Central Japan: Forefront of Manufacturing

Endowed with fertile land and rich nature,
Central Japan has cultivated the "culture of manufacturing."
It is a history of taking up challenges
to develop new technologies every day
and continuously introducing innovation in various fields.
Its driving power is "trusts and dreams" in manufacturing.
Let's look at the current forefront of manufacturing in Central Japan.

For the next 100 years of cars:
Toyota FCV "MIRAI"

In the side profile, the body/cabin is shaped like a water droplet. The design expresses the flow of water, which is produced through fuel cell power generation.

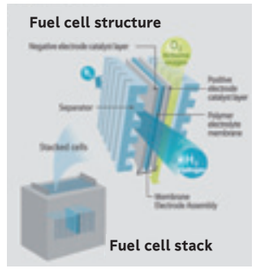
A large inverted triangular grille is arranged at the right and left ends of the front. This bold design of the parts to incorporate air (oxygen) for the fuel cell is a distinctive symbol of MIRAI as an FCV.

Toyota Motor Corporation released MIRAI, the world's first mass production model fuel cell vehicle (FCV) in December 2014.

FCVs run due to the chemical reaction of hydrogen charged in a high-pressure hydrogen tank with oxygen in the air in a fuel cell to generate electricity and thereby rotate the motor. Hydrogen is environmentally friendly and can be produced by photovoltaic power generation, wind power generation, natural gas, etc. Power generation using a fuel cell is energy efficient and emits no CO_2 at all. Only water is emitted when FCVs run. While it takes a long time to recharge electric vehicles (EVs), MIRAI can be charged with the fuel, namely hydrogen, in approximately three minutes. When fully charged, the car can run over a distance of about 650 km (measurement by Toyota in accordance with JC08 mode: fuel efficiency measurement method specified by the Ministry of Land, Infrastructure, Transport and Tourism). Thus, MIRAI is an ultimate eco car. The external power supply system installed in the car can provide the power generated using the fuel cell to houses and shelters as an emergency power source at the time of earthquakes and other situations.

"When a new technology is developed, people look at the technology itself, but what is actually most important is that the technology can be used for manufacturing. Even if the technology is excellent and can greatly contribute to the environment, it is meaningless if it does not take form," said Mr. Yoshikazu Tanaka, who is responsible for the development of MIRAI. He emphasizes that FCVs exist only when accepted by users. The development was driven by the design and production technologies of Toyota, and also depended much on the manufacturing technologies accumulated by companies in Central Japan, according to Mr. Tanaka. In the development of FCVs, Toyota took more than 20 years to achieve two challenging technological targets: to make the fuel cell small enough to be installed in a car and the output high enough; and to ensure quality that can satisfy users and create excitement to make users want to ride in it. As the final stage of the development of FCVs, MIRAI has opened the door for mass production.

MIRAI is looking at the realization of a hydrogen society. If hydrogen is used commonly as a car fuel, the understanding of hydrogen energy will be promoted to change society dramatically. A project to operate fuel cell buses in preparation for the Tokyo Olympics has also been set in motion. Toyota has disclosed all of its 5,680 patents related to MIRAI and made them publicly available without any fee. The goal is to create new innovations together with various players. MIRAI is the first step toward it.



FC stack is a unit to generate power using the chemical reaction of hydrogen with oxygen in the air.

In the FC stack of MIRAI, 370 cells are arranged in a series. A cell*1 is 1.34 mm thick. Titanium foil groove flow passages*2 (the world's first 3D fine mesh passages) are introduced into the stack to improve the drainage of the water generated by chemical reaction, as well as the diffusion of oxygen. The development of this and other groundbreaking new technologies has improved the performance of the FC stack and reduced its size and weight.

*1: The minimum unit of a fuel cell, which is composed of electrolyte membranes, catalysts, gas diffusion layers/passages and separators

*2: Grooves where hydrogen and oxygen for chemical reaction, as well as the water generated by chemical reaction, flow

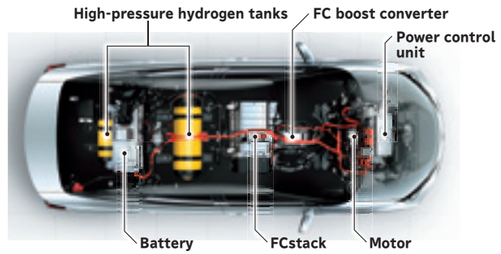


Photo courtesy of Toyota Motor Corporation

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Toyota Ecoful Town —Let's experience the future town

Pavilion
This center introduces the activities of Ecoful Town. Visitors can experience the latest environmental technologies through videos and quizzes.
The woman in the photo is driving a standing riding type vehicle called Winglet. This personal mobility device can be operated with minimum electric power. Visitors can take a test ride.

