

INNOVATION

Mazda has been committed to manufacturing unique cars that fascinate people with the pleasure of driving, brightening customers' lives through car ownership, and offering cars that are sustainable for the earth and society. To this end, the Company has been developing unique technologies and enhancing cooperation with business partners, universities and research institutions, and administrative organs.

Mazda-unique Innovation

With the aim of developing innovative vehicles that exceed the expectations of its stakeholders, Mazda has promoted company-wide efforts to review the vehicle-manufacturing processes from scratch. In FY March 2017, these efforts were highly appreciated both inside and outside Japan (see p.134).

Innovation in Base Technologies "SKYACTIV TECHNOLOGY" a

Mazda engages in research and development with the aim of creating the most functional products with the maximum efficiency. SKYACTIV TECHNOLOGY,^{*1} which the Company began introducing in models in 2011, achieved comprehensive improvements in base technologies, such as improving the efficiency of powertrain components including the engine and transmission, reducing vehicle body weight, and improving aerodynamics. In 2019, the Company will introduce cars equipped with the Skyactiv-X, which is set to become the world's first^{*2} commercial next-generation gasoline engine to use compression ignition, and the next-generation SKYACTIV-VEHICLE ARCHITECTURE (see p.126).

a SKYACTIV TECHNOLOGY*

Name	Features
SKYACTIV-G	Highly efficient direct-injection gasoline engine
SKYACTIV-D	Highly efficient clean diesel engine
SKYACTIV-DRIVE	Highly efficient automatic transmission
SKYACTIV-MT	Highly efficient Manual transmission
SKYACTIV-BODY	Lightweight body with high rigidity
SKYACTIV-CHASSIS	High-performance, lightweight chassis

* For next-generation technologies, see p.126.

Design Theme, KODO – Soul of Motion b

Since 2010, Mazda has striven to create cars that embody the dynamic beauty of life through application of its KODO—Soul of Motion design philosophy. To maintain and further deepen value, the Company has been pursuing the expression of a new elegance based on Japanese aesthetics characterized by a beauty that is subtle and restrained yet rich and abundant. The next-generation designs will focus on a "less is more" aesthetic that cherishes space and eliminates non-essential elements to create simplicity of form. The challenge then is to bring the car to life via carefully honed reflections on the body surface. The Company is reinterpreting the very essence of Japanese aesthetics, a subdued beauty cultivated since ancient times. The goal is to create an elegant and refined look with a sense of vitality that makes Mazda cars truly come alive.

b Next-generation design vision model (released in October 2017)



^{*1} It covers all Mazda's base technologies such as the engine, transmission, chassis and body.

^{*2} As of August 2017, according to in-house investigation.

TOPICS Mazda wins the METI Minister's Prize under the Seventh Monodzukuri Nippon Grand Award^{*1}

In February 2018, Mazda won the METI Minister's Prize under the Seventh Monodzukuri Nippon Grand Award for its *Monotsukuri*, or Product Development and Manufacturing That Underpins the Mazda Brand, KODO—Soul of Motion Design through the integrated process from design to production.

At Mazda, our goal is to manufacture cars that embody the KODO—Soul of Motion design theme to offer driving pleasure to customers. Co-creation activities have been promoted to understand and share the ideals and sensibilities to be achieved through seamless collaboration between departments and between internal and external entities. These activities have helped to establish new technologies such as forming technologies and made it possible to manufacture cars that properly reflect the designers' intentions, which used to be considered extremely difficult.

^{*1} The Monodzukuri Nippon Grand Award is granted every two years by the Ministry of Economy, Trade and Industry. The award recognizes individuals or groups that overcome advanced engineering issues and develop and commercialize superb and innovative products, parts, materials, etc. Mazda won the METI Minister's Prize for the second time.

For particularly relevant SDGs (sustainable development goals), see p. 21 for details of SDGs.



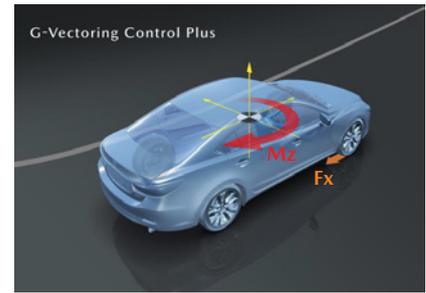
G-Vectoring Control Improves Comfort, Handling, and Stability

Mazda has been pushing ahead with the development of Skyactiv-Vehicle Dynamics, a series of new-generation vehicle dynamics control technologies. These technologies provide integrated control of the engine, transmission, chassis and body to enhance the car's *Jinba-ittai* driving feel—a sense of connectedness between the car and the driver.

