Resonac's R&D

See the "R&D" website for additional information.

Masato Fukushima
Chief Technology Officer (CTO)

Value Nurtured by Co-creation and a Sustainable Future

The evolution of Resonac's R&D is driven by the two wheels of "cheerful challenges" taken on without fear of failure and the "solid results" that come from them. Each individual demonstrates their expertise and freely exchanges ideas to create new value. I like this culture and want everyone to empathize more.

In recent years, industrial structure and social issues have become increasingly complex, so it is more difficult for a single company to solve them alone. In this context, technology is truly valuable when we work with customers to solve problems and realize the results in the field. Through the process of co-creation, we create "usable technology" and create a path to new challenges based on trust. Furthermore, it is the mission of all of us at this chemical company to promote technological development that reduces environmental impact and aim for carbon neutrality. We believe that challenges undertaken by each engineer will shape Resonac's future, and will link all elements such as computational science, generative AI, intellectual property, and marketing to research and development to deliver solid value to society.

An explanation! A microcosm of Resonac's R&D
Resonac's core competencies (A) consist of "Chemistry to Synthesize (materials technologies)," "Chemistry to Formulate (basic design technologies)," and "Chemistry to Think (computational science, analysis, and interpretation technology)" that supports them. By combining these competencies and utilizing and deepening our four strengths (B to E), we are able to develop products and technologies that correspond to a wide range of fields, from upstream to downstream of the supply chain. We also create practical and advanced innovations by increasing our corporate value through intellectual property strategies (F) and carefully understanding customer needs and fusing multiple technologies (G).

In the future, we will position the semiconductor and electronic materials fields as pillars of growth and actively invest and develop technologies. Even in these fields, where technological innovation must be speedy, we have established a system that can respond flexibly and quickly through co-creation both inside and outside the Company.

A microcosm of Resonac's R&D

Roadmap for Co-Creative R&D

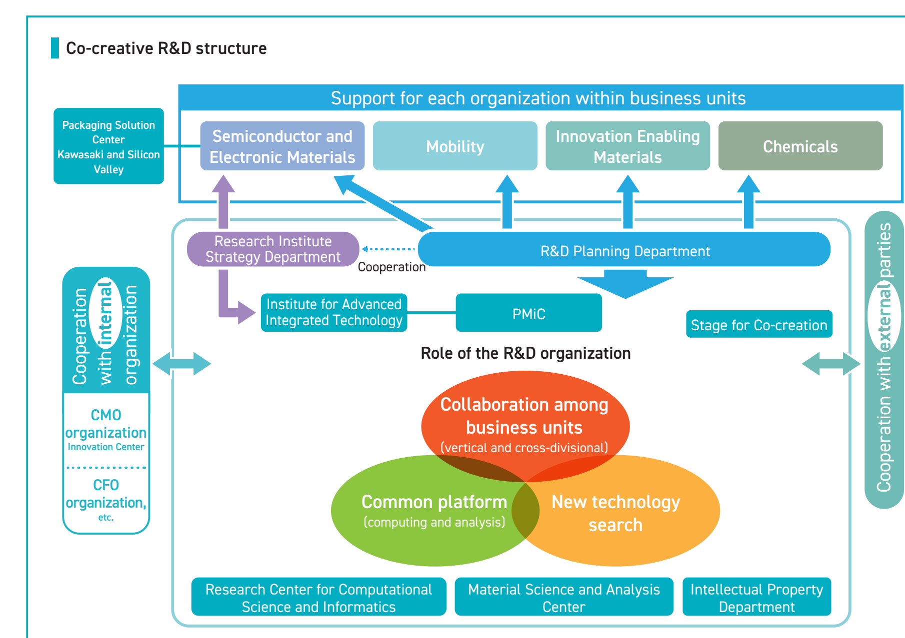
By 2030, we aim for our co-creative R&D to drive continuous innovation and consistently deliver technologies that contribute to a sustainable society. We will continue to cultivate leaders and research professionals and advance their capabilities. Since the integration of the two companies, we have formulated strategies for our technology and talent platforms through 2024. From 2024 to 2030, we will embed these initiatives company-wide and aim to lead in addressing social issues through innovation by 2030. As a co-creative chemical company, we will expand the possibilities of chemistry, which underpins all industries, and help create a sustainable, prosperous future.

