

Technology and Intellectual Property HQ

Core Technologies as One of the Key Sources for Innovation Driven by Social Needs

The Technology and Intellectual Property HQ, OMRON's corporate R&D unit, is responsible for strengthening the competitiveness and growth of each business. By anticipating social issues that may arise in the near future and evolving core technologies to resolve them, we are endeavoring to achieve innovation driven by social needs. For this purpose, the Technology and Intellectual Property HQ oversees governance across OMRON of intellectual property and intangible assets, which are important corporate management resources, formulating and implementing intellectual property strategies for R&D and each business. Thus, our role encompasses OMRON's technology management with respect to both "technologies" and "intellectual property." Our core technologies "Sensing & Control + Think" are the source of OMRON's creation of customer value through innovation driven by social needs. In order to address the three social issues set under SF2030—"achievement of carbon neutrality," "realization of a digital society," and "extension of healthy life expectancy"—the Technology and Intellectual Property HQ has been focusing on the core technology domains of robotics, sensing, power electronics, and AI and data analysis, while promoting technological development for social implementation based on "near-future design." Specific initiatives are described below.

■ Robotics

OMRON began verification tests with Chugai Pharmaceutical Co., Ltd. to realize a next-generation laboratory automation system that automates a series of

experiments in drug discovery research. (July 2023)
Technologies, such as robotics to assist/automate drug discovery experiments conducted by humans and autonomous driving to enable robots to move freely in the confined spaces of laboratories, are being verified.

■ Sensing

A simple means of measuring blood pressure anywhere, anytime to estimate the degree of hypertension—a key factor in cardiovascular and cerebrovascular diseases—would meet a pressing need. To address that need, we are integrating sensor device design technology and AI technology to develop innovative blood pressure measurement technology enabling easy measurement with improved accuracy. We are presenting our findings at academic conferences and other events.

■ Power Electronics

We have developed new power supply technologies, including design optimization technology based on computer aided engineering (CAE) and resonant circuit design technology. These innovations enable both downsizing and efficiency improvements of the power supply, which is at the core component of the control panels that efficiently operate production equipment in factories.

■ AI and Data Analysis

We have developed causal analysis technology that reduces facility start-up time by 75% compared with conventional methods. This was accomplished by adjusting the start-up process in collaboration with local team members, based on the analysis of data obtained from production facilities and quantitative evaluation of causal structures related to quality characteristics.

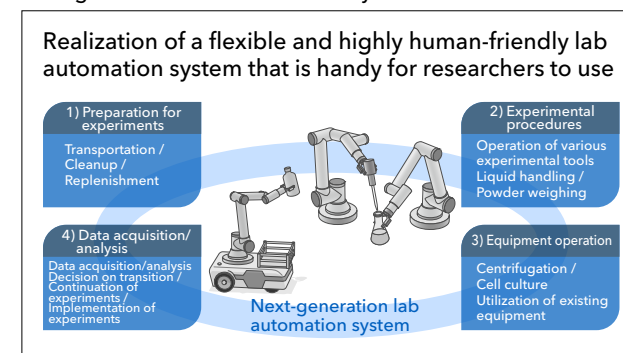
In addition to the development of these technologies, the Technology and Intellectual Property HQ took the lead in drafting the OMRON AI Policy to promote the ethical use of AI technology. (June 2024)



In this way, we have evolved our core technologies while staying closely connected with both internal and external customers. However, society continues to undergo profound change. The replacement of human tasks with, and collaboration between, generative AI and robots are advancing at an increasing pace. As a result, challenges at workplaces across a wide range of industries—not just manufacturing but also healthcare and food—are becoming more complex and customer needs are shifting dramatically. In such an environment, it is critical to develop technologies that will be a source of timely value for our customers. This requires a companywide technology strategy closely aligned with our business strategy, raising development productivity, and maintaining competitiveness. We need a technology development process that continually assesses the evolving direction of customer needs amid rapid societal changes, identifies the necessary technologies, and creates value in advance.

In fiscal 2024, we will focus on strengthening technology governance to further advance robust technology management.