The first technology in the Skyactiv-Vehicle Dynamics series, G-Vectoring Control (GVC),*¹ was released in July 2016. GVC was the world's first control system to vary engine torque in response to steering inputs in order to provide integrated control of lateral and longitudinal acceleration forces and optimize the vertical load on each wheel for smooth and efficient vehicle motion. *²

The second technology in the Skyactiv-Vehicle Dynamics series, GVC Plus, introduced in October 2018, uses the brakes to add direct yaw moment control for further enhanced handling stability. As the driver steers out of a corner by returning the steering wheel to the center position, GVC Plus applies a light braking force to the outer wheels, providing a stabilizing moment that helps restore the vehicle to straight line running. The system realizes consistently smooth transitions between yaw, roll and pitch even under high cornering forces, improving the vehicle's ability to accurately track sudden steering inputs and crisply exit corners. In addition to improving handling in emergency collision avoidance maneuvers, GVC Plus offers a reassuring feeling of control when changing lanes on the highway and when driving on snow or other slippery road surfaces.

C G-Vectoring Control Plus (GVC Plus) operation image*



* Mz: restoring moment, Fx: braking force

*¹ G-Vectoring Control: Vectoring control for vehicle acceleration (G) forces

*² As of June 2016 for mass production vehicles, according to in-house investigation

New-Generation Models* Incorporating SKYACTIV TECHNOLOGY and KODO—Soul of Motion Design (Introduced at the end of July 2018)

	Small			Mid-size	
Sedan, hatchback, wagon, etc.	Demio/Mazda2 (From September 2014)	Axela/Mazda3 (From September 2013)	Atenza/Mazda6 (From November 2012)		
SUV/crossover	CX-3 (From February 2015)	CX-4 (From June 2016)	CX-5 (From February 2012)	CX-8 (From December 2017)	CX-9 (From May 2016)
Sports car	Roadster/MX-5 (From May 2015)				

* Availability depends on country or region.
* (): timing of the introduction.

TOPICS

Mazda released concept models featuring next-generation technologies and next-generation designs at the 45th Tokyo Motor Show (organized by the Japan Automobile Manufacturers Association, Inc.) in October 2017. Specifically, the Company released a concept model of the next-generation product lineup and a concept model that embodies the vision of next-generation designs to be introduced.

Next-generation technologies

Next-Generation SKYACTIV-X Gasoline Engine

Thanks to Mazda's unique Spark Controlled Compression Ignition (SPCCI), Skyactiv-X is set to become the world's first commercial gasoline engine to use compression ignition.* The engine realizes a sharp response and exhilarating torque-rich acceleration combined with better fuel economy and cleaner emissions than ever before.

* As of August 2017, according to an in-house investigation

Next-generation SKYACTIV-VEHICLE ARCHITECTURE Platform

Skyactiv-Vehicle Architecture was developed an enhanced focus on the human-centered design philosophy to leverage the human body's inherent ability to balance itself. Mazda reviewed every component and function -- seats, body, chassis, NVH performance, etc. -- approaching development and commercial implementation from a viewpoint of total vehicle optimization. (An example is the seats, which are designed to keep the pelvis upright, maintaining the spine's natural "S" curve). This also improves the body's balance for driving operations and enhances the ultimate Jinba-ittai feeling, allowing the driver to control the car easily.

Next-generation Design

Mazda VISION COUPE design vision model

The Mazda Vision Coupe is a next-generation design vision model which showcases the "new elegance" that we have developed, drawing upon Mazda's long history of design. Within the sleek four-door coupe configuration, the strikingly beautiful silhouette imparts a stirring visual expression of the vehicle's high performance, while the sculpted athletic form is free of all decorative elements, a key factor in Mazda's minimalist design approach.

Strong highlights on the shoulders contrast with an ever-changing interplay of light and shadow on the body sides to express a new sense of natural vitality, giving rise to a uniquely Mazda sense of elegance derived from Japanese aesthetics.

The Vision Coupe sets the stage for the introduction of a more mature Kodo design language.

Mazda KAI CONCEPT compact hatchback integrates next-generation technologies and designs

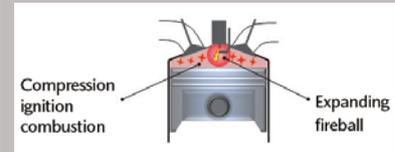
Designed as the ultimate combustion engine-powered car, the Mazda Kai Concept compact hatchback combines Mazda's next-generation technologies and design. The powertrain includes the next-generation Skyactiv-X gasoline engine. Together with Skyactiv-Vehicle Architecture, component technologies designed with an enhanced focus on the human-centered development philosophy, it achieves sophisticated performance. The design features a honed beauty free of extraneous elements, combined with the unique, powerful compactness of a hatchback. The next-generation design is intended to artistically embody Japanese aesthetics, condensed into the Kai Concept's compact form to create Mazda's ideal hatchback.

d SKYACTIV-X



e Spark Controlled Compression Ignition (SPCCI)

Spark-Controlled Compression Ignition (SPCCI) is Mazda's proprietary combustion technology that offers complete control of compression ignition combustion by means of spark ignition. Once ignited by the spark plug, the expanding fireball serves as a second piston (air piston), further compressing the air-fuel mixture in the combustion chamber and providing the necessary conditions for compression ignition. By controlling the timing of spark plug ignition, SPCCI expands the range of conditions under which compression ignition can take place.



f A seat that keeps the pelvis upright to maintain the spine's natural "S" curve

Ideal condition in a car seat

The dynamic balancing capability can be demonstrated as in the case of walking.