Before 2024		2024 to 2030		2030	
Technology strategy formulation Human resource platform strategy formulation	• Clarification of core technologies • Long-term trend analysis • Electronic laboratory notebook (ELN), to promote AI utilization activities	Penetration of each measure	• Establishment of technology landmarks • Develop new fields and evolve core technologies in key areas • Promote internal collaboration and co-creation • Foster ambidextrous talents in the use of AI	Enhancing core technologies Driving innovation	• Advanced collaboration centered on core technologies • Promoting new market development • 100% ambidextrous talents

Co-creative R&D system
We are pursuing co-creation across our business units and internal organizations, as well as with external stakeholders, to improve the likelihood of successful research outcomes. At our research sites, we are creating open environments where people from inside and outside the company can gather to discuss and collaborate freely. Our two core organizations—the Institute for Advanced Integrated Technology and the Stage for Co-creation—are advancing cutting-edge development in areas such as semiconductor materials, the creation of new research themes, and foundational technologies.

In addition, supporting organizations such as the Research Center for Computational Science and Informatics and the Materials Science and Analysis Center possess advanced capabilities in molecular design, AI-driven analytics, and structural analysis. These capabilities are accelerating our path from research to commercialization and enabling us to manufacture products with greater precision.

Co-creative R&D structure



A Accelerating Core Competencies

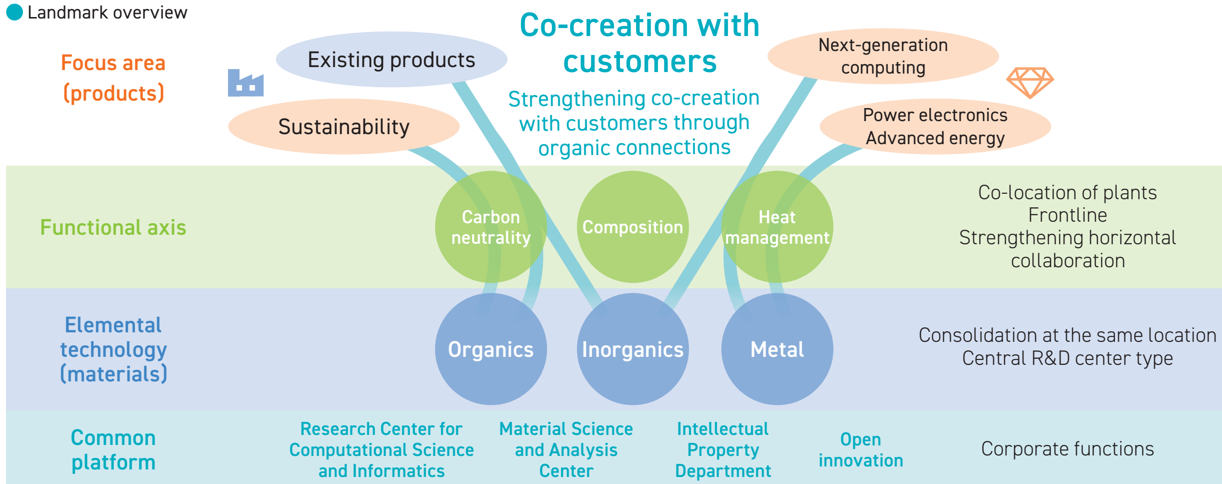
Realizing the Landmark Concept of Consolidating Elemental Technologies and Creating a Base for Co-creation with Customers

We are going deeper with the Landmark Concept, which connects elemental technologies and strengthens the network between technologies. Using the Landmark, which is based on each core competency on the common foundation, elemental technologies, and functional axes, we hope to strengthen our co-creation capabilities with customers through organic connections. This fiscal year, we are promoting the maximization of R&D functions and the realization of results, mainly through consolidating core bases for organic materials and strengthening functions in composite materials.

