

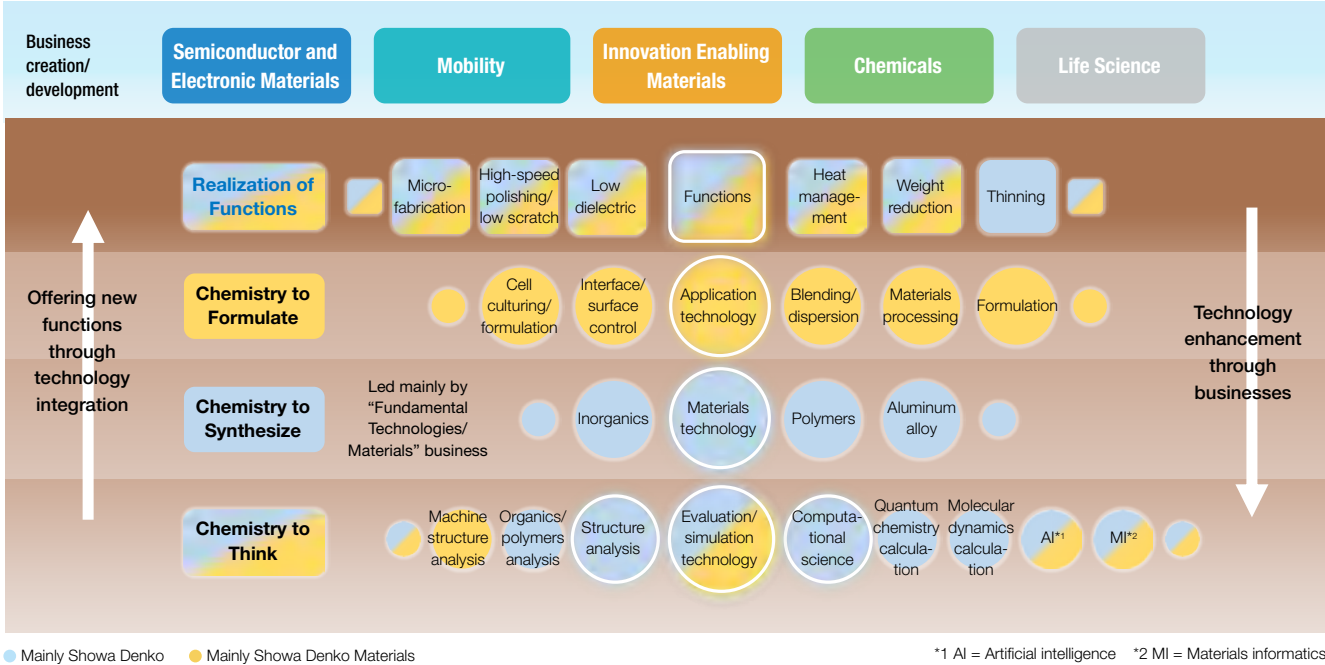
R&D Strategies

Mission of Creating Value

Inspired by its vision of generating synergies between “Chemistry to Synthesize,” “Chemistry to Formulate,” and “Chemistry to Think,” to contribute to the production of world-leading products and technologies, Showa Denko is advancing R&D activities aimed at accomplishing three missions: broadening of technology portfolios to create innovation, promotion of cross-business technology development, and changing society through long-term R&D projects.

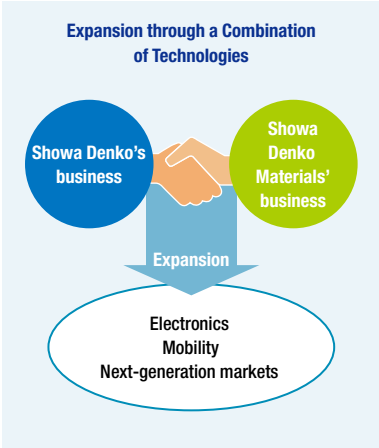
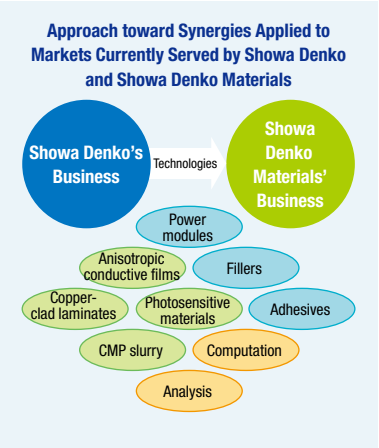
R&D Strategy Policy