While walking	Ideal condition in a car seat
The pelvis is positioned in the opposite direction from the upper part of the body.	The head is stable.

•The seat keeps The pelvis upright to maintain the spine's "S" curvature.
 •The seat transmits the force from the road surface to The pelvis and causes The pelvis to move regularly, continuously, and smoothly.

■ Ideal condition while walking and in a car seat

g Mazda VISION COUPE

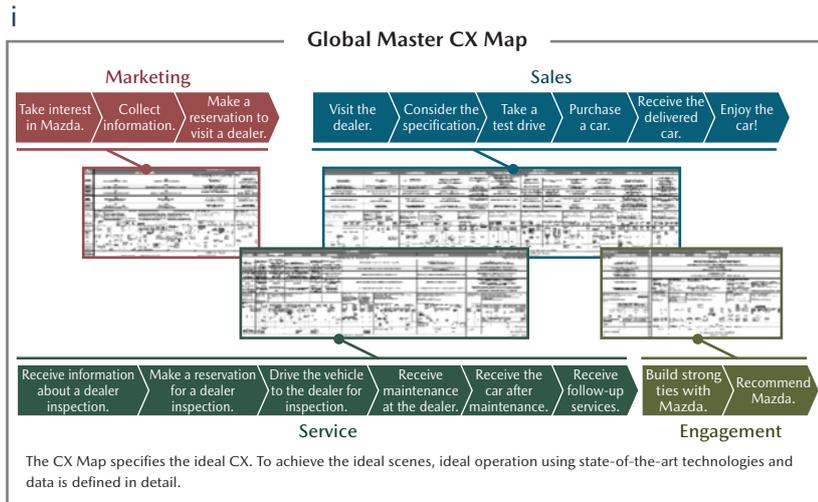


h Mazda KAI CONCEPT



Mazda Digital Innovation (MDI)

Mazda has been pushing ahead with the Mazda Digital Innovation (MDI), an initiative aimed at reforming work processes by introducing the latest IT technologies. In MDI Phase 1 (1996–2008), the Company promoted innovations in product development and manufacturing processes by employing CAD/CAM technologies, contributing to the efficient development and production of new-generation models with Skyactiv technology. MDI Phase 2 began in April 2016, in response to the advancement of IT technologies such as IoT and AI and the diversification of customer needs. The Company has been taking on challenges to continuously increase Mazda fans worldwide based on innovation through the CX MAP, which depicts the Ideal Customer Experience (CX) as a flow of Marketing Sales Service Engagement.

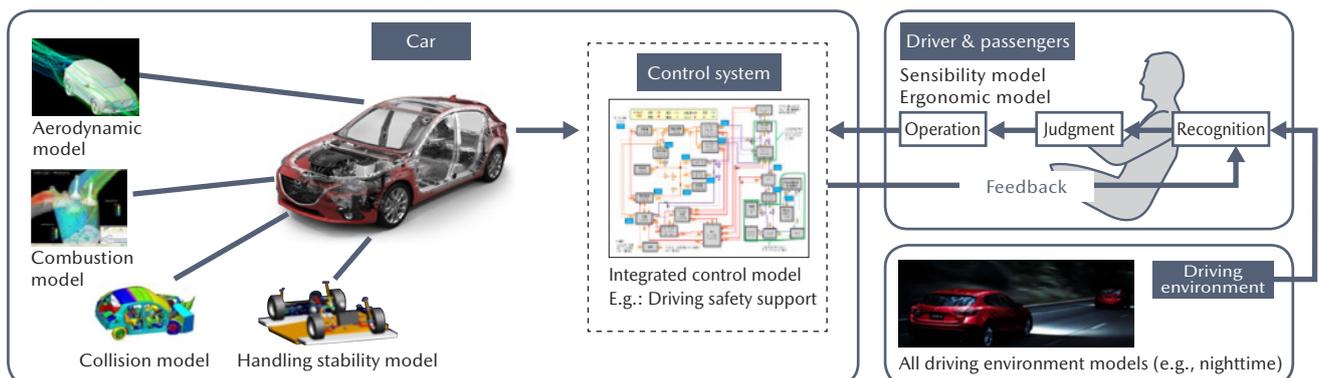


Model-Based Development (MBD)

Cars are being called on to provide increasingly advanced and diverse functions, while vehicle architecture and control systems are becoming more and more complex. Model-based development, which uses computers to efficiently replicate development processes, is essential to keep developing complex systems quickly and with limited resources. Model-based development involves creating computer models of the vehicle, control systems, drivers, passengers, driving environments and other development subjects, and conducting development via thorough computer simulation. It is an efficient method of optimization. By carrying out development through simulations from design to vehicle evaluation, we are able to reduce the number of prototype parts and actual unit verification, thereby enabling us to develop complex, highly sophisticated new products with minimum resources while also ensuring quality. Mazda will increase the application of models in collaboration with its suppliers.