Toyota City has been selected as an environmental model city, and Toyota Ecoful Town is its base for information transmission to present the activities to realize a low-carbon society. In the Ecoful Town, citizens, local communities and companies work together to propose the latest environmental technologies and practical initiatives in the fields of transportation, industry and life. Visitors to the facilities of the town can learn environmental technologies, including environmentally friendly and smart transportation means, as well as houses where energy is generated, stored and saved, to experience our future.

3-11 Motoshiro-cho, Toyota-shi, Aichi

Smart Mobility Park & COMS
This facility provides a recharging service for ultra-compact electric vehicles (COMS) and other electric mobility vehicles, and is also a rental hub for a ride sharing service "Ha:mo RIDE." By combining them with public transportation systems, people can move in a convenient, comfortable and environmentally friendly manner.(Demonstration test is underway)

Hydrogen Station:
This station has equipment to produce hydrogen on site, and can produce and store hydrogen equivalent to the amount for about 30 units of FCV "MIRAI." The public vehicles of Toyota City (MIRAI) and fuel cell buses operated by the city are also recharged with hydrogen in this station.

Photo courtesy of Toyota city

Challenge for Making a Big Dream Come True
MRJ (Mitsubishi Regional Jet)

The beautiful body design is well received. The concept was to "produce a cool aircraft unique to Japan." The three symbol colors represent the colors of Japan's traditional crafts. The major features of MRJ are fuel efficiency, which is 20% better than conventional regional jets, and the low noise level. These advantages can reduce the cost for operating airplanes.

Japan's first small passenger jet "MRJ" (Mitsubishi Regional Jet) is being developed by Mitsubishi Aircraft Corporation. This is the first domestic passenger aircraft for the country since YS-11, which made its maiden flight in 1962.

"As more than 40 years passed from the end of the production of YS-11, there was a concern that the technology might not be able to be handed down any more, which is the most unwanted situation for manufacturing. Will Japan give up producing aircraft or develop the aircraft industry as a next-generation industry along with automobiles? We concluded that we should do it now and decided to conduct development. It was started in a small group from scratch" said Mr. Hideto Kurosawa, the spokesperson who has participated in the development of MRJ since the beginning. The project was started with a marketing survey, and focused on the development of a regional jet (RJ) with 100 passenger seats or less. The maiden flight was successfully made in November 2015.

MRJ has 70 to 90 seats, and the weight has been reduced by applying carbon fibers to part of the aircraft. The beautiful body, which is also praised by international media, was designed by making full use of the world's cutting-edge aerodynamic design technology. Equipped with new engines based on the latest technologies, MRJ features selling points that place emphasis on the environment, such as low noise level, high fuel efficiency and comfortable cabin space. Using these advantages, MRJ is going to enter the global RJ market.

The production related to aircraft in Central Japan now accounts for 50% of the country's production. In particular, the region manufactures 70% of the aircraft parts produced in Japan. Now, the assembly plants for MRJ have been added. "It is an important task to use the industrial power integrated in the region. Manufacturing should not be maintained without an aim but linked to future industries by enhancing the technologies we already have. As aircraft require very sophisticated technologies, we plan to start by asking other companies to tackle the challenge together," said Mr. Kurosawa.

The development of a next-generation passenger jet has begun with a small group. It involves a new concept, design, production site and the development of overseas markets. "Challenge" is a word suitable for MRJ. "We hope to achieve a market share of at least 50%. I would be impressed if I go overseas and happen to ride on MRJ. In fact, it will be an initial goal." Mitsubishi Aircraft Corporation continues the challenge to realize the big dream by MRJ.

About 950,000 parts customized to MRJ are integrated. Seventy percent of the parts are made in other countries, and they show differences in the culture of each country. Accordingly, this process is so difficult that the integration is a sort of "cultural integration."

Cabin space
Efforts were made to improve the cabin space and allow passengers to feel comfortable during the flight for 60 to 90 minutes. To have the ceiling height of at least 2 m, the cargo that is conventionally stored under the floor is moved to the rear part of the fuselage to lower the floor in the cabin. Careful consideration, which Japanese people are good at, is made in the seats and lights as well. A sense of fun is also seen in the relief of Mt. Fuji on the ceiling.

Photo courtesy of Mitsubishi Aircraft Corporation

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SMEs in Central Japan Cooperation to improve international competitiveness

Plant in Komaki City, Aichi
Total area of 6,245 ㎡

The strength of industries in Central Japan is supported by small and medium-sized enterprises (SMEs) that cover a wide range of fields. The aircraft industry in the region, which accounts for 50% of Japan's production, is also underpinned by a cluster of small and medium-sized parts manufacturers. In recent years, those companies have been promoting the establishment of a network for cooperation beyond their short-term interests to enhance their international competitiveness.

