

EXPLORING PARTNERSHIPS FOR "CO-CREATION WITH OTHERS"

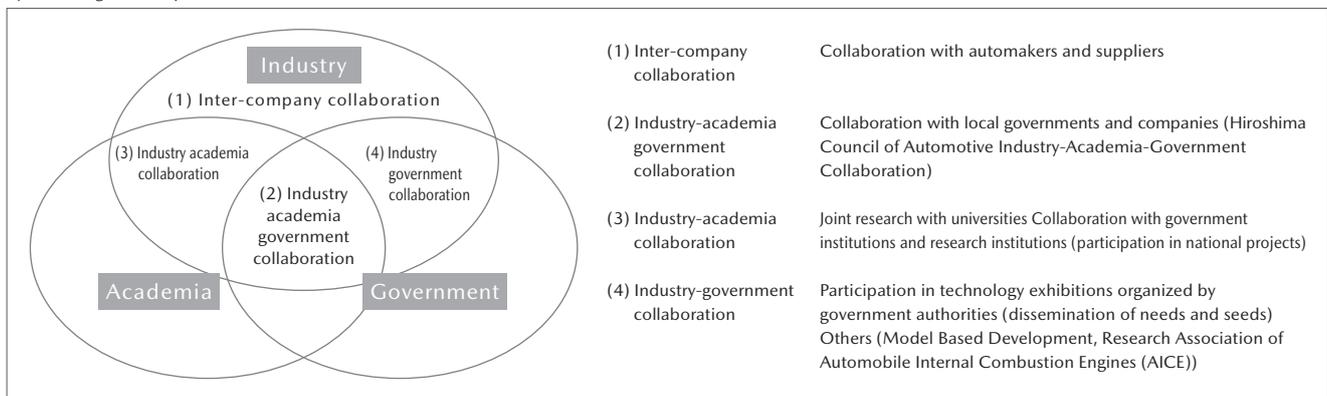
To ensure that Mazda will continue to thrive and grow, we must cherish and co-create Mazda's uniqueness together with everyone involved with it. While enhancing alliances to strengthen ties with existing partners, Mazda will continue to explore new partnerships—even outside the auto industry.

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

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

(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 partners who work with Mazda

While working hard together with its partners to realize our shared dreams, the Company wants to enable them to feel proud of their connection with Mazda, and emotionally attached to the brand. This will turn Mazda into the brand it wants it to be, connected to all stakeholders, including customers, by the strongest of bonds. On the basis of mutual trust with Toyota Motor Corporation and various other companies, the Company plans to promote active collaboration.

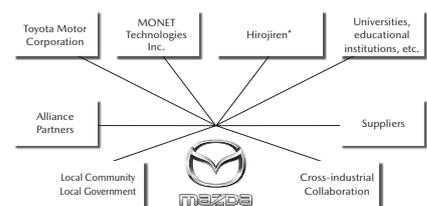
[Collaboration examples] (For examples in the environmental area, see p.33.)

March 2019: Participated in D-Call Net*¹

June 2019: Concluded a capital and business partnership agreement with MONET Technologies Inc.*²

April 2021: Reached an agreement to jointly develop technical specifications for next-generation vehicle communications devices and to promote the common use of communications systems*³