j Model-Based Development

A technique to develop outstanding products by modeling (quantifying) and connecting all four elements of (1) the car, (2) control systems, (3) the driver & passengers, and (4) the environment without using an actual vehicle



Innovation in Vehicle-Manufacturing Processes through “Monotsukuri Innovation”

In line with its efforts to manufacture attractive vehicles that go beyond diversifying customer expectations, Mazda is working to significantly improve its business efficiency by increasing product development/manufacturing efficiency. Upholding the objective of realizing both “diversity that enhances product competitiveness” and “commonality that improves manufacturing economies of scale” at a high level, Mazda launched “Monotsukuri Innovation,” an initiative to review all vehicle-manufacturing processes from scratch, and is promoting it on a global scale.

The integrated planning initiative of the *Monotsukuri* Innovation involves close collaboration among several departments, such as product development, manufacturing, purchasing, logistics and quality, as well as suppliers. They plan together the models to be introduced in the future across the vehicle classes/ranks and segments from a five or ten-year perspective. This initiative has resulted in improved quality, brand strength and profit margins, while enabling flexible response to requirements for manufacturing several models with different production scales and changes in production volume.

Establishing a Global Production Framework

To enable each production site both in Japan and overseas to carry out high-quality and highly efficient production activities that encourages mutual learning and improve the Mazda brand value and, Mazda has promoted the Global Manufacturing Network since 2013. Production sites in Japan (the Hiroshima and Hofu Plants) take the initiative in fostering skills in process management and improvement (“workplace capabilities”) to enable overseas sites that differ in maturity to conduct production activities at the same levels of quality and efficiency. Activities are promoted at each site facilitate simultaneous, even, and high-quality production during the preparation phase of mass production of new models, in addition to daily production activities.

In promoting this initiative, to support overseas sites in improving their workplace capabilities in daily practices, the Company actively hosts various forms of personnel exchange, such as accepting trainees in Japan from overseas sites and dispatching skilled personnel to overseas sites. The Company has held the Global Manufacturing Forum annually since 2014 to share its medium to long-term goals, as well as successful examples and problems at each of its sites. At the fifth Global Manufacturing Forum in April 2018, the concepts of next-generation products, *monotsukuri*, or product development and manufacturing, and brand value management were shared by production sites to promote understanding. The entire Mazda Group has been working to introduce new products.

Establishing Global Logistics Framework

To deliver products that exceed customer expectations in a highly efficient and flexible manner and provide the best services in all stages including after sales, Mazda has been establishing a logistics framework in which all its logistics sites in Japan and overseas collaborate to enable globally optimal transportation within the entire Mazda Group.

To establish an optimal framework, the Company has held the Global Logistics Meeting annually since 2014. To improve the brand value throughout the supply chain, the Company pursues best practices and enhances ties while sharing problems and successful cases of improvement across the Mazda Group. Personnel from both in and outside Japan will continue to meet to discuss quality, cost and delivery time from the viewpoint of designing logistics.

k |

k Global plant vision



| Global Manufacturing Forum



m Global Logistics Meeting

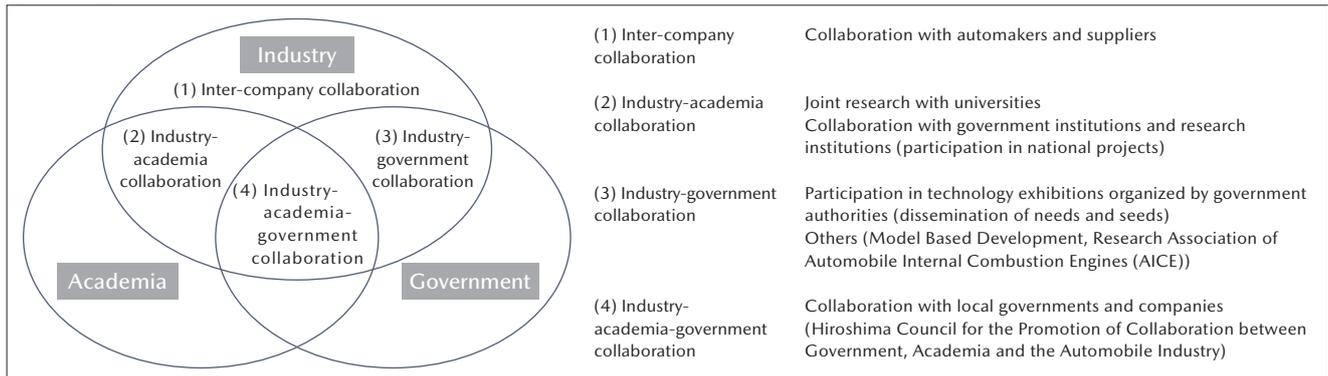


Open innovation

Mazda has promoted collaboration with companies, universities and government authorities, aiming to efficiently resolve business issues by obtaining new knowledge from outside the Company and to achieve the sustainable growth of society and businesses (open innovation).