Purposes of Landmark Concept

- Formation of a hub and center for technology and functions
- Strengthening collaboration across functions and technologies

Landmark overview

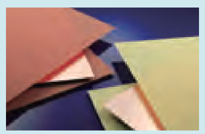


Progress in Co-creation <Some Semiconductor-related Examples>

The Research Center for Computational Science and Informatics is an organization that integrates computational science (molecular simulation, structural and fluid simulation) and informatics (AI, MI, image analysis, natural language processing, and development of the infrastructure for data utilization) technologies at a single location. The Center's mission, as an infrastructure for all business segments, is to position Resonac as a world-class functional chemical company Here, we introduce examples and results of co-creation both inside and outside the Company.

Developed low thermal expansion copper clad laminates for next-generation semiconductor packages through simulation

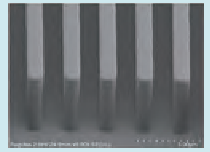
By applying "multiscale analysis*," a computational science technology, we clarified and developed the design guidelines for each material that makes up the copper clad laminates. We have developed this technology into a general-purpose physical property visualization system and have now introduced it within the Company.



Copper clad laminates for next-generation semiconductor packages

Developed a new photosensitive film for advanced semiconductor packages

We have developed a new high-resolution photosensitive film for use in the manufacturing of advanced semiconductors, such as AI processors. In the development process, co-creation was carried out by four business units. In this development, we utilized AI technology provided by the Research Center for Computational Science and Informatics to perform optimal resin design.



Resist pattern (resist line width 1.5 μm / wiring pitch 1.5 μm)

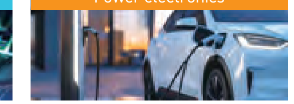
Accelerating semiconductor materials development with AI-based cutting-edge simulation technology

We have introduced a new neural network potential technology that combines first-principles calculation method and AI for the first time to simulate the semiconductor circuits polishing mechanism using CMP slurry. This technology will help clarify the behavior of complex materials, thereby leading to the rapid creation of new materials.

*An analysis that couples the physical properties or behaviors of structures at different scales.
By homogenizing the material properties of composite materials made from multiple heterogeneous materials, it facilitates understanding of the overall behavior of composite materials.

B G Linking New Field Exploration Focus Areas with Marketing Strategy

Resonac has identified four strategic focus areas for new growth—next-generation computing, power electronics, sustainable technologies, and advanced energy technologies—based on their fit with our business portfolio and their future market attractiveness. Through close collaboration between Marketing and R&D, we match market needs with our technical capabilities, accelerating the cycle from ideation to concept validation.

New field exploration focus area	Next-generation computing	Power electronics	Sustainable technology	Advanced energy technology
				
Subdomain examples	✓ Next-generation semiconductor technology ✓ Non-von Neumann type computers	✓ Next-generation heat management materials ✓ Next-generation packaging solutions	✓ Bio-based materials ✓ Next-generation mobility materials	✓ Energy generation and storage technology ✓ Clean nuclear energy

To turn proposals into formal research themes, ideas are sourced from Marketing insights and staff proposals within the focus areas, then developed into projects with appropriate resource allocation. Next, we hold a Theme Proposal Review to assess the proposal and validate the business model. We also upskill staff through training programs, and advance only those themes with a high probability of success that are jointly endorsed by Marketing and R&D.

Flow toward the development of a theme

	1 Idea creation	2 Concept verification / 3 Feasibility verification
Point of activities	• Marketing in focus areas • Proposals from staff • Resource optimization through project development	• Overview at new theme proposal meeting • Business model verification • Marketing educational program • Improve staff levels by using project management and educational programs • Themes are developed for projects that have been agreed upon by the marketing and R&D organizations as being highly feasible

Resonac is promoting problem-solving marketing close to the needs of customers, combining multiple products and technologies to solve customer issues. Meanwhile, in the long term, we would like to create new business ideas in fields other than semiconductors and mobility. That is why our marketing and R&D departments are currently holding repeated discussions in new theme review meetings, examining possibilities for new business ventures in advanced energy and environmental fields. We hope to eventually involve each business unit in this system, making it a company-wide effort.