Partnership strategies



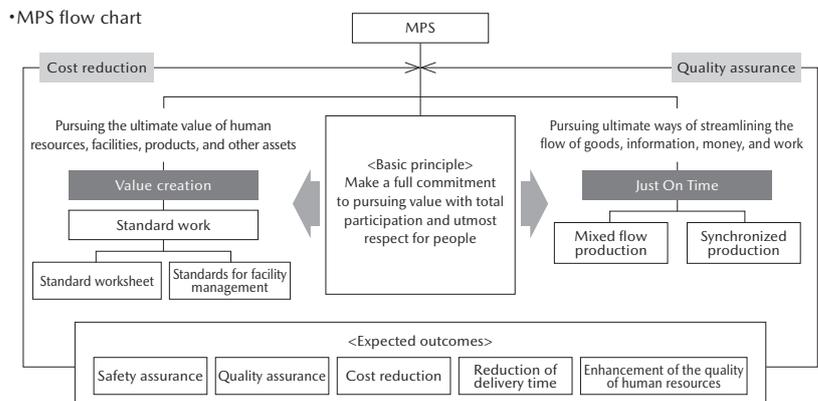
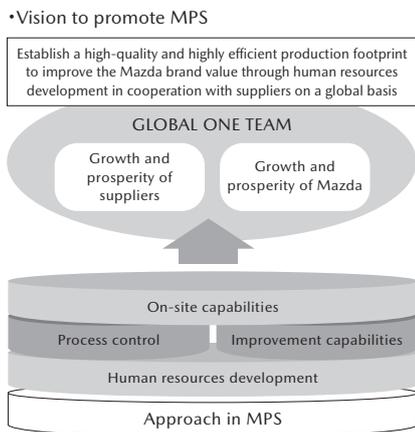
* Hiroshima Council of Automotive Industry-Academia-Government Collaboration

¹ An advanced automatic collision notification system that uses vehicle connectivity technology.
² A company that works to create an environment to promote MaaS (Mobility-as-a-Service), aiming to encourage the widespread use of next-generation mobility services and to resolve Japan's social mobility issues. The MONET shareholder structure is as follows: SoftBank Corp., Toyota Motor Corporation, Hino Motors, Ltd., Honda Motor Co., Ltd., Isuzu Motors Limited, Suzuki Motor Corporation, Subaru Corporation, Daihatsu Motor Co., Ltd., and Mazda Motor Corporation.
³ An agreement between Suzuki Motor Corporation, Subaru Corporation, Daihatsu Motor Co., Ltd., Toyota Motor Corporation, and Mazda Motor Corporation that the five companies will jointly develop and share safer and more convenient connected services with the aim of providing such services as early as possible.

Implementation of the Autonomy Development Program That Supports the Autonomous Growth of Local Suppliers

Mazda has conducted the Autonomy Development program aimed at promoting the autonomous growth of local suppliers since 2019. This program was created for local suppliers based on the approach adopted in the Global Manufacturing Network (GMN), which has been promoted since 2013 to enable each production site in Japan and overseas to autonomously carry out high-quality and highly efficient production activities that improve the Mazda brand value and to learn from each other at the same time. The program is designed to enhance human resources development as the key to the autonomous growth of local suppliers, for which the J-ABC program as a foregoer was not clearly intended. In the Autonomy Development program, promoters are assigned to play a leading role in promoting understanding of the approach in the MPS through top management training and promoter training. Local suppliers are encouraged to create a system to develop human resources through practical project work toward the company-wide operation of the system. Launched at three model suppliers in August 2019, the program is being conducted at a total of 17 suppliers (as of September 2021), with an MPS (Mazda Production System) Master Trainer appointed from one of those suppliers to lead other supervisors toward full in-house implementation of the program.

C Conceptual diagram of the Mazda Production System (MPS)



Program developed for local suppliers



Supplier organization	Training program	Outline	Period of training	Certification / Activity
Head Office Officer in charge of manufacturing Human resources manager	(1) Top management training	MPS training Lectures and workshops at Mazda	56 hours in seven days	Completion certification •Support promoters •Set and pursue the ideal vision and goal of the manufacturing sector
Plant B Plant manager / Assistant plant manager	(2) Promoter training	MPS training Lectures, workshops and site visits at Mazda	80 hours in 10 days	Completion certification •Create a system to develop human resources •Formulate and implement a human resources development plan •Set and pursue the ideal vision and goal of the manufacturing sector
Plant A Section chief / Subsection chief Supervisor	(3) Management training	Practical project work at suppliers	About one year of practice	Master trainer qualification •Implement project work (Practice activities) •Train up other foremen

