

Monozukuri Manufacturing to Accelerate an Increase in ROIC

The Maxell Group produces approximately 8,000 products at 23 bases (17 in Japan and 6 overseas) spanning its 61 project groups. With its shared motto of “producing good products at lower cost and with better timing,” the entire Group is working to develop a *Monozukuri* manufacturing system that will help to increase return on invested capital (ROIC), one of its core indicators.

Monozukuri Manufacturing Policy for Increasing ROIC

The Maxell Group is accelerating the adoption of ROIC as a core indicator for the Group, having introduced it in fiscal 2019. In the manufacturing process, we are working to increase productivity through quality improvement activities, technology development such as AI, and by identifying issues in the supply chain to strengthen improvement activities. We will aim to increase our *Monozukuri* manufacturing capabilities by setting profit potential (PP) as a new indicator correlated with ROIC.

The Maxell Group's *Monozukuri* Manufacturing Policy

“Producing good products at lower cost and with better timing”

Good products: Maxell-Process Assurance AMI (Net) System (M-PAAS)

At lower cost: Technology development such as AI

With better timing: Issue Map Supply Chain Basic (SCB)

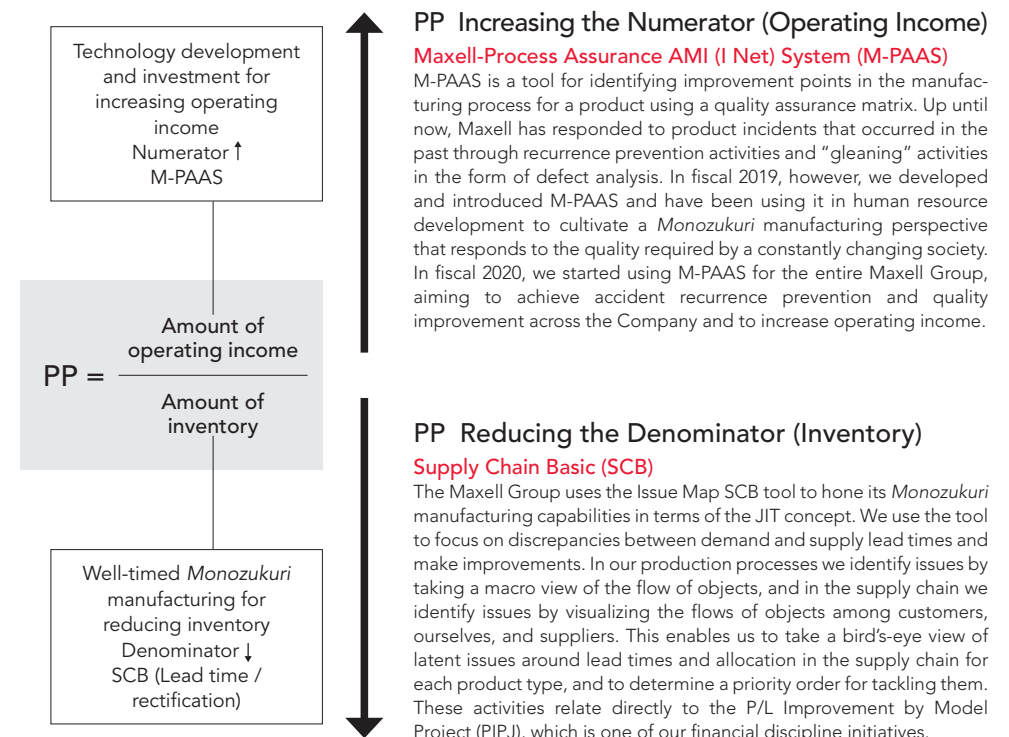
Monozukuri Manufacturing Evaluation Indicator: PP

This indicator aims to strengthen the Maxell Group's manufacturing by focusing on the relationship between a denominator and numerator represented by (investment for) technology development to increase operating income and well-timed production to reduce inventory. Within the motto “Producing good products at lower cost and with better timing,” “good products” represents quality, and “lower cost” represents efficiency in the form of curbing processing expenses and reducing the headcount to generate operating income. “With better timing” refers to the just-in-time (JIT) concept. These are our basic approaches to improvement.