Next-generation Lab Automation System



Technology Governance Enhances Development Productivity and Competitiveness and Supports Technology Management

Technology is at the source of the challenge we have undertaken, namely, to create innovation driven by social needs and continuously resolve social issues. Strengthening the competitiveness of individual businesses is insufficient. The Technology and Intellectual Property HQ must spearhead OMRON's ongoing efforts to create technologies and achieve intellectual property outcomes. To achieve this, it is crucial to create technologies that are needed by both business and society, while firmly linking R&D, technology development, and product development from the customer's perspective. As a companywide organization, the Technology and Intellectual Property HQ is uniquely positioned to facilitate collaboration across businesses, maximizing the impact of development outcomes. Working together with technological talent from across the company, the Technology and Intellectual Property HQ is the central unit driving technology management with the goal of maximizing OMRON's corporate value. To further enhance R&D productivity and sharpen competitiveness, we are implementing two initiatives to strengthen technology governance.

■ Formulating a technology strategy for each business domain

Closely aligning the business strategy with the technology strategy, we will formulate a technology strategy for each business domain and prioritize technologies from a companywide perspective. This approach will enable us to execute high-quality development themes based on these strategies, leading to more efficient contributions to business and higher development productivity.

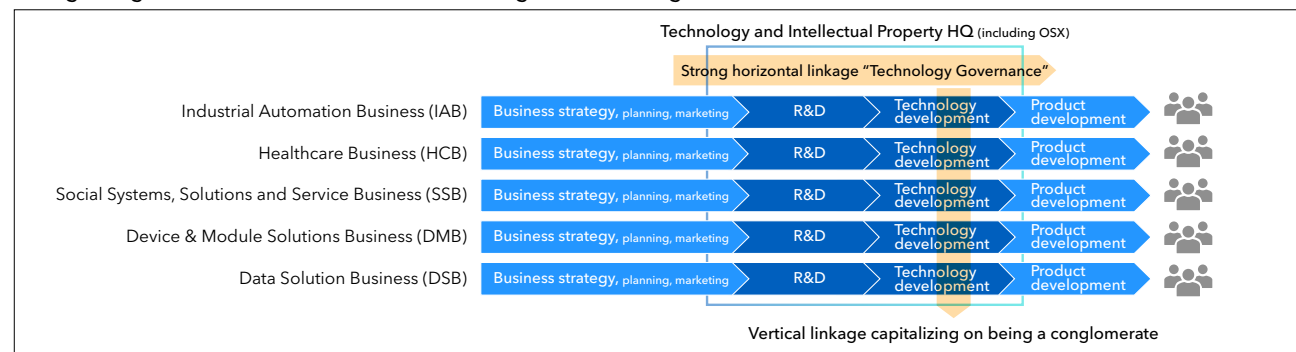
■ Development of indicators to enhance effectiveness of technology strategies and their companywide implementation

To monitor the effectiveness and progress of on-site development productivity and technology strategies, we will

develop indicators to help determine whether our technological capabilities are necessary and sufficient for success in terms of "competitiveness." These indicators will be integrated into our companywide business operations system to inform management discussion and decision-making. Through these initiatives, we are endeavoring to evolve robust technology management. For instance, collaboration with the Social Systems, Solutions and Service Business (SSB) has led to the creation of technology that delivers customer value through a pipeline reflecting strong linkage between business strategies, product strategies, and technology development. An example of this is the pursuit of carbon neutrality, which requires the reduction of CO₂ emissions from homes through the use of solar power generation, storage batteries, electric vehicles, plug-in hybrid vehicles, etc. A vehicle-to-everything (V2X) system, which enables bidirectional power supply between the home and vehicle, can greatly contribute to energy management tailored to household lifestyles. V2X is also attracting attention as a means of strengthening resilience against natural disasters, which have occurred frequently in recent years. With a business strategy focused on addressing these social issues, SSB has been promoting product development to realize a highly flexible system that can be installed in limited spaces and other locations where

installation was previously difficult. Meanwhile, the Technology and Intellectual Property HQ has been conducting advanced research and technology development in the energy solution business domain, and proposed to SSB the use of gallium nitride (GaN) devices to realize this V2X system. Although GaN devices had not yet become commonplace in power conditioners, we forecast that they would eventually become the de facto industry standard. GaN devices, which are next-generation semiconductor power devices formed on gallium nitride crystals, offer several advantages over conventional silicon-based power devices. They can handle higher power with less loss and allow much more compact circuit design. However, GaN devices are difficult to use because they tend to generate noise. By developing drive and filter circuits to suppress the noise, we realized one of the smallest and lightest power conditioners in the industry at that time. We continue to develop leading-edge technologies to address future business challenges. Furthermore, the GaN device technology we adopted in view of technological evolution can be horizontally deployed across other business domains, such as factory automation, to meet customer needs. We believe that by linking this technology with each business strategy and incorporating it into our products, we will be able to exceed customer expectations. The ability to