Implementation of the Autonomy Development Program at Overseas Production Sites and Their Local Suppliers

In the course of transition to the Autonomy Development program in Japan, the Company has adopted the Global Manufacturing Network (GMN) at overseas production sites toward the autonomous growth of local suppliers. A total of 20 local suppliers participate in this network at the five overseas production sites of AutoAlliance (Thailand) Co., Ltd. (AAT), Mazda Powertrain Manufacturing (Thailand) Co., Ltd. (MPMT), Changan Mazda Automobile Co., Ltd. (CMA), Changan Mazda Engine Co., Ltd. (CME), and Mazda de Mexico Vehicle Operation (MMVO). MPS Master Trainers have already been appointed from three suppliers of MMVO.

(2) Industry-academia-government collaboration

Mazda, in establishing the Industry-Academia-Government Collaboration Secretariat, has promoted collaboration with local companies, universities and government authorities. Through collaboration among government, academia and industry, the Company has contributed to the local community in terms of developing new creative technologies and nurturing human resources capable of bringing about innovation.

Hiroshima Council of Automotive Industry-Academia-Government Collaboration (Hirojiren)*1

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 activities have been conducted, such as creating new frameworks to support local businesses, investigating next-generation automotive societies, and raising awareness in society. In FY March 2019, a research program proposed by Hiroshima Prefecture was selected to receive a subsidy under the Cabinet Office’s Project for Revitalization of Local Universities and Regional Industries.*2 As part of the program, the Digital Monozukuri (Manufacturing) Education Research Center was established in Hiroshima University. The center started R&D activities to create innovative multifunctional composite materials and a smart system using data-driven control technology and sensing technologies, with a view to social implementation of these inventions.

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d Digital Monozukuri (Manufacturing) Education Research Center



The 2030 Industry-Academia-Government Collaboration Vision Upheld by Hirojiren

- 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.

*1 A council that promotes industry-academia-government collaboration. Motivated by the strong hope and enthusiasm for encouraging the manufacturing industry in Hiroshima, its member organization have voluntarily joined Hiroshima Council of Automotive Industry-Academia-Government Collaboration, to consider what manufacturing ought to be and to leverage innovation that will lead to industrial development.

*2 The Hiroshima Prefecture Special Committee to Promote the Project for Revitalization of Local Universities and Regional Industries was set up. Chairperson: Hidehiko Yuzaki, Governor of Hiroshima Prefecture
Project manager: Masamichi Kogai, Senior Advisor to Mazda Motor Corporation

Major initiatives

	Initiative	Details and results
Assisting elementary schools in providing programming education	Assisting local elementary schools in offering hands-on programming classes by following a curriculum designed under the leadership of Hirojiren and using videos and car-shaped robots (providing a series of educational materials, offering preparatory training to teachers, and assisting in teaching practical skill classes)	Provided support for programming education at elementary schools, which has become compulsory in Japan since FY March 2021, as an initiative to foster the next generation of innovators by assisting elementary schools in Hiroshima Prefecture in offering programming classes following a curriculum focused on the theme “Let’s think about the future of our lives and cars.” Created and provided learning videos on issues faced by automotive society and efforts to solve them, gave programming classes using crash-free car-shaped robots, and offered preparatory practical skill training to teachers working at the participating schools (with the participation of 980 students at 16 schools).
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, and research on a lightweight frame structure ② Innovation training ③ Review of the creation of collaboration synergies and the next-generation vision
Studies on future energies	Demonstration testing of next-generation biodiesel vehicles at the Energy Work Group	Demonstration testing of vehicles fueled by next-generation biodiesel made of algae and used cooking oil is now under way to explore the potential of biomass-derived, carbon-neutral liquid fuel, known as a future energy source for automobiles, and the possibilities for its practical applications.
Research and development of internal combustion engines	Applying the combustion research results to product development	The combustion research results achieved through the Hiroshima University-Mazda joint study course on next-generation automotive technology were utilized in the development of the next-generation Skyactiv-X gasoline engine. Model-Based Development (MBD)* advanced in the field of combustion and catalysts.
Research and development in KANSEI (sensitivity) 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 Created a technology that quantifies places where human eyes are focused (real-time saliency mapping) and a method that measures the sense of anxiety, and had them tried at various companies toward social implementation. The hands-on experience of real-time saliency mapping was provided at the Future Vehicle Technology Experience Workshop (held in November 2019). ② Gained a new insight on integrated texture of car interior and smart designing of car space (space innovation) by analyzing the results of real-time saliency mapping of car interior parts conducted on general subjects and clarifying the sensitivity of passengers to the parts. ③ Deployed sensibility technology in the food industry in Hiroshima Prefecture, including establishing its protocol toward the development of new product package.
Human resources development in Model-Based Development (MBD)*1 field	Aiming to enhance the research & development capabilities of local companies, opening basic courses for the development of human resources with MBD/CAE 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 the past six years since FY March 2017, a cumulative total of 6,297 individuals participated in the training (as of January 2021). 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.