In Aichi, Hoden Seimitsu Kako Kenkyusho Co., Ltd., Kosaka Iron Works Co., Ltd. and other companies have set up a group and completed a new parts plant for integrated processing of engine parts (low-pressure turbine blades) over a period of six years. The plant initiated the production as a mini cluster in August 2015. This plant introduced the latest production systems from the planning stage to realize higher quality and lower price and thereby strengthen the international competitiveness. For example, the operations that used to depend on the skills of workers in the production site have been digitalized and automated to reduce cost. In addition, the group has received new orders for parts and started production through the cooperation of small and medium-sized parts manufacturers in a similar way. Such movements are now in progress in each of the five prefectures in Central Japan.

Diagram with Mini clusters of the five prefectures in Central Japan

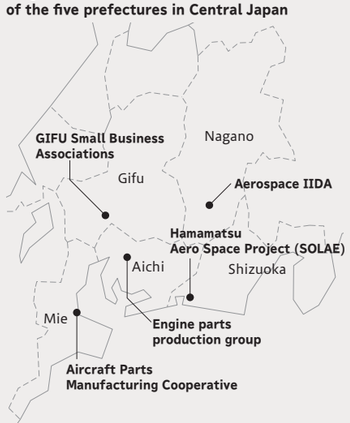


Photo courtesy of HODEN SEIMITSU KAKO KENKYUSHO CO.,LTD.

From H-ⅡA Launch vehicle to H3 Launch vehicle :
Launch vehicle development supported by the integration of te chnologies

Launch of the H-ⅡA Launch Vehicle No.29
The upgraded H-IIA launch vehicle enabled the substantial extension of the time between the launch and the separation of the satellite from about 30 minutes to about 4 hours and 30 minutes, which resulted in delivering the satellite closer to the geostationary orbit.

In response to the internationally increasing demand for the launch of commercial satellites, Japan's primary large-scale launch vehicle, H-IIA Launch Vehicle No. 29 successfully launched the country's first commercial satellite in November 2015, which opened a new door for Japan's launch vehicle business. The procedures from the conclusion of contracts with customers to the manufacturing and launching of launch vehicles are performed by Mitsubishi Heavy Industries, Ltd (MHI). In fact, the launch service operations using H-IIA launch vehicles, which was originally provided by the Japan Aerospace Exploration Agency (JAXA), was transferred from JAXA to MHI in 2007.

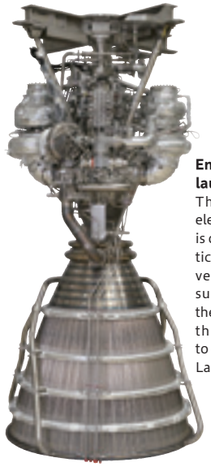
The H-IIA Launch Vehicle No. 29 had an upgraded vehicle, which was developed to respond to the commercial satellite launch market. When a geostationary satellite is launched to be put into a geostationary orbit (about 36,000 km above the equator), the launch vehicle conventionally separates the satellite at an elevation of about 300 km. On the other hand, this upgraded vehicle was able to deliver a satellite to the height of about 34,000 km to reduce the burden on the satellite. This has increased the percentage of the commercial satellite launch market which can be dealt by H-IIA launch vehicles from around 10% to about 50%, enhancing its competitiveness among the market.

As many as approximately one million launch vehicle parts are mainly produced in various regions of Japan, and most of them are delivered to Central Japan and assembled to take shape. "The base was established in Central Japan because the region had the necessary technologies for aerospace industries," said by Mr. Koki Nimura, Launch Executive Officer at MHI. Those technologies include, for example, the technology to weld aluminum alloys, and to manufacture engines, which are considered to be very difficult. In particular, most of the engine parts are produced in this region. In addition, the technologies in this region for the development and production of clean launch vehicle engines fueled by liquid hydrogen are also at world-class levels.

So far, the launch success rate of H-IIA launch vehicles has reached 96.7%, which is at the top international level. Furthermore, the "punctual launch rate" of them, or the ratio of the vehicles launched on the scheduled date and time, is the highest in the world. "The reliability and certainty of Japan's launch vehicle system have reached the world's top level," Mr. Nimura said confidently. "The launch vehicles we handle are essential equipment for Japan to operate space activities independently and flexibly. We are working to make them as efficient as possible with a hope to help space-related businesses in Japan expand and achieve great success."

The company is also committed to the development of the H3 Launch vehicle, a new generation launch vehicle that also offers a competitive launch price. It is aimed to be launched by fiscal 2020.

