

Innovation



Message from the CIO

Innovation is the catalyst to dramatically increase our corporate value.

Larry Meixner

Managing Corporate Executive Officer
Chief Innovation Officer
Chief Technology Officer

Innovation has always been an important driver of economic growth, for companies as well as for nations. But from a practical perspective, how can we, the MCHC Group, reach beyond our established businesses to create differentiation? How can we be first to adapt to market changes and transcend outdated approaches? These questions inspire us as we move into a new era characterized by post-pandemic market shifts and the global imperative to achieve a carbon-neutral society.

R&D as the seed of innovation

R&D is a core element of MCHC Group innovation, contributing to portfolio reform by stimulating development of new businesses (see P. 52). For example, we view GHG reduction not as a burden, but as a significant business opportunity. This drives us to strengthen our R&D capability to create next-generation structural, battery, and thermal management materials, while at the same time exploring new frontiers in material recycling and bio-based polymers. In healthcare, even as we develop new pharmaceuticals including Muse cells, we also emphasize “around the pill” digital solutions to fulfill unmet patient needs. And since completing the acquisition of MTPC in 2020, we have actively promoted synergistic R&D between our materials and healthcare business segments (see P. 54).

Creating the future: DX and venture engagement

Maximizing the business impact of innovation across the MCHC Group requires that we continuously nurture the capabilities and attitude to stimulate new, productive lines of inquiry. We are building this innovation infrastructure through DX, corporate venture capital (CVC) initiatives, and strategic new business development.

Our Digital Transformation Group (see P. 53) provides a central core of digital expertise and drives high-value projects across the MCHC Group. In addition, to foster the “digital mindset” critical to our future success, DXG provides education and training programs (see P. 50) used by thousands of MCHC Group employees and conducts staff exchanges and shared work assignments with the operating companies.

Access to global innovation allows us to leverage our advantages of scale and domain knowledge while overcoming the constraints of conventional thinking and risk-averse processes. We therefore initiated CVC activities and founded Diamond Edge Ventures, Inc., in Silicon Valley in 2018 (see P. 55). With our first five portfolio companies, we are stimulating strategic collaborations in growth areas across the MCHC Group. We are also developing new business models that leverage cross-company strengths, including data-based solutions for customers in the food value chain.

Winning the global race

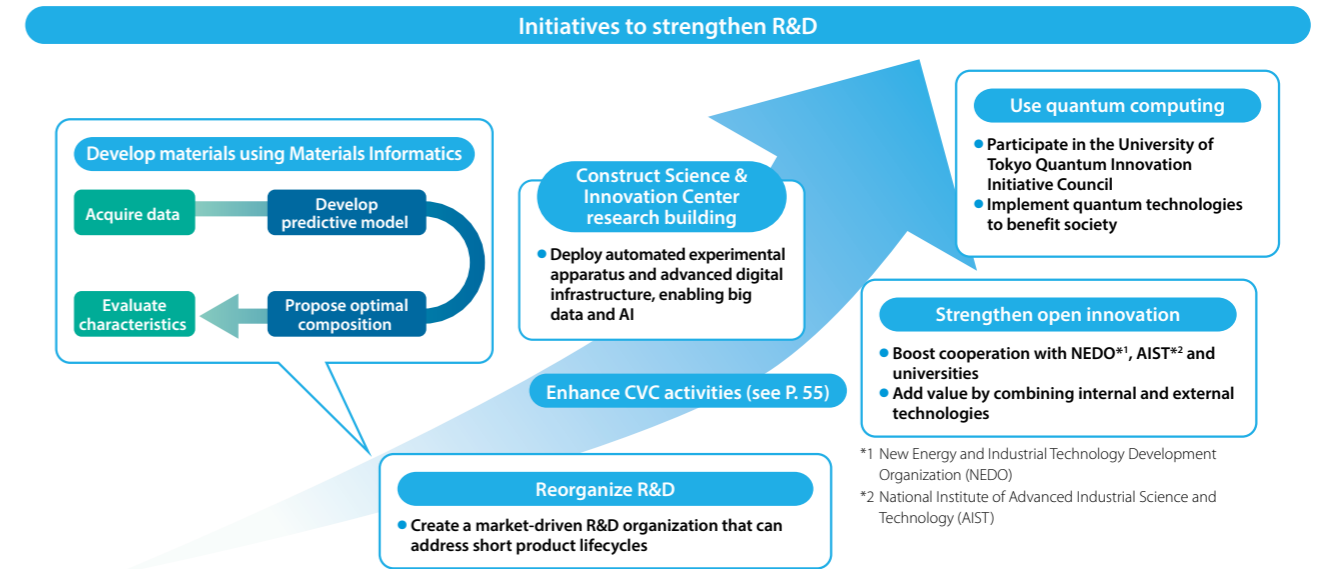
To keep pace in the global innovation race, we emphasize objective benchmarking and measurement (see MOT Indices, P. 24). Only by constantly evaluating our strengths and weaknesses can we develop into a global innovation leader.