Strong linkage with business units and vertical linkage within the organization



undertake such initiatives is a key advantage of the Technology and Intellectual Property HQ, a corporate R&D unit conducting technology development. We believe this is one of OMRON's core strengths as a conglomerate able to leverage manifold capabilities.

Unceasing Creation of Innovative Technologies for Social Implementation

In a rapidly changing society, to create technologies that exceed customer expectations, we must continuously anticipate future technological needs from a medium- to long-term perspective and accumulate the necessary technological capabilities. OMRON SINIC X (OSX) is in charge of this task. OSX is taking on the challenge of creating innovative technology by employing a "near-future design" approach from a broad perspective unconstrained by the frameworks of existing business or technological development, viewing society and technology from the "science" perspective of the SINIC Theory. AI came its own in society in 2023. Typified by generative AI, social implementation of AI technologies, which had been in the R&D phase, began and they spread worldwide. In light of this technological progress, OSX is conducting research on cutting-edge themes, including robot learning technology, which utilizes machine learning and reinforcement learning, and AI technology to increase the efficiency of materials research within materials science. With a cumulative total of more than 60 research papers accepted at top-tier international conferences, OSX has gained recognition both in Japan and internationally as a unique corporate research institute and continues to steadily accumulate research outcomes. In fiscal 2023, to facilitate the social implementation of this research outcomes, OSX focused on promoting collaboration, establishing a co-creation processes from the customer's perspective and seeking co-creation partners, while actively engaging in technology communication activities. For example, through an internal open recruitment system

for concurrent positions, OSX recruited "near-future design evangelists" who will communicate OSX's vision of "near-future design" to the public. These are individuals who aspire to create pioneering products and services that set OMRON apart from the competition through collaboration with cutting-edge researchers. They are also inspired by the challenge of contributing to business by "communicating" and "delivering" both within the company and externally. In fiscal 2023, to enhance the competitiveness of each business, together with the "evangelists" we sought to create opportunities for proposing technological outcomes of OSX and the Technology and Intellectual Property HQ in collaboration with the product development teams of each business unit HQ. While interacting with various departments—including sales, planning, and product development—we focused on finding intersections where our technologies could help resolve customer issues. We also strengthened the dissemination of our results through the web and social media. Moving beyond simply announcing the acceptance of papers, we now explain our technological outcomes in a way that is easy for non-specialists to understand, aiming to generate interest so as to facilitate co-creation with external parties. As a result of these activities, customers consult with our sales department on the issues they are facing, and these interactions have evolved into co-creation of solutions.

In-house technical exchange



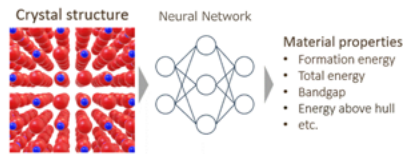
Case Study: Co-creation Process for Social Implementation of Research Outcomes

In business development based on cutting-edge technologies, there is often a "valley of death" where R&D outcomes are not commercialized, thwarting their advancement to the social implementation phase. To overcome this challenge, it is crucial to generate ideas by identifying issues from the customer's viewpoint in a timely manner. We use an in-house recruitment system to attract motivated individuals from throughout OMRON who are eager to link R&D outcomes to business and achieve social implementation. However, if they are "transferred" to another organization, they may lose touch with the voice of the customer, making it difficult to identify the issues. Therefore, recognizing the need to engage in the commercialization process while continuing their regular duties, we actively utilize the internal open recruitment system for concurrent positions. By fostering a co-creation process from the customer's perspective, we aim to spur business creation.