The business environment in which companies operate is becoming increasingly competitive due to stricter environmental and safety regulations, new competitors from other industries, and diversification of the mobility business. Through open innovation, the Company will achieve the growth of the Mazda Group and contribute to society, thereby fulfilling the Corporate Vision.

System diagram of open innovation



Objectives of opening innovation

- [Contribution to society]
 - Achieve a sustainable society, advance *monotsukuri* or product development and manufacturing (share knowledge and skills), and enhance regional empowerment
- [Achieve the growth of the Mazda Group]
 - Improve engineering capabilities, improve the brand value, and increase R&D efficiency

(1) Inter-company collaboration

Mazda has been promoting inter-company collaboration with other automakers and suppliers to enhance their manufacturing and engineering capabilities and create synergies.

Collaboration with automakers

Mazda is promoting an alliance strategy with other automakers to mutually complement our products, technologies, and regions in the most appropriate way and efficiently improve the value of the Mazda brand.

In August 2017, Mazda entered into an agreement on a business and capital tieup with Toyota Motor Corporation to further deepen their cooperative relationship.

Partnership Strategies to Complement the Brand



Collaboration with suppliers

The Company builds a system for efficiently developing high-performance parts through collaboration with suppliers with advanced engineering capabilities.

In FY March 2018, Mazda concluded an agreement to jointly develop a 12 V lithium ion battery for starting cars (see p.67).

TOPICS Business Capital Tie-up with Toyota Motor Corporation

In August 2017, Mazda entered into an agreement on a business and capital tieup with Toyota Motor Corporation. By further enhancing each other's excellent technologies and business foundations and deepening their cooperative relationship, the two companies will take on and overcome challenges together to realize sustainable growth in this period of drastic change. Establishing an equal and amicable long-term relationship that respects the independence of both parties, the two companies will advance efforts toward the agreed joint projects. Working together to "create new value in cars" as long-term partners, Toyota and Mazda will accelerate and expand mutual cooperation to satisfy customers and contribute to the development of a sustainable society.

<Matters agreed in relation to the business tie-up>

- Establishing a joint venture production company for complete vehicles in the U.S.
- Jointly develop technology for electric vehicles
- Collaborate on next-generation technologies, including connected car and advanced safety features
- Seek further opportunities to complement each other's product lineups

Details <http://www2.mazda.com/en/publicity/release/2017/201708/170804c.pdf>

Activities to Improve Manufacturing Capabilities in Collaboration with Local Suppliers

Mazda is rolling out its J-ABC (Jiba ["local"] Achieve Best Cost) program for local suppliers in and around Hiroshima Prefecture starting in 2004. Under this program, Mazda staff visit suppliers' plants and use the approach employed in Mazda production systems as a basis for identifying wasteful, unnatural or problematic manufacturing processes. The Company then works cooperatively with the suppliers to formulate and implement countermeasures. This program is also expected to enhance potential for improvement at manufacturing sites in connection with Mazda's *Monotsukuri* Innovation activities (see p.128). It has helped increase productivity and reduced production costs by around 3 billion yen per year.

Results of J-ABC activities for FY March 2018

Case Example	Objective	Initiative	Results for FY March 2018
Cooperative Improvement Efforts	Improving operation rates, shortening cycle times, improving logistics operations (started in 2004)	A total of around 2,000 visits to 50 plants at 23 companies were carried out to implement cooperative improvement activities.	Held 54 results-reporting meetings Promoted a shift from site-based activities to company-wide activities.
J-ABC Karakuri [®] *1 Kaizen Dojo	Fostering high levels of creativity and making work more fun without incurring additional costs (launched in 2006)	Offered practical programs such as lectures and on-site guidance meetings to improve the ability to devise mechanisms for increased productivity.	11 participants from nine companies successfully completed the program. The Master Trainer qualification system introduced in 2016, to qualify leaders within local suppliers. Outstanding works are proactively submitted to the Mazda Hiroshima Plant Karakuri Exhibition and Karakuri Kaizen [®] Mechanism Exhibition.
J-ABC Maintenance Workshop	Preventing facility stoppages and drops in production capability (launched in 2010)	Practical programs such as lectures and on-site guidance meetings were offered to improve the ability to both detect and properly respond to irregularities.	Held twice a year in the Hiroshima and Hofu districts, with a total of three members from three companies successfully completing the program in FY March 2018. Under the leadership those who have completed the program with the help by their plant managers, self-motivating maintenance initiatives took place at 18 plants.
J-ABC Conference	To encourage study through the sharing of J-ABC activity policy and outstanding activity examples (started in 2005)	Held for all participating companies, providing a venue for presentations, awards, and other events.	At the 2017 conference, the morning session (in which messages were delivered, the policy was explained, and outstanding activities were presented and commended) was attended by a total of 450 participants, with 400 participants from 52 local suppliers and 50 participants from Mazda. In the afternoon session (in which outstanding activity examples were presented, and karakuri, or self-motivating maintenance initiatives, were exhibited), 21 examples, eight works, and two activities were presented and introduced.