We are living in a period of dramatic social change due to the COVID-19 pandemic, transformational developments in digital technology and the biological sciences, and significant geopolitical shifts. In such an era, entire industries may disappear while new ones emerge. This environment does not reward timidity. As we transform our portfolio and our corporation itself over the coming years, innovation will be the catalyst that allows us to dramatically increase our value to our stakeholders and to society.

Advancing R&D and Developing Next-Generation Businesses

R&D lies at the very heart of innovation, and we are improving R&D efficiency by applying materials informatics and expanding open innovation. Advancing innovation in this way will accelerate the creation of next-generation businesses.

Streamlining R&D with digital technology and open innovation



R&D initiatives for next-generation businesses

Noteworthy R&D themes expected to deliver value for growth businesses (Step 2) and next-generation businesses

Growth business areas	Solutions	Examples of R&D themes	Technologies and products
GHG reduction	<ul style="list-style-type: none"> Lighter mobility Electrification solutions Decentralized energy management 	<ul style="list-style-type: none"> Strong, lightweight materials Next-generation battery materials Thermal management materials 	<ul style="list-style-type: none"> Lightweight materials for mobility
Carbon cycle	<ul style="list-style-type: none"> Bio-based polymers Chemical and material recycling CO₂ capture and utilization Hydrogen society 	<ul style="list-style-type: none"> Biomass plastics Plastics recycling technology Artificial photosynthesis Carbon-free hydrogen stations 	<ul style="list-style-type: none"> Carbon-free hydrogen stations
Food and water supply	<ul style="list-style-type: none"> Decentralized food and water systems Alternative food and taste solutions 	<ul style="list-style-type: none"> High-performance packaging materials Food preservation gas 	<ul style="list-style-type: none"> High-performance packaging materials
Digital society infrastructure	<ul style="list-style-type: none"> Next-generation high-speed communication solutions Semiconductors Next-generation displays 	<ul style="list-style-type: none"> Next-generation communication related materials Advanced semiconductor materials Next-generation display materials 	
Human interface	<ul style="list-style-type: none"> Symbiosis of human and robot solutions 	<ul style="list-style-type: none"> Antibacterial and antiviral materials Non-contact materials 	
Medical advances	<ul style="list-style-type: none"> Regenerative medicine Preventive care Precision medicine 	<ul style="list-style-type: none"> Muse cells Cell culture materials VLP vaccine Genetic medicine Phenotype medicine 	<ul style="list-style-type: none"> Muse cells VLP vaccine

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Value Creation through Digital Transformation

MCHC is applying digital technologies and developing the capabilities to achieve digital transformation (DX), which will allow us to create new value through innovation.

Accelerating digital technology development and deployment

MCHC established the Digital Transformation Group (DXG) in 2017 to promote DX across the broad portfolio of MCHC Group companies. Since then, DXG has served as a central core of digital expertise, a stimulus for operating companies to develop their digital capabilities, and a resource for individual projects. Our overall approach has been to identify high-value initiatives that can be refined and targeted for broad adoption across the MCHC Group.

Engaging with high-value initiatives through digital applications

For example, we are applying digital technologies to improve product quality, optimize and automate business processes, and accelerate R&D. Specifically, we have implemented image-based quality control of specialty chemical products using automated identification of defects. Using data analysis and optimization tools, we have created methods to optimize supply chains to meet customer and market demands in our global markets. And we are exploiting

Materials Informatics to speed up materials discovery R&D, while also deploying the technology for pathfinding applications at relevant business units. These examples illustrate the increasing contribution of DX to strengthen manufacturing, business and R&D processes across the MCHC Group.