Research Showcase: Crystalformer

While the application of generative AI is rapidly progressing in the digital realm, particularly for text creation and image generation, research is also underway for its use in the real world. For example, generative AI is beginning to be used to increase the efficiency of materials development, such as for finding new materials for all-solid-state batteries with better energy efficiency. OSX is developing AI technology to improve productivity in inorganic materials development. Recently, we developed "Crystalformer", a Transformer-based neural network to predict the physical properties of materials from their crystal structures with high accuracy. The transformer is a neural network architecture that was originally conceived for text translation and is now the foundation for large language models used in recent AI chat technologies. The transformer uses its main module, called the self-attention mechanism, to capture the meaning of words in context while estimating relationships between them. In our work, we point out the similarity between Transformer's self-attention mechanism and the interatomic potential summations used in the energy calculation algorithms for crystal structure simulations. By taking advantage of this similarity, Crystalformer performs physically inspired calculations for interatomic interactions, which enable the accurate estimation of states of atoms in crystal structures. We believe this technology will significantly enhance development productivity and contribute to new discoveries and applications in materials science and nanotechnology. This research is conducted as part of the "Materials Exploration Platform; Expanding Search Space by high-throughput technology" (Project Leader: Mr. Keisuke Nagato, The University of Tokyo) which is a full-scale R&D project in the "Common Platform Technology, Facilities, and Equipment" mission area of the Japan Science and Technology Agency's JST-Mirai Program. The research is being promoted through open innovation in collaboration with various research institutes and researchers.

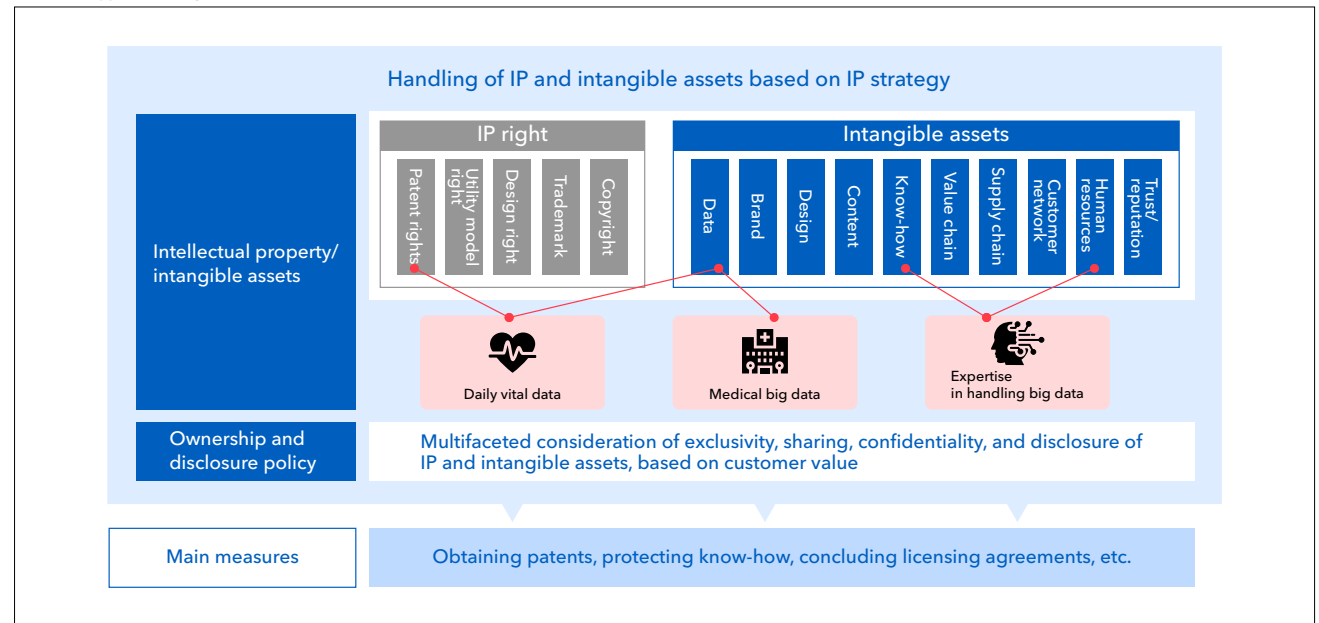


Evolution of customer-centric IP and intangible asset activities

In fiscal 2018, the Intellectual Property Center defined its mission and vision for the creation and delivery of new value through intellectual property, setting OMRON on a trajectory of sustainable growth. Since then, it has been evolving its intellectual property/intangible assets initiatives. In recognition of these IP and intangible asset activities, OMRON has been selected as one of the "Top 100 Global Innovators" by Clarivate, which selects the world's most innovative companies and research institutions, for eight consecutive years. OMRON's IP activity policy is to pursue "Ambidextrous IP Activities" by combining "Exclusive to Other Type" and

