, ‘Subsidy for Regional Universities and Regional Industrial Revitalization’ project)
  Joint research on autonomous robots through innovative robotics technology

• Tokyo Institute of Technology
  With the theme of research on ultralight actuators for collaborative robots, “Yaskawa Joint Research Course on Future Technology” was established

• JA Zen-Noh (National Federation of Agricultural Cooperative Associations of Japan)
  Business alliance for contribution to developing Japanese agriculture and strengthening Japan’s international competitiveness in food field.