System for Strengthening *Monozukuri* Manufacturing Capabilities

Executive Officer Kenichi Sano	Production technology system	AI robot development
	Manufacturing technology system	Well-timed <i>Monozukuri</i> manufacturing
	<i>Soshinjuku</i>	Human resource development (quality)

Note: From April 2020, Executive Officer Sano was appointed general manager of the *Monozukuri* Business Unit, and is working to strengthen *Monozukuri* manufacturing across the Group.



Column

Soshinjuku: Developing Human Resources to Cultivate *Monozukuri* Manufacturing Capabilities

The *Soshinjuku* program was started in November 2017 with the goal of developing human resources to cultivate Maxell's *Monozukuri* manufacturing capabilities. The program has been conducting training using M-PAAS. *Soshinjuku* equips people with connections across different business units, allowing them to come into contact with ways of working outside of their own

divisions. It has produced results as a forum for expanding people's views and enabling benchmarking across the organization. With the groupwide introduction of M-PAAS in fiscal 2020, *Soshinjuku* will also continually introduce new programs that help to further promote the policy of “good products at lower cost and with better timing” within the Group.

Research and Development Founded on Analog Core Technologies

The Maxell Group's source of value creation is its three Analog Core Technologies: Mixing & Dispersion technology, Fine Coating technology, and High Precision Molding & Forming technology. We are using these to create completely new products and services.

Why All-Solid-State Batteries?

Following the Maxell Group's mission, "Contribute to a sustainable society by innovating unique, original technologies," the Energy Division is working to create businesses that will help to solve social issues, such as the SDGs. The division has been focusing particularly on all-solid-state batteries.

All-solid-state batteries are batteries that contain no liquid whatsoever, as their name suggests. Until now, batteries have required the use of a liquid called electrolyte that conducts ions to create a path for ions to travel back and forth between the anode and cathode. Today's lithium ion batteries use an organic electrolyte, and although they can achieve high working voltages in excess of three volts and high energy density, there are concerns over their safety because electrolyte is a hazardous substance. In an all-solid-state battery, a solid ion conductor is used in place of organic electrolytes, and since the entire battery is constructed with solid materials, it can achieve both high energy density and high safety.

All of the solid-state electrolytes that have been researched to date have low conductivity for lithium ions, and it was therefore considered difficult to realize a high-performance all-solid-state battery. Recently, however, the development of a solid-state electrolyte that shows ion conductivity comparable to organic electrolytes has brought all-solid-state batteries back into focus as a next-generation battery capable of simultaneously improving multiple aspects, including safety, heat resistance, service life, high energy density, and high output power.

In the Energy Division, we have expectations that all-solid-state batteries could become the main power source contributing to solutions for social issues such as the SDGs. Since they are superior in terms of service life and heat resistance, they require replacement and other maintenance far less frequently, helping to solve the issues presented by a declining working population. Furthermore, by increasing safety, they will help to increase the usage of wearable devices in medicine and healthcare, reducing the workload of medical professionals and encouraging advances in at-home medical care. In addition, all-solid-state batteries have the potential to make a major contribution to social development and safety, such as reducing CO₂ emissions from transport through their use in the mobility field, which requires a large amount of energy.

In April 2019, our small coin-type, all-solid-state batteries with sulfide-based solid electrolytes moved from the research phase to the commercialization phase. With the goal of leading the world by starting mass production from 2021, we are collaborating with materials and components manufacturers in an effort to commercialize the batteries for use in wearable devices. By eliminating the harsh restrictions on temperature range and service life of lithium ion batteries and developing batteries that can be used safely anywhere and anytime by 2025, we will contribute to the realization of a sustainable society.

Background to Development

Recent years have seen an increase in devices that use miniature batteries as a power source, such as wearable devices and industrial devices. Maxell has developed batteries in line with the needs of customers who deal in such devices and seek heat resistance, safety, input-output characteristics, and so on.