With an eye to fulfilling its purpose, Showa Denko will carefully monitor market trends, to expand the range of markets in which it participates, by combining its expertise in fields of strength where it can differentiate itself on the material level. Furthermore, we will take a hybrid approach combining “Chemistry to Synthesize,” “Chemistry to Formulate,” and “Chemistry to Think” while enacting a strategy of generating synergies between the material technologies of Showa Denko and the application technologies of Showa Denko Materials.



As one facet of these efforts, coordination will be pursued between the teams of the chief technology officer (CTO), the Chief Strategy Officer (CSO), and the chief marketing officer (CMO) to create dimension maps to track the technologies and products offered by both companies. This approach will enable employees from all divisions to better create value for customers by effectively combining products and technologies, the scope of which has become substantially larger following the integration, within their respective functions.

Multiple projects have been launched to pursue short-term synergies in areas such as anisotropic conductive films, power modules, CMP slurry, and heat management. We plan to increase the number of such projects in the future.



Based on the measures prescribed for realizing our long-term vision, in 2022 we will move ahead with efforts to prepare for the complete integration scheduled for 2023, focused around five priority measures. The first priority measure is integrated operation through a virtual organization. We are advancing the substantive integration of functions through a virtual management approach that will remove the barriers between R&D organizations a step ahead of other divisions. The second priority measure is the promotion of projects to generate synergies and broaden our technology portfolio. In fiscal 2022, we will work to generate synergies between the technologies of both companies, and these synergies are anticipated to contribute to higher sales, in the areas of semiconductor and heat management materials. The third priority measure is to implement deep-level digital transformation. To this end, electronic experiment notes and statistical analysis software will be deployed throughout the Company and a material informatics (MI) platform will be constructed. We aim thereby to foster a culture of utilizing accumulated data and promote the evolution of digital technologies using MI and process informatics. The fourth priority measure is the promotion of co-creation. This measure will be advanced through the pursuit of internal synergies as well as through open innovation with external partners. The fifth and final measure is the achievement of carbon neutrality. The path toward carbon neutrality will be paved by means of our efforts through the new Stage for Co-creation venue (➡ P.57) and activities based on long-term R&D themes.

Through such ongoing efforts, we aim to evolve our R&D organizations to make them vessels of unending innovation by 2030, by enhancing our R&D activities from a large-term perspective and broadening our technology portfolio.

Initiatives to Resolve Social Issues as a “Co-creative Chemical Company”

Cultivation of Co-creative Human Resources

As the first step of our efforts to become a “Co-creative Chemical Company,” it is important to cultivate engineers who can respond ably to the operating environment and social changes. Moreover, these engineers must possess an effective understanding of the integration of our organizations and be proactive in learning about our new colleagues.

Meanwhile, many of our engineers have voiced their desire to contribute to the resolution of social issues through a new, cross-organizational network based on their role in supporting the technologies that are core of the Company. Seeking to protect and nurture this self-driven spirit of altruism, we have begun initiatives to cultivate co-creative human resources.

Kagaku no Wa

Kagaku no Wa is an exchange forum that was established to provide a venue for interactions between researchers from both Showa Denko and Showa Denko Materials. We anticipate that this venue will provide a casual environment for researchers to get to know one another, discuss technologies, and thereby generate synergies. Kagaku no Wa meetings are held once a month, and a total of roughly 200 people have participated thus far. Moreover, these activities are giving rise to new initiatives, such as sustainability forums and statistics study groups.