Shigeru Fujita
Chief Marketing Officer (CMO)

Accelerating the development of heat management materials through mounting and evaluation of power devices and cutting-edge semiconductor packages for automotive and data center applications

In electronics, heat management of power devices and semiconductor packages is especially crucial. Heat generation in devices leads to the deterioration of elements and junctions, reducing reliability. Efforts to minimize energy loss and designs to effectively dissipate generated heat are required, with advanced thermal conductivity and insulation of materials being particularly crucial. These heat management measures need to be optimized not only through circuit design but also in collaboration with materials development. We promote materials development through device assembly, evaluation, and analysis tailored to our customers' specifications.

Development of heat management materials through mounting and evaluation of semiconductor packages and power modules

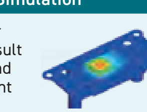
Prototyping and mounting

Performance evaluation and verification

Powered on and measured in a state that simulates actual use

Simulation

Simulation for evaluation result verification and pre-experiment prediction



From 2025 Conduct evaluations jointly with customers

Improving properties through heat management

Accelerating the customer co-creation cycle

Resonac's R&D

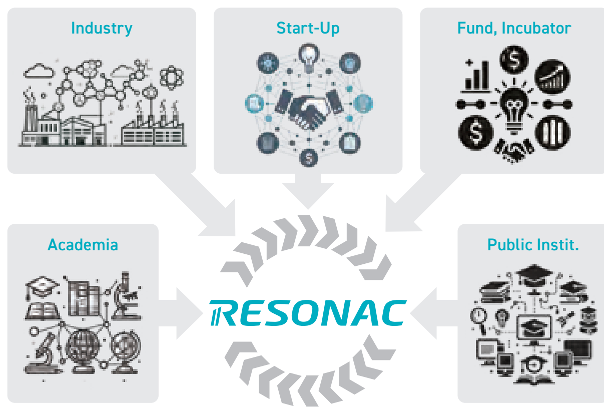
C Promoting a R&D Ecosystem by Utilizing Open Innovation (OI)

We are building an R&D ecosystem that maximizes the use of external resources worldwide, from extensive collaboration with external research institutes to partnerships with university laboratories and start-up companies, in order to promote technological development. This will help create new value that leads the way in areas such as innovative materials, carbon neutrality, thermal management, digital transformation (DX), evaluation, and process technology, and contribute to a sustainable society.

Make maximum use of external resources, from comprehensive collaboration with external research institutions to collaboration with university laboratories and start-up companies

Innovative materials
- Magnetic particles for high-frequency applications
- Particle surface treatment technology
- Heat storage and utilization system for use on the lunar surface
- High refractive index polymer
- High adhesion polymer

Carbon neutrality
- Synthetic gases to olefins
- Bio-based aromatic chemistry
- Research on CO_2 conversion catalysts
- Innovative CO_2 separation
- Plastic decomposition using microwaves
- Gas separation membranes



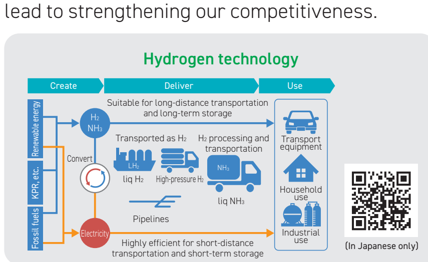
Heat management
- Heat diffusion evaluation of thermally conductive filler
- Thermal characteristic evaluation of filler complexes
- Spin caloritronics
- High thermal conductivity polymers