Initiative to Develop Human Resources: Implementing Internship Programs

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As an effort for human resource training through industry-academia-government collaboration, Mazda provides internships for technical college and university students. Since FY March 2016, Mazda has improved the organizational relationship with the schools to provide a program with different levels that cover students from lower grades up to the doctorate level. This is provided as a place of self-training with a focus on the foundation of innovative human resources, that is, high ambition and practical skills. Students can nurture their own ambition and dreams through the corporate ambition and philosophy, and improve their practical skills through co-creative work and practical training. Although no internship programs were implemented due to the COVID-19 pandemic in FY March 2021, Mazda began to support various projects in collaboration with the Employment and Labor Policy Division of the Hiroshima prefectural government, such as a project using human resource development tools developed by Mazda and local universities’ projects to hold startup seminars and company visits.

e A scene from a FY March 2020 internship program



(3) 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 https://isma.jp/en/	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
Hiroshima University	<p>Next-generation automotive technology joint study course (since April 2015) Mazda has set up five joint study courses with the 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>Monozukuri</i> (product development and manufacturing) through human resources development and research and development based on Model-Based Research (MBR) and Model-Based Development (MBD).</p> <p>Comprehensive collaboration agreement (since February 2011) Through collaboration in broad areas, from technologies related to research and development and production to social science fields such as planning, management, and marketing, proactively conducting joint research.</p> <p>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.</p>	<p>Opened next-generation automotive technology joint-study course (in April 2015)</p> <ul style="list-style-type: none"> 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. 33) Model based development lab (opened in April 2019) <p>Comprehensive collaboration agreement (since February 2011) Proactively conducted joint research, from exploring research themes to finding solutions. Also cooperated in examining the ideal form of internship, and decided the method of accepting interns and setting themes for human resources development.</p> <p>Regional empowerment and open innovation Participated in the Co-Creation Consortiums in the Material Model Based Research Division and the Data-Driven Smart System Division of the Digital Monozukuri (Manufacturing) Education Research Center (see p. 100).</p>
Hiroshima City University	<p>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.</p>	<p>In FY March 2021, held a co-creation seminar that conducted formative activities on the theme “Tokimeki (heart throbbing).”</p>
Kyushu University	<p>Establishment of a joint research department (since August 2017) Mazda has set up a joint research department with the university to find solutions to long-term technological issues and to develop human resources to implement the solutions.</p> <p>Inter-organizational collaboration regarding next-generation automotive technologies (since May 2011) Mazda has been working together with the university to reinforce research and development projects and to encourage academic research and education activities.</p>	<p>Opened the Mazda Next-generation Energy Storage Joint Research Department (in August 2017).</p> <p>Delivered a special lecture on introduction to automotive science in the Department of Automotive Science of the Graduate School of Integrated Frontier Sciences (in April 2019).</p>
Kindai University	<p>Agreement concerning comprehensive research collaboration (since December 2012) Cooperating in bolstering cutting-edge research development and in strengthening the technological capabilities of local industries.</p>	<p>Research Collaboration Promotion Committee</p> <ul style="list-style-type: none"> Held meetings to discuss the progress of joint research projects and specific measures to strengthen cooperation.
University of Hyogo	<p>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.</p>	<p>Set up an experimental station dedicated to research into applications of advanced analytical techniques.</p>
Tokyo Institute of Technology	<p>Mazda’s participation in Tokyo Tech’s Super Smart Society Promotion Consortium (from October 2018) In the consortium, industry, government and academia collaborate in accelerating the development of both essential technologies and human resources that are necessary to realize a super smart society (Society 5.0). Mazda has contributed to integrating physical-space technology and cyberspace technology toward a connection between people, the earth and society and to providing education about a combination of the most advanced sciences and technologies, including quantum science and artificial intelligence.</p> <p>Membership system (from April 2020) In April 2020, Tokyo Tech’s Industry Liaison Member system shifted to the Membership system. Mazda pursues comprehensive information sharing and collaboration with the institute. Comprehensive Security Protection Agreement (from October 2016) The agreement defines comprehensive security protection rules that apply to technical consultation and other occasions.</p>	<p>Mazda’s participation in Tokyo Tech’s Super Smart Society Promotion Consortium (from October 2018)</p> <ul style="list-style-type: none"> Participated in matching workshops for exchange of information about research seeds and companies’ needs, held twice a year, to provide support for education about the integration of cyberspace and physical space Conducted joint research utilizing big data, machine learning, etc. <p>Membership system (from April 2020)</p> <ul style="list-style-type: none"> Assisted in materializing joint research projects, held free seminars, etc. Comprehensive Security Protection Agreement (from October 2016) Simplified the procedure for security protection during technical consultation