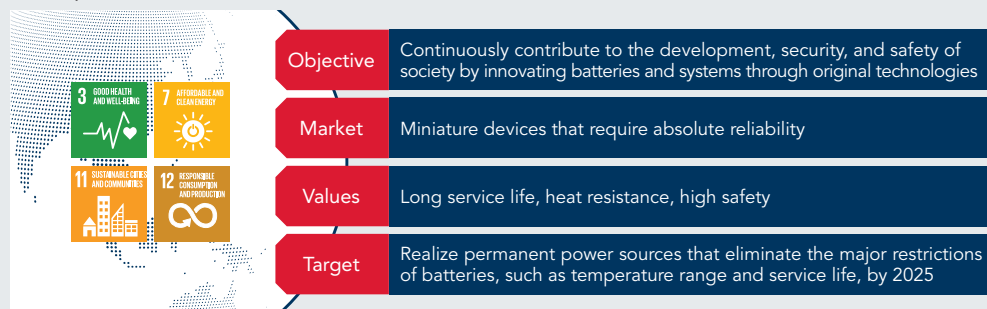
The current generation of lithium ion batteries has seen advances in innovative technology for extending battery life since around 2010, when smartphones began to enter the mainstream, and energy densities have been expanding rapidly. However, these increases in energy density are limited by the ability to maintain safety using conventional materials. Since around 2015, there has been a rise in battery incidents related to reliability, including combustion and swelling. Subsequently, out of concern for safety, no significant increases in the energy densities of lithium ion batteries have been made.

All-solid-state batteries offer superior performance to current lithium ion batteries in terms of chemical stability and safety. However, it is vital to improve their ion conductivity in order to increase their energy density and input-output characteristics. Maxell is collaborating on research with Mitsui Mining & Smelting Co., Ltd., one of a small number of companies that has succeeded in developing a solid-state electrolyte with high ion conductivity. Mitsui Mining & Smelting and Maxell have a

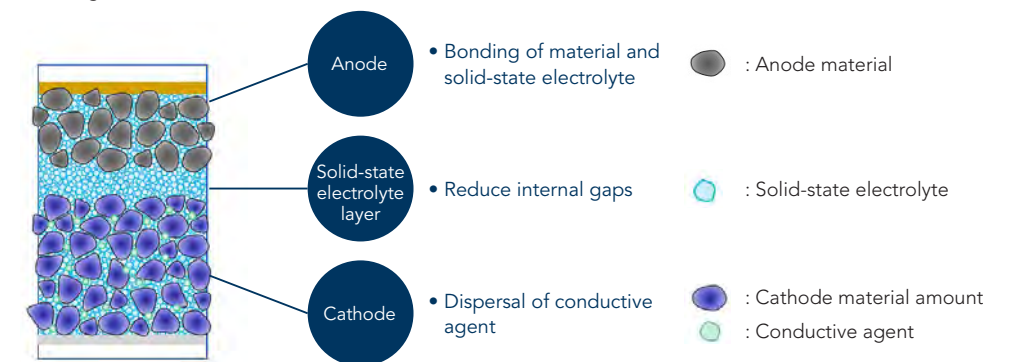
longstanding collaborative relationship in the fields of alkali dry-cell batteries, micro batteries, and lithium ion batteries, and the relationship of trust that we have developed over many years has enabled us to enter joint development on all-solid-state batteries.

Two types of commonly used inorganic solid-state electrolytes are oxide-based and sulfide-based. Oxide-based electrolytes have an ion conductivity that is less than 1/10 that of sulfide-based electrolytes. In addition, they require high temperature calcination when the batteries are manufactured, which limits the range of options for materials. This makes it difficult to achieve both energy density and favorable input-output characteristics. Maxell uses an argyrodite-based electrolyte, which has especially high stability, ion conductivity, and formability, even for a sulfide-based electrolyte. This electrolyte enables battery manufacture at room temperature and has the potential to deliver high energy, high input-output for batteries that will satisfy the requirements of wearable device manufacturers and automotive device manufacturers, who are Maxell's customers. Maxell aims to achieve mass production of sulfide-based all-solid-state batteries at an early stage, making maximum use of its strengths in Analog Core Technologies in the process.