"Sharing & Resonating Type" in an optimal balance. In Exclusive to Other Type, IP is used only by the company in principle for the purpose of increasing sales and market shares of the company's products, whereas in Sharing & Resonating Type, necessary IP is mutually shared while emphasizing alliances with partners. In particular, in Sharing & Resonating Type IP activities, we cover not only individual IP rights, which have been the focus of our activities so far but also intangible assets. We are working to manage IP and intangible assets with a view to maximizing customer value. As the first step, for businesses that utilize data, such as the Health & Productivity Management Alliance, members of the Intellectual Property Center participate in projects from the phase of business conception onward and establish IP strategies closely linked

IP Strategy Development Process



with business strategies, including the handling of IP and intangible assets that are essential to the business. Going forward, the IP strategy establishment process cultivated through involvement in data utilization businesses will be horizontally deployed to other businesses of the OMRON Group. Improvement of the efficiency of companywide utilization of IP and intangible assets will become increasingly important for obtaining the maximum advantage from investment in terms of business competitiveness. All employees need to recognize the IP and intangible assets that exist within the OMRON Group and be able to utilize them. The Intellectual Property Center is categorizing the in-house technologies accumulated for each business based on the functions necessary to realize customer value, while also working on systematic visualization, linking the technologies with human resources by utilizing information such as inventor information related to patents. Through these activities, we aim to improve the efficiency of utilization of IP and intangible assets. In order to further promote these IP and intangible asset activities, we are considering KPIs for IP activities linked to business success from the perspective of “advanced technology development efficiency,” that is, how efficiently R&D investments are converted into competitive technologies; the perspective of “social implementation rate,” that is, to what extent the IP and intangible assets created are linked to OMRON’s business growth and business advantages; and the perspective of “human resources capability,” that is, to what extent human resources capabilities are improved as a result of development activities.

Customer-centric IP and intangible asset activities

We apply “IP landscaping,” which uses IP information to analyze customer and business environments, in marketing and other business decision-making processes. For example, in the phases of formulation of business hypotheses and establishment of development themes, we are efficiently running a cycle of hypothesis testing to

promote “identifying customer needs,” “creating a story to win in business,” and “improving return on investment in business.” Such IP information analysis activities are conducted by a dedicated team directly under the Intellectual Property Center, and are implemented from upstream of the business process to enhance the quality of management, business, and technology strategies. Moreover, the Intellectual Property Center consolidates the technologies and knowledge of each business unit as IP/intangible assets and deploys them companywide. For this purpose, we are preparing to transition the structure of the Intellectual Property Center from a structure based on business to one based on IP function, thereby eliminating the barriers between businesses and enabling companywide management of IP/intangible assets. In the future, the Intellectual Property Center will centrally manage the technologies and knowledge held by each business of OMRON, aiming for their efficient companywide utilization. Furthermore, we are emphasizing the use of AI to accelerate customer-centric IP activities. For example, we aim to dramatically improve operational efficiency by proactively

utilizing generative AI to generate ideas that it was previously thought could only be conceived by humans. We also aim to further improve the quality of hypothesis testing in IP landscaping and achieve high-cycle management. To achieve these aims, we are implementing systematic and continuous education programs designed to refresh the mindsets and enhance the skillsets of all members of the Intellectual Property Center. Through these customer-centric IP and intangible asset activities, the Intellectual Property Center endeavors to improve the efficiency of investment in technological development from the perspective of IP/intangible assets and contribute to creation of the value propositions of businesses. We will continue to be the source of a stream of technologies that exceed customers’ expectations, illuminating a path to the future through innovation driven by social needs.

OMRON Intellectual Property Center Mission

We deliver unique value for people around the world by leveraging our core assets of intellectual property.

We develop and deepen appealing ideas.

We deliver peace of mind and confidence to customers.

We enhance our presence to our competitors offensively and defensively.

OMRON Intellectual Property Center Vision

We bring the IP specialists together from diverse fields and continue to create innovation.

We defy stereotypes.

We create a new paradigm of connections.

We strive to increase the trust from the management team.