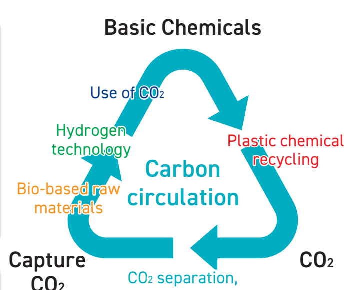
DX, evaluation, process technologies
- Data-driven analysis of polymers
- Digital twin of mass production process
- Polymer informatics
- Synthetic real-time monitoring
- Magnetic characteristics evaluation of recording media
- Seamless microfabrication technology

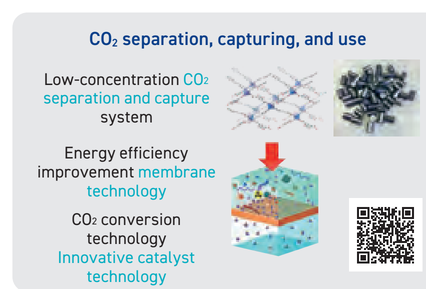
E Identifying Themes of Socially-Driven Issues (Carbon Neutrality, Digital Transformation)

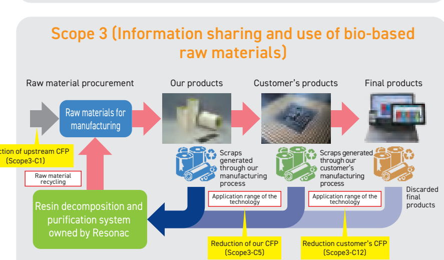
We aim to achieve carbon neutrality by 2050, and are contributing to the transition to a society that uses non-fossil-based raw materials and hydrogen. Specifically, we are promoting initiatives through industry-government-academia co-creation and collaboration, such as technology to manufacture basic chemical raw materials from waste plastic using microwaves, technology to utilize ammonia and hydrogen, CO_2 separation, capture, and utilization technologies, and CO_2 emissions reduction throughout the entire product life cycle, expanded to Scope 3.

As for digital transformation, we are focused on the advancement of AI semiconductor materials. AI semiconductor materials realize dramatic improvements in computing performance and power efficiency. Creation and implementation of innovative materials is essential as a basic technology that will play a central role in the next generation of AI, and we will focus on this as an important area that will directly lead to strengthening our competitiveness.







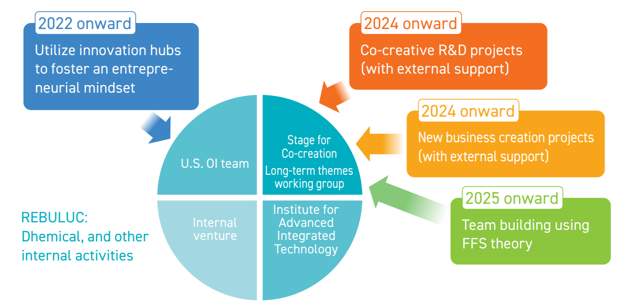


D Human Resource Development that Creates Chemistry to Synthesize, Chemistry to Formulate, and Chemistry to Think

We have set a new R&D strategy that combines research themes and technology strategies with human resource strategies, and are working to build a training guideline that understands and develops the diverse personalities of our engineers. We aim to develop diverse and outstanding professionals by actively using training plans and personnel exchanges that are suited to each individual's personality and career plan, as well as study abroad and dispatch to universities and external institutions. In addition, we foster an entrepreneurial mindset and promote the development of innovators through new business creation projects and innovation process experience programs . Furthermore, we are focusing on creating a culture and system that makes the most of personality, and are working to improve both individual and organizational performance. For example, we are also conducting FFS diagnosis in the CTO organization, and from 2025, we started building teams using it. P63

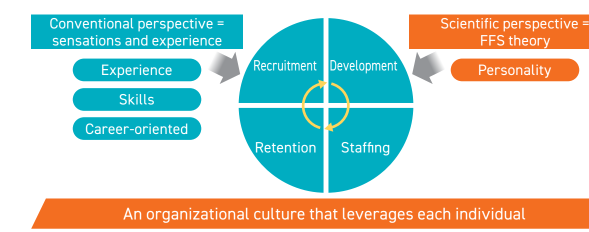
To realize co-creative R&D, we will push forward with the design of human resource diversity and a system to utilize it