Development Strategy for All-Solid-State Batteries



Challenges to Overcome for Sulfide-Based, All-Solid-State Batteries



Research and Development Founded on Analog Core Technologies

All-Solid-State Batteries Based on Analog Core Technologies

As we proceed with commercializing all-solid-state batteries (under the product name PSB), we will leverage Maxell's three strengths.

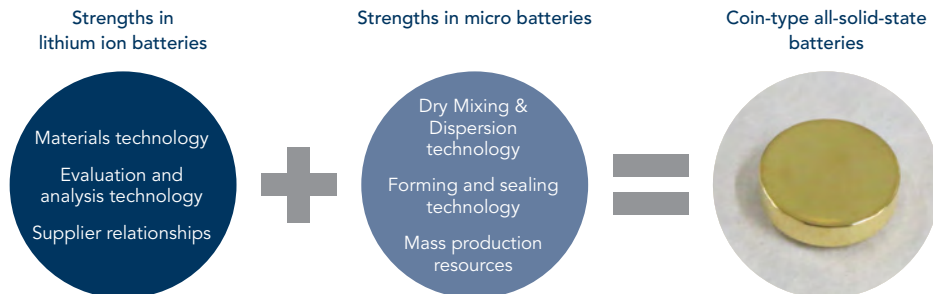
The first strength is our powder process technologies for Mixing & Dispersion, and forming. In addition to our two Analog Core Technologies of Mixing & Dispersion of electrolyte material and High Precision Molding & Forming of electrodes, we have strengths in the form of a long track record in mass production of coin-type batteries and other micro batteries. In particular, High Precision Molding & Forming is an extremely important process in all-solid-state batteries. Unlike liquid electrolytes, solid-state electrolytes have low fluidity, and when gaps exist inside the battery, these limit the movement of lithium ions, reducing performance. Therefore, one of our main challenges for development has been how to increase the degree of filling inside the battery. Since we have experience in overcoming a similar issue for existing micro batteries, we used our insight on this problem and set the rate of fill as a KPI for the initial development stage. Tackling this issue from an early stage enabled it to be solved.

The second strength is the use of *Monozukuri* manufacturing technology and existing facilities in a dry environment. Since sulfide-based solid-state electrolytes react with water and break down easily, the electrode materials and electrodes must be handled in a dry environment. Maxell aims to create an all-solid-state battery that can be mass produced

at a reasonable cost for devices that could not previously have batteries fitted, or that have had to be used under restricted conditions, for various reasons such as safety and heat resistance. This means that we needed mass production technology for manufacturing the electrodes made from solid-state electrolyte and electrode material in a dry environment, and sealing them efficiently inside an exterior casing with a coin shape and so forth. Maxell already has mass production equipment for forming the electrolyte and electrode and equipment for sealing them inside a metal case in a dry environment. We plan to leverage this equipment and our expertise in mass production of all-solid-state batteries to commercialize them in a short time.

The third strength is materials technology and the strong relationships with suppliers that are associated with this. Through its battery and magnetic tape businesses, Maxell has developed technologies related to materials, such as material synthesis and powder surface treatments. In the process of acquiring deeper knowledge about materials, we have established deep relationships with many suppliers, such as Mitsui Mining & Smelting, mentioned above, and power treatment equipment manufacturers. This enables Maxell to acquire and examine suitable materials and equipment to make the all-solid-state battery in line with its plans from an early stage. Collaboration with major suppliers is dramatically increasing the commercialization speed of the all-solid-state battery.