Assembly of an H-ⅡA launch vehicle
The manufacturing of parts of a launch vehicle involves more than 350 primary subcontractors, and the number increases to more than 1,000 if every subcontractors are included. "This may not be rewarding from a commercial perspective because sophisticated technologies are required to manufacture and to finish the products as designed, and because the number of orders is small. Still, the subcontractors support us saying that they can expand the production area by obtaining sophisticated technologies," said by Mr. Nimura.



Engine of the H-ⅡA launch vehicle
The clean engine fueled by liquid hydrogen is one of the characteristics of the H-IIA launch vehicle. Technologies such as the ignition of the second-stage engine three times were put to practice in the H-IIA Launch Vehicle No. 29.

Photo courtesy of Mitsubishi Heavy Industries, Ltd

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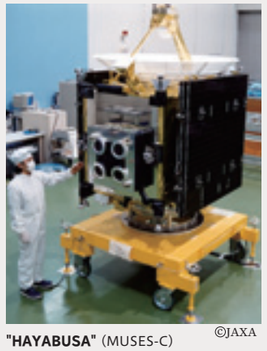
Manufacturing technologies in Central Japan are used in Asteroid Explorer "Hayabusa2"

©Akihiro Ikeshita

Hayabusa2
This explorer was launched by H-IIA Launch Vehicle No. 26 from the launching site for large rockets at Tanegashima Space Center on December 3, 2014. Hayabusa2 is scheduled to reach asteroid Ryugu in 2018 and return to the earth in 2020.

Infrared image sensor developed by Hamamatsu Photonics

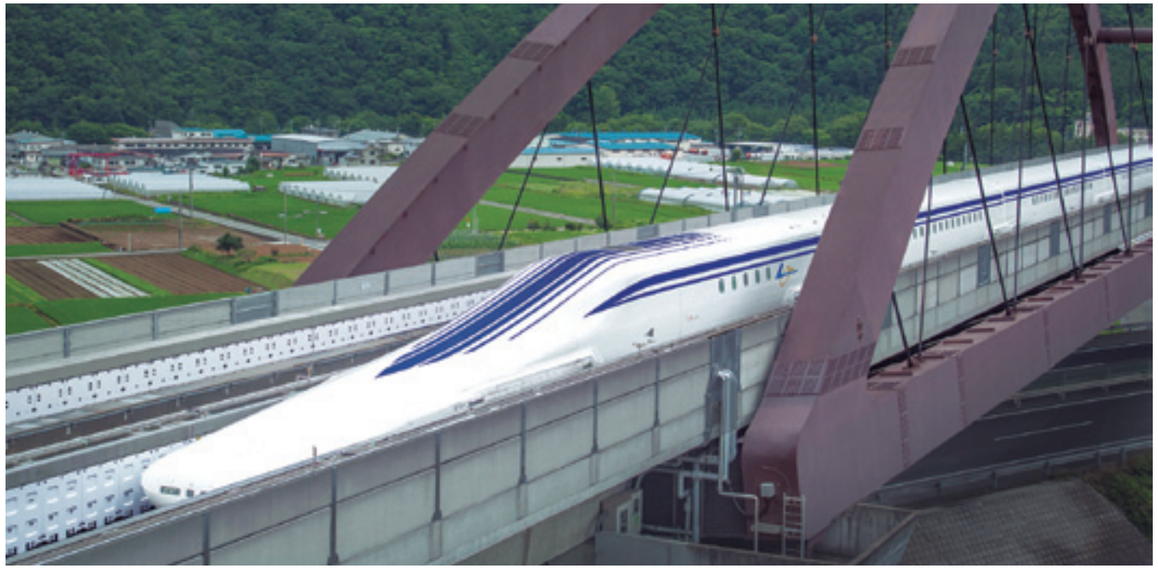


"HAYABUSA" (MUSES-C) ©JAXA

Asteroid Explorer "Hayabusa," which was created by combining manufacturing technologies of Japan to try a return trip to an asteroid for the first time in the world, successfully completed a sample return mission from Itokawa, an S-type asteroid, in June 2010. Its successor "Hayabusa2" is currently cruising smoothly to Ryugu, a C-type asteroid. It is believed that C-type asteroids still retain the traces of the time and place when the solar system was born in a relatively good form, and their scientific observations and sample returns are expected to provide clues to learn the origin of the solar system and the earth, as well as the origin and evolutional process of life.