Innovator development system



"FFS", mean for use diversity

Previously, decision-making in our HR strategy relied heavily on experience and intuition. By adding a scientific perspective, we can achieve:
- Realization of the potential of various engineers, and
- Creation of a reproducible and sustainable human resource management system



R&D personnel use computational science and informatics like air

We will train researchers who have a high level of expertise and can autonomously select and utilize computational science, AI, and data science (DS) as one of the research and development tools. By effectively using computational science and informatics tools with specialized domain knowledge, we will further accelerate research and development. Ultimately, we will ensure that researchers use computational science and informatics like air.

What a researcher should be like in 2030

- Highly specialized professionals
- Free use of computational science and informatics (as research and development tools)

100% ambidextrous talents in the R&D center by 2030

Strategy and vision for strengthening computational and informatics skills

Processes	At present	Future (2030)
Theoretical analysis (first time only)	Theoretical analyst uses software to perform analysis	Theoretical analyst uses software and AI to perform analysis
Lab verification	Researcher conducts experiments	DS talent uses robotics
Data assetization	DS talent stores data	DS talent uses AI to collect and organize
DS analysis	DS talent uses MI to analyze	DS talent uses MI and AI to analyze

Legend: Conventional | Ambidextrous

▶ See here to learn about the members of our in-house community REBLUC P22 / How Far We've Come! Fostering Resonac's Corporate Culture

F Co-creative intellectual property strategies

Naotake Ota
General Manager, Intellectual Property Department

To achieve our purpose of "Change society through the power of chemistry," we are promoting a dual-purpose strategy of exclusivity and co-creation based on three principles: (1) Proactive IP: accelerating value creation through proactive IP activities, (2) Fascinate with IP: disseminate intellectual assets that contribute to realizing our Purpose in the right place at the right time, and (3) Reliable IP: protecting and guiding our business through an IP landscape and IP management platform.

In 2025, we organized a Corporate Value Enhancement Committee within the Intellectual Property Department to update our efforts to date and accelerate our IP portfolio reform. By 2028, we aim to reach the top tier globally in PatentSight's TR and MC within the functional chemicals field, contributing to the enhancement of corporate value originating from our intellectual property.

Before 2024

- Analyze the synergistic effects of the integration of the two companies through the IP landscape and report to the management
- The proportion of our international patent applications rose to 52% (compared to the overall applicant average of 39.5% according to Japan Patent Office data)
- Established the Fascinate with IP initiative to actively disseminate intellectual property-related information externally
- Support the promotion of intellectual property strategy by strengthening the foundation of our intellectual property management system (SWIPS)

2025

- Establishment of the Corporate Value Enhancement Committee Set annual targets and manage progress for the following activities
  — Build a value-creation foundation linked to R&D and business strategies
  — Implement measures to increase competitive advantage and presence
  — Vitalize innovation creation activities
- Restructuring the organization to execute IP strategies aligned with business strategies
- Strategic development of intellectual property ownership and contract frameworks in co-creation activities such as US-JOINT
- Expansion of the internal use of IP landscape across departments Use for exploration of themes and co-creation partners up 2.8x year on year

2026 onward

- Accelerate co-creation to establish intellectual property superiority over competition
- Expand our strong patent portfolio, including in overseas markets, aiming to rank in top tier for TR and MC in key technology areas of functional chemicals (TR>1.2, MC>1.0)
- Innovation in intellectual property operations and governance through the use of generative AI
- Redefine intellectual property skills and talent for the new era
- Visualize business contributions through effective use of intellectual property, including exercising, leveraging, and monetizing rights