*1 Karakuri Kaizen[®] is a registered trademark of the Japan Institute of Plant Maintenance.

Activities to Improve Manufacturing Capabilities in Collaboration with Overseas Production Sites and their Local Suppliers

As the importance of overseas production sites increases along with its attempt to establish a global production footprint, Mazda is promoting activities to improve manufacturing capabilities, with a view to improving quality and productivity jointly with local suppliers. While paying respect to the differences in national characters and cultures and understanding the key points necessary to promote continuous improvement activities at worksites, the Company employs the know-how obtained through the J-ABC activities. The Company has also established a system to develop leaders at both local production sites and suppliers in promoting activities to support improvement of suppliers. Mazda will continue to expand the activities in cooperation with its suppliers.

A-ABC activities in Thailand

In 2013, Mazda launched the A-ABC (ASEAN Achieve Best Cost) program at AutoAlliance (Thailand) Co., Ltd. (AAT), starting with five local suppliers.

As the contribution of the activities under this program to improving quality, productivity and cost performance has been gradually gaining recognition among other suppliers, the number of participating suppliers has reached 10 as of June 2018. Three Mazda representatives in charge of the A-ABC program and four AAT promotion representatives serve as facilitators in conducting activities. This program is designed to have each supplier envision an ideal, understand and analyze the present situation, develop and implement measures for improvement toward realizing said ideal, and finally report the results. It is carried out twice a year. The A-ABC conference is held annually, to encourage communications and information exchange among participants. In FY March 2017, the fourth year of this program, past activities were thoroughly reviewed and expanded to promote both structural reform and fundamental improvement, which are the two wheels of the program, so as to enable AAT/suppliers to conduct autonomous activities.

M-ABC activities in Mexico

Mazda de Mexico Vehicle Operation (MMVO) launched the M-ABC (Mexico Achieve Best Cost) program in 2015, starting with two local suppliers. The number of participating companies has reached six as of June 2018. Two Mazda representatives in charge of the M-ABC program and six MMVO promotion representatives serve as facilitators in promoting activities in cooperation with local suppliers.

Similar to the A-ABC program, the program is designed to have each supplier envision an ideal, and activities are carried out twice a year. The members first address themes related to stable quality and stable supply of production lines, and gradually move to issues related to productivity and quality improvement. Local promotion members are called national staff. National staff members are encouraged to autonomously and independently operate the program. To this end, Japanese management of MMVO and its suppliers are making joint efforts to facilitate autonomous operation.

p A-ABC activity



q M-ABC activity



(2) Industry-academia collaboration

Mazda has a system to efficiently offer advanced training through collaboration with educational institutions such as universities and research institutions.

Participating in World-Leading

National Projects and Joint Studies

Mazda participates in world-leading national projects and joint studies with external research institutions, with the aim of solving social problems facing the automobile industry.

Relevant government institutions/organizations	Project name	Outline
Ministry of Economy, Trade and Industry / New Energy and Industrial Technology Development Organization / Innovative Structural Materials Association	Development of Innovative New Structural Materials Technology http://isma.jp/en/index.html	Research and development on structural materials, bonding technology, etc., to fundamentally reduce the weight of automobiles and other transportation equipment, for the purpose of reducing CO ₂ emissions
Ministry of Economy, Trade and Industry / New Energy and Industrial Technology Development Organization / Thermal Management Materials and Technology Research Association	Research and development on innovative technology to utilize unused thermal energy http://www.thermat.jp/english/	Research on technology to make use unused energy*1 released as thermal energy into the atmosphere

*1 In Japan, refers to the energy consumed in the living environment, industry, and transportation fields and released as unused heat energy into the atmosphere.

Collaboration with Universities

Through enhancing collaboration with universities in various fields, Mazda aims to solve a broader range of issues from a wider perspective, thereby contributing to society.