TOPICS Mazda Receives the JSME Education Award

Mazda received the Japan Society of Mechanical Engineers (JSME) Education Award for its joint research with Hiroshima University aimed at designing and implementing a curriculum for Model-Based Development (MBD) education. This award was given to Mazda in recognition of its contribution to developing a cumulative total of over 1,500 human resources not only within Mazda but also at many other local companies. The Company achieved this by offering MBD Human Resource Training in 2016 and MBD Process Training in 2017, the latter of which was developed through industry-academia-government collaboration led by the Hiroshima Council of Automotive Industry-Academia-Government Collaboration, and by publishing a learning material based on the above mentioned curriculum in 2018 to solve the challenge of ensuring wider spread of the concept of MBD among engineers involved in product development. Mazda will continue to strengthen its partnerships with various universities to further contribute to society.



(4) Industry-government collaboration

Mazda efficiently promotes cutting-edge joint research and shares needs and seeds with suppliers 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 2021 activity

Organized an event to share information about Mazda's needs with the National Institute of Advanced Industrial Science and Technology (AIST), including divisional meetings aimed at exchanging information about specific technological fields.

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 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 addition, Mazda formulated the guidelines for smoothly promoting model distribution between companies, based on the results of activities implemented by the study group thus far. In December 2018, the study group and ProSTEP iVip,^{*2} an international standardization organization, jointly announced these guidelines to the world, as international rules originating from Japan.

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) 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^{*3}), 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. AICE is currently conducting basic research toward zero CO₂, zero emissions under a research scenario aimed at achieving carbon neutrality by 2050. 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. Beginning in April 2019, the Company has expanded the scope of its development efforts to include mechanical resistance reduction and heat management technologies.

^{*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. https://www.meti.go.jp/english/press/2018/0404_001.html

^{*2} An international standardization organization based in Germany. Its membership comprises 185 companies, primarily automakers in Europe, the United States and Japan, as well as airlines and software companies. ProSTEP iVip works to develop and promote international rules regarding CAD and MBD.

^{*3} Research Association of Automobile Internal Combustion Engines, participated in by nine Japanese auto manufacturers and two organizations (as of April 2021).