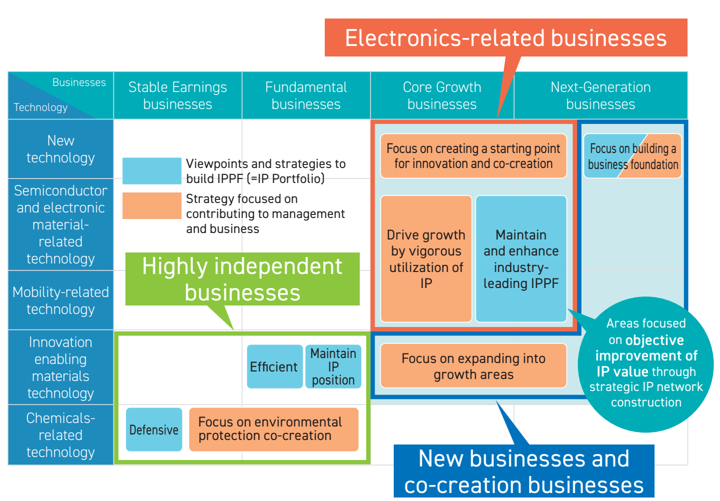
Intellectual Property Strategies to Increase Corporate Value

We categorize our organization into three areas based on a matrix with technology areas on the vertical axis and portfolio attributes (stable earnings businesses / foundational businesses / core growth businesses / next-generation business areas) on the horizontal axis, and we pursue the optimal approach tailored to the characteristics of each area.

Highly independent businesses	: Building barriers to entry with a multi-layered patent network that focuses on cost efficiency based on differentiated technologies
Electronics-related businesses	: Overseeing the entire supply chain, we execute a dual intellectual property strategy combining exclusivity and co-creation
New businesses and co-creation businesses	: Use intellectual property as a catalyst to facilitate an influx of partners, allowing for market development and risk diversification

We have assigned IP Designers to serve as hubs in the field. IP designers' mission is not only to obtain patent rights, but also to visualize the market, competitors, and customers in the IP landscape, and to design application strategies, contract structuring, and business schemes in a seamless manner. They aim to create a direct connection between intellectual property and business by working with business units to provide intellectual property solutions that push up EBITDA and support their growth stories. In the future, we plan to develop a program to systematically train IP Designers that possess strategic thinking, financial knowledge, and negotiation skills. By producing talent in such a systematic manner, we also aim to strengthen our competitive advantage in terms of human capital.

Furthermore, we are undertaking initiatives that are expected to contribute financially, while also creating new technologies and businesses that solve social issues, such as the patent license agreement with Shimadzu Corporation and the partnership with PulseForge. By communicating the results of this "IP-driven co-creation" to society, we will demonstrate the contribution of our IP strategy to enhancing corporate value.



Signed patent license agreement with Shimadzu Corporation

Partnership with PulseForge

Initiatives to Improve Intellectual Property Value

We position intellectual property as a "strategic asset that generates future cash flow" and continuously monitor TR (technology relevance) and MC (market coverage) from LexisNexis's PatentSight* as our core KPIs. TR and MC are calculated based on the number of citations and the number of countries where applications are filed, objectively demonstrating how widely our intellectual property covers the market and establishes technological advantage.

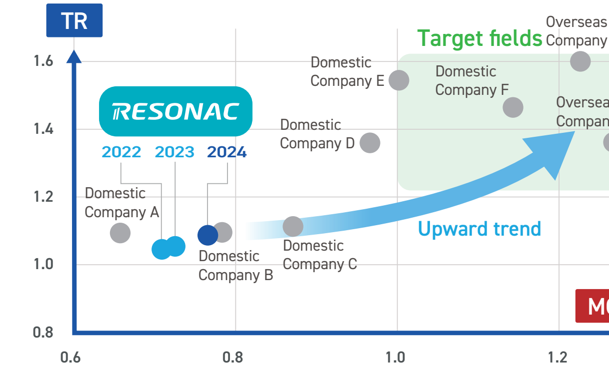
We have strengthened our market advantage and technological leadership by globally obtaining rights to our research and development results in an "early, multifaceted, and layered" manner, conducting quarterly TR and MC reviews, and dynamically inventorying low-value-added patents. As a result, TR and MC have steadily increased since 2022.