Characteristics of Maxell's All-Solid-State Batteries



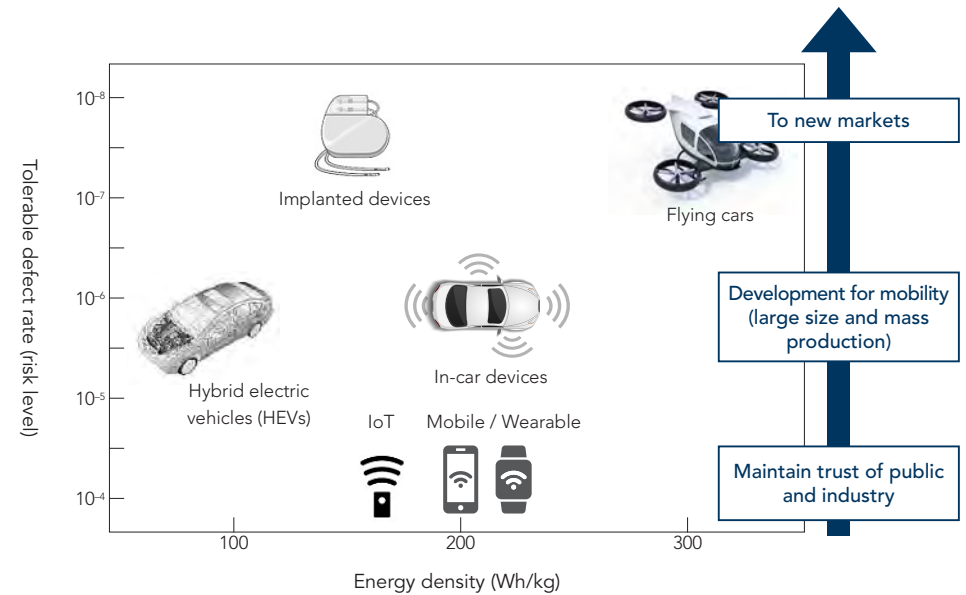
Evolution of All-Solid-State Batteries: The Road Ahead

The figure below shows the target markets and road map for all-solid-state batteries. Currently, we are making steady progress in development for the commercialization of the world's first sulfide-based, coin-type all-solid-state battery. The next step is to increase the capacity and performance of the battery, and develop it for use in next-generation wearable devices, including medical and other

devices. We are promoting joint development with automotive companies to increase the scale of all-solid-state batteries to make medium and large-sized ones, eyeing entry into new fields such as 5G devices and onboard telematics. We aim to create new markets where only all-solid-state batteries can be used ("Market X"), including fields with high reliability requirements such as implants.

Future Development

To markets that require safety and reliability, which are difficult for ordinary lithium ion batteries to reach
 ⇒ Achieve high functionality and reliability along with high safety



Initiatives to Stimulate the Organization

The Group is conducting overseas short-term fieldwork to develop diverse human resources worldwide. In 2019, the *Konoyubitomare* project was launched by participants in the overseas short-term fieldwork. The Maxell Group is promoting both top-down and bottom-up initiatives to stimulate its organization.

Konoyubitomare—A Space for Making Connections between People with Shared Aspirations throughout the Group



A *Konoyubitomare* briefing at the Kobuchizawa Works



A seminar on *Konoyubitomare* × SDGs

Konoyubitomare was created as a platform that connects people who (1) are in the Maxell Group, (2) have a desire to act autonomously, and (3) have shared aspirations, with a view to stimulating communication within the Group. This initiative is a bottom-up activity by the *Konoyubitomare* Executive, which was created primarily by the participants in an overseas fieldwork training event held in California, United States, in January 2019.

Konoyubitomare is managed using the Company's internal social networking service (SNS) tool. The Maxell Group is comprised of numerous divisions and operating companies, so *Konoyubitomare* was launched in April 2019 with the goal of stimulating wider communication within the Group beyond the participants' immediate work-related contacts. As of March 2020, the platform has grown to include 248 participants. It handles diverse themes ranging from work to hobbies, and in fiscal 2019 for the first time its activities included offline events such as a vision-sharing roundtable meeting and a sports event.