The production of "Hayabusa2" aimed to make the technologies for asteroid exploration even more reliable based on the experience on "Hayabusa" and to try new technologies at the same time. Hamamatsu Photonics K.K., which is based in Shizuoka Prefecture, was responsible for the development of infrared image sensors to analyze the materials that form planets. While their sensors were also installed in "Hayabusa," the company developed a new sensor with an even wider range of observable wavelengths for measurements involving water content this time. Manufacturing in Central Japan supports Japan's technologies that lead the world in asteroid exploration.

Transportation system that opens the door for the next genera tion
Superconducting Maglev



Series L0 (L Zero) running on the Yamanashi Maglev Line

Central Japan Railway Company has been committed to the development of the Superconducting Maglev, which is an internationally acclaimed, cutting-edge technology unique to Japan. Superconductivity is a phenomenon where the electric resistance falls to zero when some types of metal, alloy or oxide are cooled to below a certain temperature. When a coil in a superconductive state is electrified, the electric current continues to flow almost permanently due to the absence of resistance and generates magnetic force. This is a superconducting magnet. When a Superconducting Maglev train runs, the magnetic force between the superconducting magnets installed in the vehicles and the coils on the ground lifts the vehicles about 10 cm. This enables the train to run at the speed of 500 km per hour in a stable manner.

Recorded the speed of 603 km per hour in a manned test run
(which renewed the world speed record for railroad)

Photo courtesy of Central Japan Railway Company

Research on the Superconducting Maglev was launched by Japanese National Railways in 1962, and test runs on the Yamanashi Maglev Line began in 1997. In 2015, a cumulative travel distance of 4,064 km in one day was recorded, and the speed of 603 km per hour was achieved in a manned test run (which renewed the world speed record for railroad). The Superconducting Maglev technology was evaluated by the Maglev Technological Practicality Evaluation Committee of the Ministry of Land, Infrastructure, Transport and Tourism at each stage, and has been established for future revenue service.

"One of the major challenges in the development of the Superconducting Maglev was air resistance," said Mr. Noriyuki Shirakuni, who is responsible for the development. The company repeated wind-tunnel tests and computer analysis. Based on the results of test runs on the Yamanashi Maglev Line, the shape of the nose section of the latest vehicle Series L0 (L Zero) was created. In addition, the technologies and experiences of many researchers and manufacturers have been incorporated into the Superconducting Maglev, which can therefore be regarded as an outcome of Japan's technologies.

Aiming to duplicate the main artery of transportation linking Tokyo, Nagoya and Osaka in preparation for large-scale disasters, etc., the construction of the Chuo Shinkansen using the Superconducting Maglev is now in progress for the scheduled inauguration of the operation between Tokyo and Nagoya in 2027 (and the operation between Tokyo and Osaka in 2045). The fastest travel time will be 40 minutes between Tokyo and Nagoya and 67 minutes between Tokyo and Osaka. The reduction of the travel time will activate the exchange of people, goods and information and broadly have ripple effects on the entire economy and society of Japan. Furthermore, the practical use of the Superconducting Maglev technology is expected to stimulate the activities of the manufacturing industry. Thus, the Superconducting Maglev has large potential to open the door for the next generation.

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Train that protects the safety of the Shinkansen with the latest equipment and people. The nickname is "Dr. Yellow"

A yellow Shinkansen (bullet train) sometimes runs on a track of the Tokaido Shinkansen line. Because it is not publicly announced when or where the train runs and it can be witnessed only by coincidence, it is rumored among railway fans that the sight of the train brings happiness. This train, which is nicknamed "Dr. Yellow" for its color, has an official name of "Shinkansen Multipurpose Inspection Train". While running on the railway tracks that are actually used for operation at a speed of 270 km per hour, "Dr. Yellow" inspects the tracks, power supplies, signals and communication equipment of the Shinkansen to check the distortion of tracks, the condition of overhead contact lines, the status of the signal current, etc. If any inspection result exceeds the reference value, it is automatically communicated to the General Control Center. The data obtained from the inspection are precisely analyzed and used as basic materials for the daily maintenance of the equipment. The train is literally a "doctor for the Shinkansen."

The timetable of the Shinkansen is so busy that a train is operated every several minutes. Still, it is always on time and has no serious accidents. The safety that Japan is proud of is secured with strict checks by the latest equipment and people.

Photo courtesy of Central Japan Railway Company

New materials attracting attention for manufacturing

Development and potential of carbon fibers

It is not an exaggeration to say that a wide range of manufacturing fields including automobiles and aircraft depend on carbon fibers these days. A composite material made by solidifying them with plastic, or carbon fiber reinforced plastic (CFRP), features lightness, strength and durability, as well as high intensity and elasticity. CFRP is also free of fatigue or corrosion and is chemically and thermally stable. Furthermore, these various characteristics are also stable even in severe conditions. This is why CFRP is expected to play a pivotal role in the reduction of product weight by replacing conventional metal materials.