In semiconductor materials, our Competitive Impact (CI), calculated as TR × MC, has also improved significantly. The improvement in CI indicates that: (1) our patent network establishes exclusivity exceeding industry benchmarks, (2) we have built a global patent network covering key markets, and (3) strengthened barriers to entry allows us to expect sustained margins in the medium to long term.

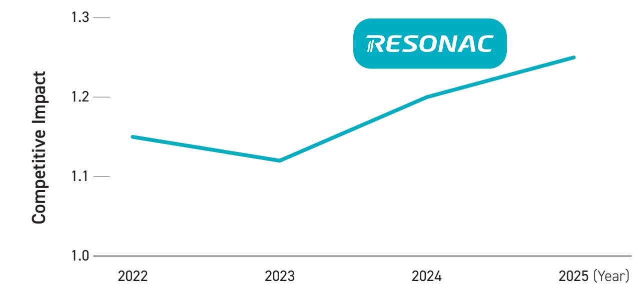
Our goal is to raise TR and MC to a globally top-tier level in the functional chemicals field by 2028, and to accelerate the creation of free cash flow and sustainable profit growth originating from our intellectual property. Through a robust IP network and portfolio optimization, we will clearly demonstrate the enhancement of long-term corporate value with continuous numerical disclosure and performance reporting.

*"PatentSight" is a registered trademark of PatentSight GmbH in Japan and other countries.

Improvements in the Technology Relevance (TR) and Market Coverage (MC) of the patent portfolio and target areas



Trend in indicator of competitiveness in the semiconductor-related field



*Competitive Impact (CI) is an evaluation of valid patents using the LexisNexis patent database, being an indicator of the competitiveness and quality of a patent family. Calculated based on the TR and MC of each patent. (CI = TR × MC)

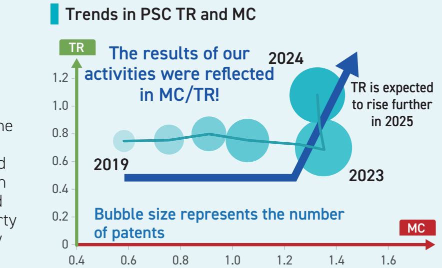
Example Intellectual property supporting business strategy: PSC: Packaging Solution Center

The Packaging Solution Center (PSC) works to create value by formulating intellectual property measures that are linked to our business strategies from the early stages of research and development. In PSC, we have equipment and lines equivalent to mass production processes that enable prototyping of semiconductor packages, allowing researchers and developers to immediately incorporate customer needs and conduct demonstrations. This enhances technical reliability and steadily increases our market presence and the speed of co-creation with customers.

In addition to traditional acquisition of IP for the purpose of exclusivity, PSC is actively promoting the acquisition of IP centered around co-creation. Patent portfolios reflecting the customer perspective expand the points of co-creation, strengthen our technological capabilities and brand recognition, and contribute to establishing a corporate position where we continue to be chosen. For example, through co-creation with customers, we pioneered the theme of moisture absorption in the industry, patented it*, and achieved high ratings (TR 13.9, MC 1.7). The assessed value of PSC-related intellectual property has increased year by year as a result of these initiatives. We are expanding our intellectual property portfolio as a source of competitive edge that create future cash flows.

*Patent No. 6950699

Trends in PSC TR and MC



Example Proactive intellectual property strategies: Exploring needs to propose new themes using IP landscape

We are horizontally deploying our IP landscape beyond R&D to include the creation of new businesses and exploration of growth areas. When formulating new research themes, the R&D department, which drives technology, and the marketing department, which capture market trends, collaborate closely and set themes from a customer-centric perspective. By surveying global market trends, customer challenges, and competitor technologies through the IP landscape, we improve the accuracy of theme exploration and support appropriate decision-making.

Furthermore, we have established an environment in which all employees can use cloud-based patent research and analysis tools, normalizing the use of intellectual property information at the on-site level. This structure enables the entire organization to seize opportunities both from market and technological perspectives and quickly and flexibly translate them into value creation.

Scheme for proposing new themes