Fostering “digital natives”

Ultimately, our purpose in applying these digital innovations is to enable the creation of novel operational, customer, and social value. Now that DX has become well established within the MCHC Group, we are moving beyond our initial focus on operational excellence to initiate projects that create customer and social value. In addition to promoting open innovation beyond industry boundaries, we are laying the foundation for data-driven management by nurturing a new generation of “digital natives” through extensive digital education and the adoption of new ways of working (see P. 50). In this way, even as we execute projects that add value today, we are strengthening our digital foundation to enable continuous advancement in the years ahead.

Comments from the Chief Digital Officer

We generate innovation from change created by each employee, walking together on the path to transformation.

In this time of unpredictable change, innovation plays an increasingly important role in business growth. Digital innovation does not arise from digital technology alone, but rather in combination with the resources of our company and the experience of our employees.

To create business value, it is important for each employee to see change as their own responsibility and to actively promote change. We will continue to promote DX activities across the entire MCHC Group, as a light that illuminates the path for a team that walks together.



Naohiko Uramoto
Executive Officer
Chief Digital Officer



Solutions to environmental and social issues

The Group's Material Issues
• Intensification of DX

Deploying mathematical modeling to optimize company-wide energy costs

MCC has a large number of manufacturing sites, some of which have their own power generation facilities and surplus generation capacity, while others purchase from electric power companies. One major cost reduction opportunity is to minimize energy costs such as electricity (utility) costs at the company level. To address this opportunity, MCC launched the Wide-Area Energy Cooperation Project in September 2017. In response to the Japanese government's liberalization of electricity policy, we needed a system to optimize and efficiently operate our power generation and power purchase plans among multiple locations.

DXG built and verified a large-scale mathematical model, consisting of three million variables, to optimize company-wide utility costs. We then worked closely with the plant teams to adapt this theoretical model for deployment. Coupled with a negotiation of contract terms with power companies, MCC reduced utility costs by 10% in fiscal 2020 compared to fiscal 2017. This significant efficiency improvement was achieved through collaboration between plant personnel, business units and digital scientists. Our current work centers on further refinement of the model and increased automation of demand optimization and decision-making, with the goal of rolling out the model across the entire Group.

Creating Group synergies

Integrating MCHC Group assets to develop next-generation healthcare businesses leveraging the microbiome

When MTPC became a wholly owned subsidiary, MCHC set up a synergy creation committee. This initiative led to a joint project to develop next-generation healthcare businesses leveraging the microbiome (the ensemble of microorganisms in the human body) by MCC, MTPC and the MCHC Group.

Under this project, data on microbiomes will be collected and market trends analyzed to provide intelligence to inform the development of business models. Decisions on where to focus (in terms of diseases and stages, from prevention to treatment and convalescence) will be made based on business potential.

We aim to provide healthcare services in the future, but over the medium term, we will provide food ingredients that tap into the microbiome. We are also considering the use of the collected data to create health-related service solutions.

Initiatives for microbiome

Mitsubishi Tanabe Pharma
Know-how in drug discovery

Mitsubishi Chemical
Food ingredients and lactic acid bacteria businesses

Developing an infrastructure that integrates the technologies of the companies

Microbiome data | Data analytics | Intervention techniques

Draw on data to develop a comprehensive healthcare business encompassing medicine and food

Food ingredients	Services	Medical care
<ul style="list-style-type: none"> Ready-made meals Processed foods Food for long-term care and hospitals 	<ul style="list-style-type: none"> Health-related information 	<ul style="list-style-type: none"> Use in drug target discovery Precision medicine through biomarkers and patient stratification Prevention, pre-symptomatic disease care and prognostic interventions

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Corporate Venture Capital Activity

MCHC launched its corporate venture capital (CVC) activity in 2018 to engage with startups around the world, creating business options for both the Group and its partners. Over the next 10 years, we plan to invest \$150 million to expand our existing business and \$50 million to cultivate new fields.

Engagement to create new business with partners around the world

MCHC CVC activity is in its third year since establishing our Silicon Valley-based subsidiary, Diamond Edge Ventures (DEV), in 2018. With members in Japan, America, and Europe, and deep connections with business units across the entire MCHC Group, we pursue strategic engagements to create business options for both MCHC and our startup partners.