National Composites Center Japan (NCC) has been established in Nagoya University with the aim of encouraging society to more actively introduce CFRP in particular as materials for the reduction of energy consumption and environmental impact through specific initiatives performed in collaboration between industry, government and academia. NCC is positioned as an important research and development institute for the next generation of manufacturing in Japan.

Specifically, NCC tries to develop technologies to reduce the weight of automobiles with CFRP as Concentrated Research Consortium at the Nagoya University of Innovative Structural Materials Association. It is participating in an R&D project of the New Energy and Industrial Technology Development Organization (NEDO) on innovative new structural materials, etc. The Concentrated Research Consortium at the Nagoya University conducts a practical study of high-speed press forming of large works (LFT-D method) using thermoplastic CFRP as a technology to reduce both weight and cost.

With NCC of Nagoya University as the core, the research is promoted under an industry-academia collaboration system involving carbon fiber manufacturers, automobile manufacturers and production machine manufacturers. Achievements have been made steadily, such as the floor panels and side frames for automobiles that were completed this fiscal year.

In addition, in aerospace and other areas, projects are underway with a focus on the study of a new thermoplastic CFRP manufacturing technology and the operation of lightning strike resistance testing facilities.

While carbon fiber plastic composite materials are commonly used in aircraft nowadays, the promotion of application of them to automobiles, train cars and machine tools in plants will be accelerated. Such application helps improve the energy efficiency of transportation machines and reduce the size of machines and equipment to obviously make great contributions to the reduction of greenhouse gas emissions, which is a major challenge for human beings. These black materials will thus brighten the future of human beings.

Equipment of NCC
[35,000-kN large press forming system]

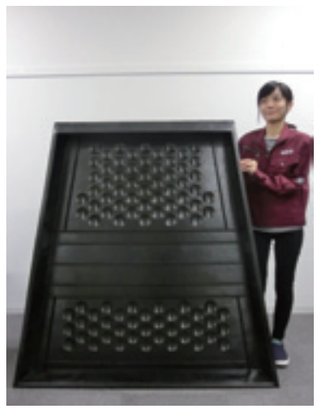
Photo courtesy of Nagoya University

Development of innovative new structural materials and technologies

[Side frame] [Floor panel]

Conceptual drawing of structures for technical demonstration after assembly

Research outcomes



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Find research by 6 Nobel Prize winners at Nagoya University Higashiyama Campus

Akasaki Institute

Dr.Ryoji Noyori

Dr.Toshihide Maskawa

Dr.Makoto Kobayashi ○

Dr.Osamu Shimomura

Dr.Isamu Akasaki ◎

Dr.Hiroshi Amano

Dr. Ryoji Noyori (2001), Dr. Toshihide Maskawa, Dr. Makoto Kobayashi and Dr. Osamu Shimomura (2008) and Dr. Isamu Akasaki and Dr. Hiroshi Amano (2014) are all Nobel Prize winners in natural sciences who were once enrolled in Nagoya University. For this reason, Nagoya University has facilities that present the progress of their research, namely Noyori Materials Science Laboratory, Akasaki Institute and Nobel Laureates Gallery. The facilities have hands-on spots to "experience the mass of a quark" and to "light green fluorescent proteins (GFP)," as well as exhibits of signals, mobile phones and laboratory equipment using blue light emitting diodes, to allow visitors to feel familiar with the researchers and their Nobel Prize winning research.

Nobel Laureates Gallery

Noyori Materials Science Laboratory

○: Photo courtesy of KEK ◎:Photo courtesy of Meijo University Others: Photo courtesy of Nagoya University

Introduction of robots is underway in various industries

Future of the Robot Industry

Photo courtesy of
DENSO CORPORATION

Robot for the pharmaceutical and medical fields "VS-050S2"
This industrial vertical multi-joint robot was developed by DENSO CORPORATION, one of the world's largest manufacturers of small industrial robots, to be used mainly in the pharmaceutical and medical fields. Its sterilization resistance and sanitary properties are so high that the robot can be operated in a clean and strictly sterilized environment with H2O2 gas, UV irradiation, etc., in the pharmaceutical and food fields. Elaborate finishing and unique plating processes are applied to VS-050S2 to meet the hygiene requirement directly. This robot, which was developed jointly with DENSO WAVE INCORPORATED, has been designed in a way that evokes an image of the production site in the near future, and won Japan's Good Design Grand Award for fiscal 2014.