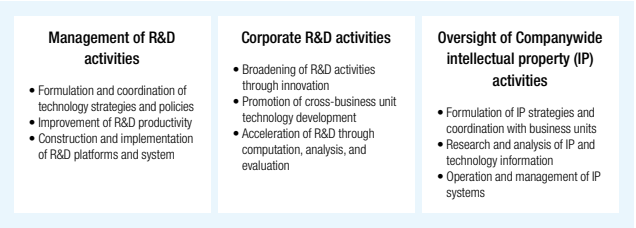
Technology Forums

Technology forums are arranged as an opportunity for everyone involved in the R&D process to consider the type of researcher they wish to become, make new discoveries, and change how they think and act. It is anticipated that like-minded researchers will gather at

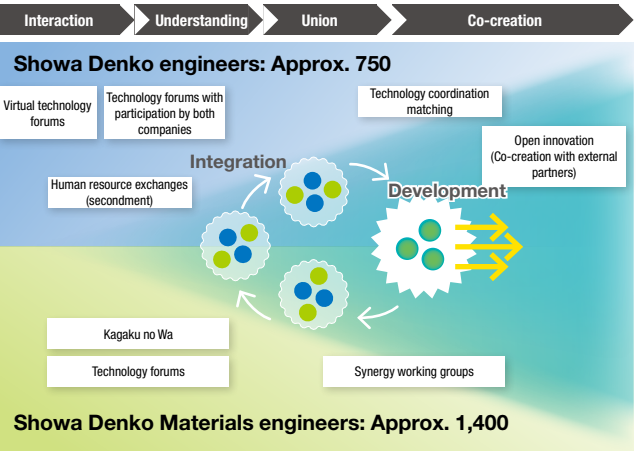
Measures for Realizing the Long-Term Vision

- Strategic allocation of resources
- Establishment and implementation of technology strategies based on industry trends and product roadmaps
- Promotion of projects to generate synergies and expand the technology portfolio
- Creation of innovation by broadening the technology portfolio
- Deep-level digital transformation of R&D activities using computational science and AI
- Construction of platforms to support and reinforce R&D activities to create future new businesses
- Advancement of cross-business technology development
- Promotion of open innovation and co-creation as a “Co-creative Chemical Company”
- Creation of a workplace environment that attracts diverse human resources and is conducive to the development of new pipelines
- Advancement of activities through the Stage for Co-creation venue based on long-term R&D themes
- Contribution to the realization of a sustainable society through innovation
- Cultivation of a corporate culture emphasizing safety and compliance

Functions of the CTO Team



these forums and help each other to work toward their respective goals. These forums were originally an initiative implemented by Showa Denko Materials, but the activities have been inherited by the newly integrated company based on the widespread endorsement of their spirit among Showa Denko engineers. We have positioned technology forums as a venue open to free participation by anyone, regardless of position or rank. Overcoming the limitations imposed by the prolonged COVID-19 pandemic, we were able to arrange forums with participation by employees from both companies in fiscal 2021. Subsequently, an organization committee was assembled in 2022 to transform these forums into an event that is planned, operated, and held by volunteer engineers from any company. In fiscal 2022, these forums included 67 presentations and were attended by 730 people.



R&D Strategies

Topics

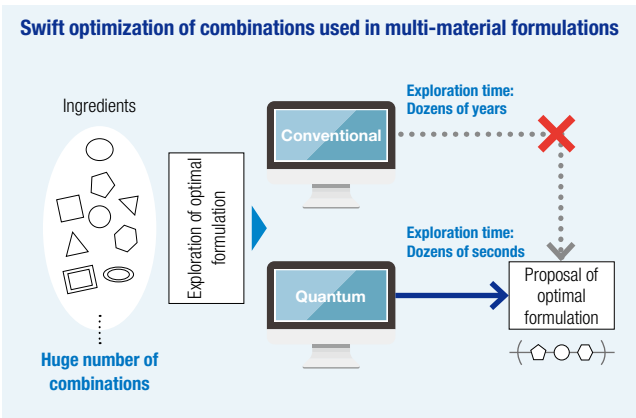
The Computational Science and Technology Information Center supports “Chemistry to Think,” which is advocated by Showa Denko through its use of simulation, artificial intelligence (AI), and MI technologies. Simulation technologies are used to formulate highly reliable development policies based on solid logic and to win customers’ trust with effective explanations of the underlying mechanisms of technologies. Meanwhile, increased attention has been directed toward AI and MI technologies in recent years, and these technologies have helped us to break away from our prior dependence on intuition and experience to accelerate material development. In fact, we have been named among the top 30 companies in the world in terms of our MI technologies,*1 indicating the strong global presence that we have established in this area.