These collaborations extend far beyond the five companies in which we have invested as of April 2021. We have introduced over 1,000 opportunities across the MCHC Group, leading to 200 engagements, including 12 joint development agreements (JDA) and 6 business contracts. MCHC has announced its long-term commitment to CVC activity, comprising a "Platform Fund" to expand current business and a "Frontier Fund" to seed new business areas for the MCHC Group.

	Platform Fund	Frontier Fund
Duration	FY2021–FY2030	
Description	Investment to support the expansion of current business via startup engagement	Investment to cultivate new fields to create a future business pipeline
Investment area	Current and adjacent fields to realize KV30	Frontier fields to expand KV30
Target outcome	New revenue for current businesses	Revenue from new businesses
Fund size	\$150 million (10 years)	\$50 million (10 years)

Mitsubishi Tanabe Pharma	Therapeutics Fund (MP Healthcare)
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Breakthrough technology to enable next-generation semiconductor production

French startup aveni S.A. is the most recent addition to the DEV investment portfolio. aveni has developed breakthrough metallization technologies that enable the next generation of semiconductor devices for memory, logic, and lighting. In conjunction with this investment, MCC entered into a JDA with aveni, reflecting MCHC's strategy to expand our core offerings in the semiconductor sector. "The Diamond Edge Ventures team's professionalism, efficiency and expertise helped us close an incredibly complex deal in record time," said Bruno Morel, president of aveni.

Accelerator program for a circular economy

In 2020, we organized the KAITEKI Challenge, an accelerator program aimed at contributing to a circular economy. This program was in partnership with Greentown Labs, the largest climate-tech incubator in the United States. Our theme of "Reimagining Proteins, Plastics, and Packaging" reflects our concern about global over-consumption of resources and excessive waste generation. Six startups were selected competitively to participate in the KAITEKI Challenge. These startups are working closely with MCHC Group business and technical teams to transform their innovative concepts into commercial reality.

Comment from the DEV President

Continuing along the road to true innovation that will allow us to leapfrog the competition

"You can't manage innovation with a rear-view mirror." This statement still resonates with me, many years after first hearing it. Basing strategy on what your market peers are doing is tempting, as it gives you a direction to competitiveness based on current market knowledge. But true innovation is not about catching up, it is about leapfrogging! Sometimes you need help from the outside to do so. This is true for startups and large corporations alike.

I am proud of the portfolio of investments we have created in less than three years. The road to innovation is seldom straight, but we can help MCHC anticipate curves

and bumps by aggressively creating mutual business value with our startup partners.



Patrick Suel
President, Diamond Edge Ventures, Inc.



The Group's Material Issues
• GHG reduction

Investment in AddiFab ApS

In June 2019, DEV invested in AddiFab ApS, a Danish startup developing next-generation molding technologies that combine 3D printing with injection molding.

What followed is already a CVC success story. "Diamond Edge Ventures hit the jackpot with AddiFab," says Randy White, Chief Innovation Officer of Mitsubishi Chemical Advanced Materials (MCAM). "This partnership is already a huge win for both AddiFab and MCC within the first two years."

For business growth, AddiFab benefits from the strong commercial and technological support of multiple MCC teams. For example, MCC is developing new dissolvable resins for AddiFab's process, while multiple MCC business units leverage AddiFab capabilities to diversify their injection molding business, enabling them to expand beyond their current customer base. With AddiFab as its partner, MCAM is now the exclusive service provider promoting Freeform Injection Molding, reinforcing MCAM's global solutions provider status.

MCAM became AddiFab's largest customer by installing five sets of AddiFab equipment around the world, starting with MCAM's Innovation and Technology Center in Arizona in early 2020. Additional equipment is now fully operational in

the United States, Belgium and Japan. MCAM plans to add more sites in 2021 in order to keep up with the demand for this fast and affordable prototype business, branded as "MCAM SPRINT."

Through this partnership, AddiFab and MCHC customers around the world are now benefiting from the speed, design freedom and low cost of 3D printing combined with the mechanical strength of injection molded parts.



Technician inspects AddiFab 3D-printed mold at MCAM's Innovation and Technology Center in Arizona



Super-strong injection molded KyronMAX automotive bracket made using the AddiFab process