Japan is regarded as a major robot manufacturing country. While the global market of industrial robots, which are operated for welding, pressing and transportation of parts in factories, is worth $8.5 billion, Japanese companies have a share of 50.2% (as of 2011). The robot industry in Central Japan is overwhelmingly strong in the country with Aichi and Shizuoka ranking first and fourth, respectively, in the value of shipments of manufactured goods by prefecture in Japan. "The region's manufacturing technology based on mobility supports the robot industry", said Professor Toshio Fukuda of Meijo University, who is a world authority of micro robots and also served as the president of the IEEE Robotics and Automation Society. "The introduction of robots is currently underway in medical, nursing care and various other fields. In the field of medical robots, for example, companies in Central Japan supply about 90% of the parts of elemental technologies for "da Vinci," the US-made endoscopic surgery support robot that is the most commonly used in the world. Thus, the high technical power of the region has already been proved. I think that Central Japan, which has accumulated manufacturing technologies, has large potential in other fields than industrial robots as well."

Walking assistance device "ACSIVE"
This walking assistance device was developed based on the theory of passive walking robots, which is a leading-edge technology. Without electricity or a motor, the device assists the swinging of legs with the power of springs and actions of pendulums. Equipped with an original hip joint cam spring mechanism developed for passive walking robots (joint torque generator), the device allows users to move their legs more lightly and walk more easily and faster. It is as light as 500g, and also safe and low cost. Users wearing the device can move easily and flexibly. The device to gently support people with robot engineering was created from collaborative development between Nagoya Institute of Technology (Professor Akihito Sano) and Imasen Engineering Corporation.

Photo courtesy of Nagoya Institute of Technology

It is estimated that the robot market in Japan will increase to 10 trillion yen in 2035, and non-industrial robots, such as medical, nursing care and guard robots, will account for 56% of the whole market to exceed industrial robots in the share. With an eye to non-industrial robots, companies in Central Japan are currently making aggressive efforts in their respective areas of specialty.

"While companies in Central Japan are performing solid business management, many of them have their own research institutes and conduct technical research on interesting subjects in an independent and future-oriented manner. Collaborative research is also implemented actively between companies and universities. I believe that such research will generate unique results in a way to use existing technologies more effectively," Professor Fukuda expressed his expectation.

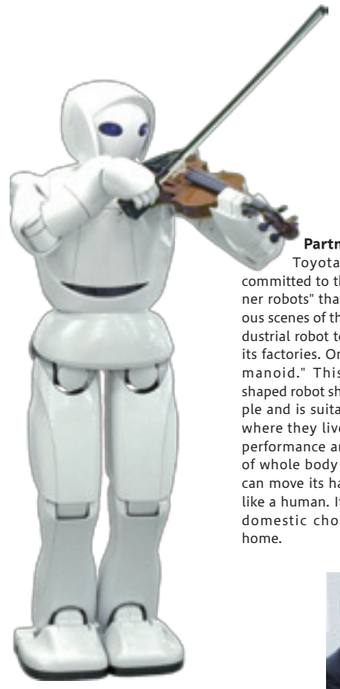

Photo courtesy of
Toyota Motor Corporation

Partner robot "Humanoid"
Toyota Motor Corporation is committed to the development of "partner robots" that support people in various scenes of their life by evolving its industrial robot technologies cultivated in its factories. One of such robots is "Humanoid." This two-legged human-shaped robot shows familiarity with people and is suitable for the environment where they live. With flexible physical performance and sophisticated control of whole body coordination, the robot can move its hands and arms delicately like a human. It aims to assist people in domestic chores and other tasks at home.

EVE: Endo Vascular Evaluator
This robot is an integration evaluation simulator for endovascular surgery that visualizes blood vessels of humans in three dimensions. The development started with research on micro surgery robots that move in blood vessels. The simulator reproduces the physical properties of vascular tissues precisely based on CT scan images of the patient, and is used for various purposes including the simulation of catheterization surgery, training of medical skills and personal simulation of surgery. Fukuda Laboratory and FAIN-Biomedical, Inc. have conducted joint science and engineering research for 25 years to develop EVE.

Toshio Fukuda
Professor at the Faculty of Science and Technology of Meijo University, and Emeritus Professor of Nagoya University. Professor Fukuda developed a longing for robots as he watched TV animation programs in his boyhood. He was the first Japanese to be President of the IEEE (Institute of Electrical and Electronics Engineers) Robotics and Automation Society, where he served from 1998 to 1999.

Photo courtesy of Fukuda Laboratory

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Voice recognition and synthesis system in "Mei-chan"

Mei-chan, a digital signage that combines a state-of-the-art technology on voice recognition and synthesis with 3D CG control. She is popular among the students and visitors, and is now an "institution" of Nagoya Institute of Technology.