University	Collaboration outline	Measures and activities
	Next-generation automotive technology joint study course (since April 2015) Mazda has set up four joint study courses and one endowed chair jointly with a university (e.g., an internal combustion engine lab, the Algae Energy Creation Lab) to find solutions to long-term technological issues and to develop human resources to implement the solutions. Industry-academia collaboration activities have been promoted to enable Hiroshima to lead Japan in <i>Monotsukuri</i> (product development and manufacturing) through human resources development and research and development based on Model Based Research (MBR) and Model Based Development (MBD).	Opened next-generation automotive technology joint-studycourse (in FY March 2016) •Internal combustion engine lab (opened in April 2015) •Aerodynamics lab (opened in July 2016) •Advanced materials lab (opened in October 2016) •Algae energy creation Lab (opened in April 2017)(see p. 69)
Hiroshima University	Comprehensive collaboration agreement (since February 2011) Through collaboration in broad areas, from technologies related to research & development and production to social science fields such as planning, management, and marketing, proactively conducting joint research from exploring research themes to finding solutions. Also cooperating in examining the ideal form of internship, and deciding the method of accepting interns and setting themes for human resources development. Regional empowerment and open innovation Mazda contributes to regional empowerment and human resources development of the Chugoku region and Hiroshima Prefecture, and to global sustainable development goals (SDGs) through collaboration with Hiroshima University and local communities and participation in national projects, etc.	
Hiroshima City University	Mazda and Hiroshima City University Faculty of Arts Co-Creation Seminar (since May 2017) Set up a co-creation seminar with the university, aiming to develop human resources who are capable of creating new manufacturing for a new era, and make Hiroshima a place to generate human resources for manufacturing that Hiroshima can boast to the world.	Held Co-creation Seminar in FY March 2019 as well.
Kyushu University	Inter-organizational collaboration regarding next-generation automotive technologies (since May 2011) Working together to reinforce research and development projects and to encourage academic research and education activities.	Opened the Mazda Next-generation Energy Storage Joint Research Department (in August 2017).
Kindai University	Agreement concerning comprehensive research collaboration (since December 2012) Cooperating in bolstering cutting-edge research development and in strengthening the technological capabilities of local industries.	Research Collaboration Promotion Committee •Held meetings to discuss the progress of joint research projects and specific measures to strengthen cooperation.
University of Hyogo	Concluded an agreement on joint research using Spring-8, a large synchrotron radiation facility (May 2016) Cooperating in the development of innovative materials and product development technologies using radiation analysis techniques.	—
Tokyo Institute of Technology	Industry Liaison Member (since August 2013) Technology transfer through joint research, for the purpose of improving the quality of research and education and promoting application of research and education results. Contributing to the creation of new industries and promotion of innovation.	•Searched for research seeds and arranged matching them with the development needs. •Participated in technology exchange seminars and hosted inhouse seminars by faculty members. •Implemented joint study on algae energy.

(3) Industry-government collaboration

Mazda efficiently promotes cutting-edge joint research and shares needs and seeds with customers through collaboration with government authorities.

Business Matching Meetings for Suppliers and Universities (Collaboration with Administrative Organs)

Mazda organizes business-matching meetings in collaboration with the local administrative organs, in which information on technological needs and seeds was exchanged between suppliers, universities and public research institutes.

FY March 2018 activities

1. New Technologies and New Engineering Solutions Exhibition and Business Meeting in Mazda organized by the Osaka Prefectural Manufacturing & Industrial Association
2. Kinki SMEs Cooperation Project (KSP)
Kinki SMEs Cooperation Project New Technologies Exhibition and Business Meeting
3. Fukushima Prefecture New Technologies and New Engineering Solutions Exhibition and Business Meeting in Mazda organized by the Fukushima Prefecture Transport Equipment-related Industry Cooperative Association
4. Kyushu New Automotive Technologies and Engineering Solutions Exhibition and Business Meeting in Mazda organized by the Kyushu Automotive-Motorcycle Industry Promotion Conference

Promotion of model distribution in the automotive industry

Mazda has participated in the Study Group for Ideal Approaches to Model Utilization in the Automobile Industry organized by the Ministry of Economy, Trade and Industry since its launch in November 2015. The Company works on initiatives with other automakers and parts manufacturers to spread Model Based Development (MBD), a development technique to achieve the advanced development and performance assessment process for automobiles through virtual simulation. In FY March 2018, efforts were made to formulate a policy to spread MBD and promote international collaboration activities with Europe, etc. In April 2018, the Company agreed on the Enrichment of SURIAWASE 2.0*¹ for the Automobile Industry (an industry-academia-government joint strategy project policy), and announced that the Company would continue with the initiatives to enrich MBD and harmonization areas, etc. In this study group, the Company takes full advantage of its knowledge of virtual simulation and unique MBD that have been refined through Mazda Digital Innovation (MDI) (see p.127) to contribute to activities for increasing the global competitiveness of the Japanese automotive industry.

Basic and Applied Research on Technologies for Internal Combustion Engines and Cleaner Exhaust Emissions

Mazda participates in the Research Association of Automobile Internal Combustion Engines (AICE*²), a new joint research organization in the Japanese automobile industry. AICE was established on April 1, 2014, with the support of the Ministry of Economy, Trade and Industry to enable automobile manufacturers to conduct basic and applied studies jointly with universities and research institutions on themes common to automobile manufacturers, and to use the research results to accelerate their in-house development activities. Taking advantage of its participation in AICE, Mazda is promoting its development of technologies for internal combustion engines and cleaner exhaust gases, with a view to achieving improved fuel economy and reduced exhaust emissions.

*¹ SURIAWASE 2.0 is an initiative to enhance the harmonization of development processes by taking advantage of an MBD process that uses virtual simulations instead of physical machines across entire supply chains in Japan. A Study Group for Ideal Approaches to Model Utilization in the Automobile Industry was organized in November 2015 by the Ministry of Economy, Trade and Industry, to further enhance the international competitiveness of the automotive industry.
http://www.meti.go.jp/english/press/2017/0331_004.html
http://www.meti.go.jp/english/press/2018/0404_001.html

*² Research Association of Automobile Internal Combustion Engines, participated in by nine Japanese auto manufacturers and two organizations (as of April 2015)

(4) Industry-academia-government collaboration

Mazda, in establishing the Industry-Academia-Government Collaboration Secretariat, has promoted collaboration with government authorities and universities. By visualizing such collaborative activities and sharing relevant information with government authorities and universities, the Company aims to achieve the maximum outcomes from its daily efforts. Moreover, through collaboration with government, academia and industry, the Company has contributed to the local community in terms of the recruitment of local people, human resources development, and the production of human resources.