Quantum computing technologies are being adopted as a means to enhance our MI technologies. These technologies can be used to calculate optimal combinations of materials at a speed dwarfing that of conventional methods. Accordingly, quantum computing technologies are key to determining the optimal combinations of multiple materials in a more reasonable timeframe when applying MI technologies to the “Chemistry to Formulate” that is a strength of Showa Denko Materials. Based on this recognition, the Computational Science and Technology Information Center has adopted the Digital Annealer*2 quantum-inspired technology*3 of Fujitsu Limited and is accumulating expertise to transition to an Ising model that uses the Digital Annealer for MI calculations. This approach has allowed for optimal combinations of semiconductor materials, with a performance roughly 30% higher than prior combinations, to be selected from among the 10⁵⁰ possible combinations in mere dozens of seconds. In this manner, quantum computing allows for optimization that is tens of thousands of times faster than the optimization provided through conventional methods, which were also restricted by a more limited scope.

The Computational Science and Technology Information Center seeks to improve its own technical capabilities while democratizing computational science technologies. To these ends, we are providing systems that development engineers can use to perform simulations and utilize AI and MI technologies by themselves. We are also cultivating data scientists. At the same time, we are creating the functions expected of us as an advanced material partner through data-driven development.

*1 Source: *Technology Landscape: Key players in materials informatics*, Lux Research, Inc.
*2 Domain-specific (dedication of computation capacity to specified domains) computer architecture (basic computer design consisting of memory and computing circuits) specialized in solving computationally intensive combinatorial optimization problems
*3 High-performance computing technologies that are inspired by quantum technology, although not directly using quantum effects

Optimization of Semiconductor Material Formulation

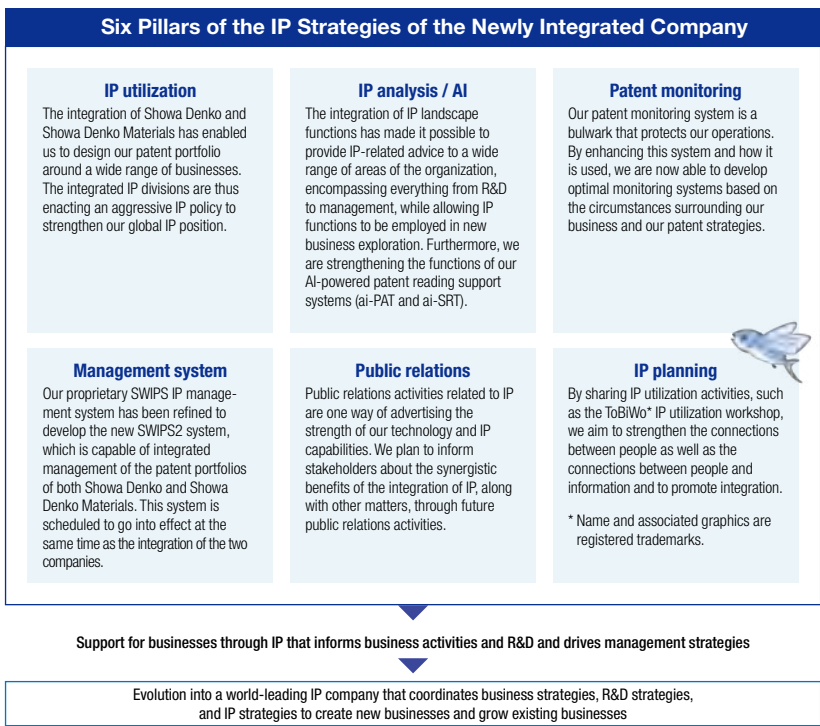


Intellectual Property Strategies

Intellectual property (IP) strategies are intimately related to business strategies and R&D strategies and are imperative to a company. Accordingly, close coordination is pursued between divisions responsible for these three types of strategies to promote seamless information sharing and co-creative strategy formulation.

Moreover, the newly integrated company regards its IP strategies as one of its important managerial strategies, and formulates and implements its business, R&D, and IP strategies in a manner that promotes synergistic resonances among them. We are also working constantly to build a robust and broad network of patents for our major business segments and important products, to maintain our competitive edge.

The four IP functions of planning and foundations, technologies and strategies, research and analysis, and contracts and relationships are housed within the Intellectual Property Department, to promote IP activities that inform and promote R&D and business activities from the standpoint of functions.