Mei-chan stands at the front gate of Nagoya Institute of Technology and responds kindly to anyone who speaks to her. When asked to have a photo taken together, she hesitantly gives a V sign. In response to a rude question, she says "I'll be angry" and changes her voice tone and expression. Unlike conventional artificial voices, her voice is characteristically natural and expressive thanks to a technology called HMM-based speech synthesis, which was developed in 1995 by a research group led by Professor Keiichi Tokuda of the university for the first time in the world. The shapes of the mouth and throat and the loudness of the voice are quantified with a special statistical model to convert them into a sound in an optimal manner and produce a voice. The technology is mostly open to the public online for free, which has led to its widespread use in various areas.

Since the technology can synthesize sounds with data of a small capacity, it has been applied to the development of a wide range of products including smartphones and car navigation systems. With the technology, it is not a fantasy to restore the original voices of those who have lost their voices due to illness. This new interface between people and machines via sounds is attracting much attention.

Photo courtesy of Nagoya Institute of Technology

The World's Most Popular Grid-Scale Battery Storage System
NGK's NAS® System

Container-type NAS battery ordered by Mitsubishi Electric Corporation and delivered to the Buzen Substation of Kyushu Electric Power Co., Inc.

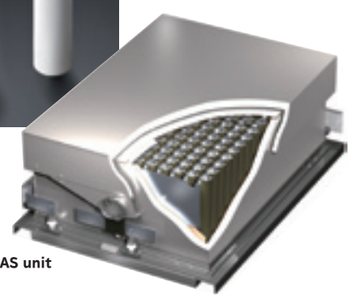
NGK's NAS® system is the world's most widely deployed grid-scale battery storage system. Since 1995, over 200 projects have been installed worldwide, totaling 530 MW and 3,700 MWh. NAS systems are operating in climates ranging from the freezing cold of Canadian winters to the desert heat of Abu Dhabi, UAE.

NAS storage systems enable grids to reliably provide some, or all, of their electricity from intermittent renewables sources, such as wind and solar. The NAS system stores, time-shifts and dispatches renewable electricity, reliably and precisely meeting demand, all day and all night.

NAS batteries are made of sodium, sulphur and NGK's proprietary beta-alumina ceramic, all of which are recyclable. "High quality, low cost and dependable performances are all essential for widespread deployment of grid storage. We have achieved these capabilities thanks to beta alumina, which we developed using our advanced ceramic technologies," said Mr. Toshiyuki Mima, who is the Executive Officer in charge of the NAS Battery Division.

Container-type NAS battery

Single NAS battery
This battery uses a special ceramic material (beta alumina) that passes only sodium ions to repeatedly charge and discharge electricity with chemical reaction of sulfur and sodium.



NAS unit

Photo courtesy of NGK INSULATORS, LTD.

NGK ships its NAS system in plug-and-play 20 foot shipping containers. Each NAS container can store the electricity used in 1 day by about 120 households. The containerized packaging allows rapid deployment, even for massive projects. NGK demonstrated this rapid deployment by building the world's largest energy storage facility in just 6 months. This 50 MW, 300 MWh NAS project was energized in March 2016. It is being used by a customer to increase the solar generation on its grid, as well as simultaneously providing many other grid functions.

NAS batteries are known for their large capacity (6 hours discharge at full power output), high energy density (triple that of lead acid batteries) and long life (15 years and 4,500 cycles). The performance, lifetime and high reliability of NAS systems are field-proven, which allows storage projects to be financed using traditional infrastructure financing.

NAS storage systems are just one of NGK's many innovative ceramic products. NGK's ceramics products are used worldwide in power systems, automotive and semiconductor applications. NGK is traded on the Tokyo stock exchange as NGK INSULATORS, LTD.

COLUMN

To Understand the Global Environment, knowing the Importance of the Environment. International Center for Environmental Technology Transfer (ICETT)

1

2

1. Study-tour of a septic tank model
2. Practical training with a water quality inspection kit (PACKTEST)
ICETT has accepted 7,882 participants from 90 countries so far.

Japan is expected to use the experience and technologies accumulated through its commitment to environmental issues to actively contribute to the world in cooperation with other countries.

In March 1990, ICETT was established in Yokkaichi in cooperation between industry, government and academia to transfer the pollution prevention technologies and know-how on environmental management accumulated in the country to developing countries. Yokkaichi had experienced severe pollution in the course of its economic growth and developed and accumulated excellent environmental conservation technologies and management methods to solve the problem.

ICETT is now promoting technical transfers to improve the environment of other countries that suffer pollution caused by rapid industrialization through introduction of public environmental conservation measures, technical guidance for companies, capacity development, support of environmental businesses and other initiatives.

Photo courtesy of ICETT