In fiscal 2020, the platform has been used in an increasing number of cases by employees working at home due to COVID-19 to consult with one another about working remotely. In addition to employees, Maxell Holdings President and Representative Director Nakamura and other directors use the platform as a space for quickly sharing their daily reflections, recommended books, and other information.

One year after the launch of *Konoyubitomare* (April 2020), we are beginning to see connections forming between people working at different sites within the Group. The *Konoyubitomare* Executive's aim is to strengthen the Group's integrated management by encouraging a greater number of connections and making them even stronger. To this end, we will continue to promote awareness and utilization of *Konoyubitomare* to Group employees, pursuing communication that enables people to help one another.

Development of Global Human Resources

As part of efforts to develop leaders for our global businesses and personnel who can contribute to our operations overseas, we have implemented overseas short-term fieldwork, which enables employees to consider Maxell's business opportunities in growth markets.

At the fieldwork program that was run in the United Kingdom in January 2020, we held training under the themes of SDGs and social issues to develop new services and products for solving issues related to social infrastructure in London. The trainees considered products and services based on feedback obtained through field research at local companies, Japanese companies, NPOs and universities, and so forth, examining them from the perspective of Creating Shared Value (CSV), which aims to achieve both social and economic value. They presented the outcomes of their fieldwork on the final day of training. Going forward, we will continue to invest in human resource development overseas with the expectation that the skills acquired through this training will be leveraged to create new businesses opportunities.



Final presentation (in London)

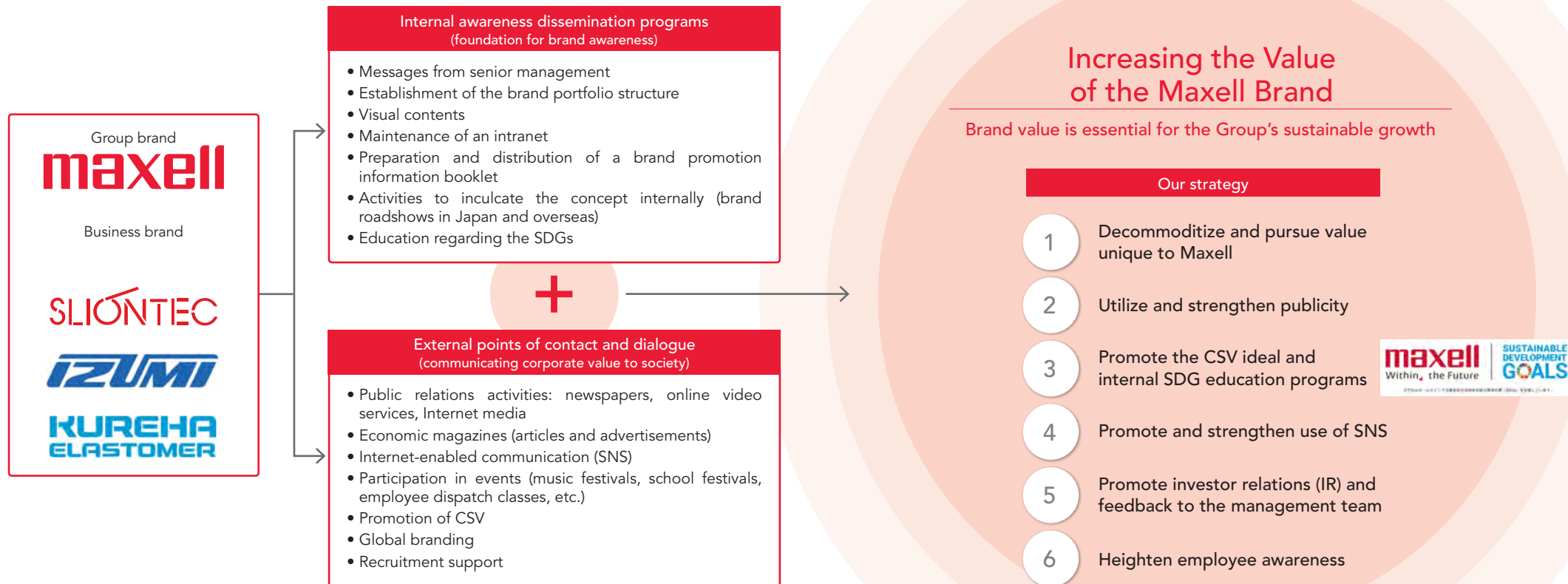
Increasing the Value of the Maxell Brand