Hiroshima Council for the Promotion of Collaboration between Government, Academia and the Automobile Industry

As a company which has its research & development and production facilities mainly in Hiroshima Prefecture, Mazda believes that cooperation with local business and industry is very important.

Under this belief, Mazda is collaborating with the Chugoku Bureau of Economy, Trade and Industry, Hiroshima Prefecture, Hiroshima City, Hiroshima Industrial Promotion Organization, and Hiroshima University to support local automobile-related companies and promote innovation and the vitalization of the region. Toward achieving the 2030 Industry-Academia-Government Collaboration Vision established in 2015, various initiatives are implemented, such as creating new frameworks to support local businesses, investigating next-generation automotive societies, and raising awareness in society.

In FY March 2018, the Company planned and organized an education and training program related to Model Based Development*1 in collaboration with the Hiroshima Digital Innovation Center,*2 which was certified by the Ministry of Economy, Trade and Industry as a Course on IT-Skill Training to Meet the Era of the Fourth Industrial Revolution. Thus, the Company launched full-scale efforts to promote the digitalization of local *monotsukuri* (product development and manufacturing).

MBD process training

- Certified as a Course on IT-Skill Training to Meet the Era of the Fourth Industrial Revolution
This is the first industry-academia-government course to be certified in Japan.



The 2030 Industry-Academia-Government Collaboration Vision

- Transform Hiroshima into a hub that attracts people seeking innovative automotive technologies and dynamic car culture, and a place that continually produces technologies that amaze the world.
- Industry, government and education sectors work together to nurture human resources capable of innovation across all generations, and enliven the region through *Monotsukuri* (product development and manufacturing).
- Develop Hiroshima's unique Industry-Academia-Government Collaboration into a leading model for "regional empowerment" in Japan, serving also as a benchmark for the rest of the world.

Major initiatives

	Initiative	Details and results
Supporting suppliers' personnel recruitment	Exhibiting vehicles and parts at career seminars, and proposing/implementing booth layout according to the vehicle supply chain (March 2018)	To help suppliers solve problems in recruitment, displayed Mazda vehicles and parts at career seminars, and proposed and demonstrated a booth layout that can effectively show how suppliers are connected to mass produced vehicles (highly appreciated by the participating suppliers).
Co-creation and technology exchange with suppliers	(1) Local companies co-creation subcommittee (2) Industry-academia collaboration subcommittee (3) Administrative organs collaboration subcommittee	(1) NVH performance assessment of a benchmark vehicle @ C-HR, and research on a lightweight frame structure (2) Innovation training, and follow-up of the briefing session on needs in FY March 2017 (3) Review of the creation of collaboration synergies and the next-generation vision
Studies on future energies	The Energy Work Group held "Symposium on Next-Generation Liquid Fuel for Automobiles 2018" (June 2018)	Focusing on biomass-derived, carbon-neutral liquid fuel, known as a future energy source for automobiles, experts in each of the industry, government, and academia sectors explained its potentials and practical applications, to think about energy in the future.
Research and development of internal combustion engines	Promoting research & development of base technologies for internal combustion engines	A study meeting was held for local companies under the theme of abrasion/friction control technologies. The study meeting led to joint research between some of the companies that participated in the meeting and a university.
Research and development in KANSEI (sensibility) field	(1) Sensibility-based <i>monotsukuri</i> (product development and manufacturing) in collaboration with local communities (2) Joint research on sensibilities with local suppliers (3) Overall coordination of sensibility activities by relevant local groups	(1) Started the sensibility innovation practical course and the needs-seeds matching meeting under the auspices of the Council for the Promotion of Innovation with KANSEI (Hiroshima Prefecture). (2) A real-time saliency map of interior parts is being created to clarify the sensitivity of drivers and passengers to the parts. (3) A sensibility monitor program was started to obtain reliable data.
Human resources development in Model Based Development (MBD)*2 field	Aiming to enhance the research & development capabilities of local companies, opening basic courses for the development of human resources with MBD abilities	MBD/CAE training courses were planned and organized for all manufacturing companies, including both auto suppliers and non-automobile industries, in collaboration with the Hiroshima Digital Innovation Center. In FY March 2018, 955 individuals in cumulative total participated in the training. Of these training courses, the MBD process training course was certified as a Course on IT-Skill Training to Meet the Era of the Fourth Industrial Revolution by the Ministry of Economy, Trade and Industry.

*1 Model Based Development: development process employing simulation technologies.

*2 The organization, which offers common services for the computer environment (e.g., super computers), and human resources development and training programs for digital technologies to local companies, was established within the Hiroshima Industrial Promotion Organization in October 2017.