Stage for Co-creation Venue for Long-Term Co-creative R&D Projects with Internal and External Partners

Overview

The Stage for Co-creation* is a venue established in Yokohama City based on our vision of becoming a “Co-creative Chemical Company.” As a diverse range of people from inside and outside the Group gather at this venue to take part in co-creation, it is expected to drive the creation of new pipelines.

Initiatives based on long-term R&D themes that will contribute to future generations are being advanced at the Stage for Co-creation, which also houses three platforms to support and accelerate R&D activities aimed at creating new, sustainable businesses. The four R&D centers (Material Science Analytics Center, Computational Science and Technology Information Center, Process Solution Center, and Chemicals Assessment & Management Center) that are currently

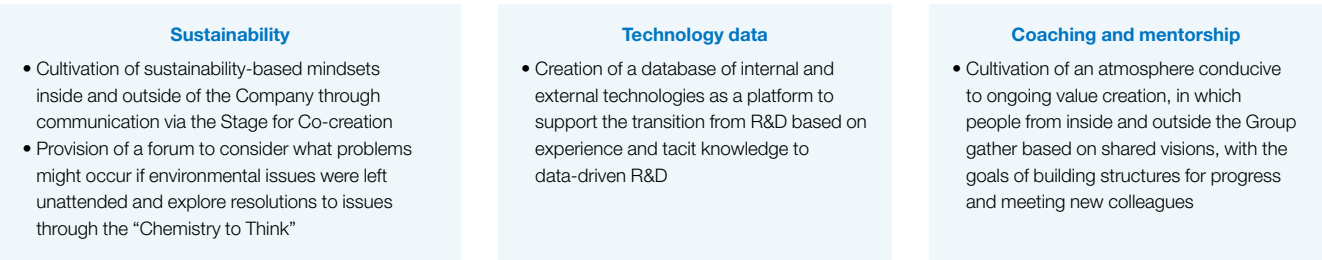
supporting R&D activities are also engaged in activities using the Stage for Co-creation.

In addition to long-term R&D themes and platforms, another characteristic of the Stage for Co-creation is cross-business technology support functions, which link the Company’s various technologies. These functions allow this facility to create and promote R&D themes that contribute to the realization of a sustainable society. Furthermore, the Stage for Co-creation is open to members of the community and even people from overseas, making it a venue for collaboration and co-creation among individuals from inside and outside the Group.

* Previously named the Stage for Fusion, the name was changed on May 1, 2022, to clarify its function as the Stage for Co-creation based on the vision of becoming a “Co-creative Chemical Company.”

Platforms

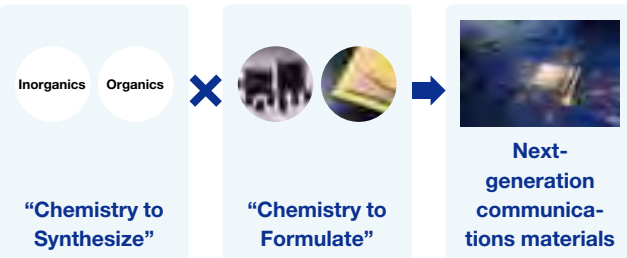
Construction of Platforms to Support and Accelerate R&D Activities Aimed at Creating New, Sustainable Businesses



Long-Term R&D Themes

Next-Generation High-Speed Communications Materials

The upcoming 6G (Beyond 5G) world is expected to feature a sustainable society in which everyone can express their humanity and where people, things, and experiences are seamlessly connected. Taking a backcasting approach from our vision for 2030, we will advance integrated development of organic and inorganic composite materials that cannot be produced using existing technologies (or refined versions of existing technologies) in the Beyond 5G world. The Company thereby aims to have developed world-leading telecommunications technologies by the 2030s.



Plastic Recycling

The environment surrounding plastic recycling has undergone massive transformations in recent years. Specifically, significant attention has been garnered by plastic-to-plastic carbon resource recycling methods, particular chemical recycling processes capable of producing recycled plastic with the same qualities as virgin plastic. Showa Denko is developing waste plastic-to-olefin recycling technologies for use in promoting carbon resource recycling and transitions in the raw materials and manufacturing processes for the basic chemical products that support society.