The Company changed its name to Maxell Holdings, Ltd. in October 2017, taking its first step in a new phase of growth through what has been positioned as a “second foundation.” In addition, we incorporated our new slogan, “Within, the Future—the future is within,” into our brand logo. We will instill an awareness of the logo and slogan in all of our employees, and based on the “One Maxell” and “We Are Maxell” sense of solidarity and identity, we will raise the visibility of the new Maxell brand worldwide.

Meanwhile, to this day “Maxell” is a byword for cassette tapes, DVDs, and alkaline batteries due to our strong presence in those products for many years. However, the Maxell Group’s product lineup is undergoing a significant expansion beyond the idea of BtoC (consumer) or BtoB (business) products. Therefore, we believe that raising the profile of the Maxell corporate brand among consumers other than those of such traditional mainstay products—particularly young consumers—is essential for our medium- to long-term growth.

Our aim is to rebuild and strengthen the Maxell brand. To this end, we will escape from commoditization and pursue our ideal of CSV (Creating Shared Value) by offering differentiated value that is unique to Maxell. In conjunction with these efforts, we will increase our points of contact with society as we expand our businesses. In addition, we will actively seek dialogue with stakeholders through publicity and the use of SNS.

Our Approach to Increasing Brand Value



Increasing the Value of the Maxell Brand

TOPICS

Branding for Business Synergy Creation

Acquisition of naming rights to “Maxell Aqua Park Shinagawa” in December 2017



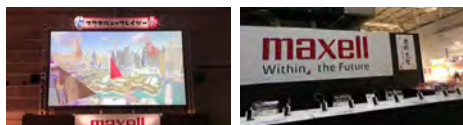
<http://www.aqua-park.jp/aqua/en/>

Sponsoring of Sports Events and Cultural Activities

Contribution to community revitalization and sports promotion as official sponsor of Hitachi Rivale



Provision of Maxell brand projectors and operation of a smartphone charging station at FM802 RADIO CRAZY event (sponsored by FM802 Co., Ltd.)



Corporate Movie

Receipt of VFX-JAPAN Awards 2019 for the Maxell Group's corporate movie “A piece of the future, in this hand.” The latest corporate movie iteration features actual employees.



■ A piece of the future, in this hand.
<https://youtu.be/xk0UifkJucl>

Video Summarizing the Maxell Group

Maxell's Analog Core Technologies explained in a four-minute video



■ Maxell - Explainer Video by simplishow
https://www2.maxell.co.jp/corporate/brand_e.html

Support for Education of the Next Generation

Proactive support for education of the next generation through employee dispatch programs, sports activities, etc.



Participation in the Da Vinci Masters program for learning science and mathematics through games

Support for the athletic development course of Kyoto Sanga F.C.

ダヴィンチマスターズ



Building a Fan Base through Use of SNS

Maxell's official Twitter account has reached more than 90,000 followers. We are running a prize campaign and providing seasonal information to promote new products, aiming to surpass 100,000 followers in fiscal 2020.



First Issue of Internal Brand Newsletter for Employees

The first issue of *Brand-NewsMaxell*, a quarterly newsletter for all Maxell Group employees, was published in fiscal 2019 to facilitate periodic sharing of information on branding activities. As of July 2020, the sixth issue has been produced and distributed.



Internal Management Policy Bulletin

To ensure that all Maxell Group employees are apprised of new management policies as quickly as possible, we create posters for display in every workplace and issue credo cards that employees can carry with them, aiming to get all Maxell Group employees thinking along the same lines.

