

Roundtable Talk among Officers in Charge of Technological Development



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What Is the Goal of Our Technological Development in Terms of Supporting Genuine Joy and Well-Being for All?

Transformative Initiatives Now Being Undertaken by Technological Development Divisions to Achieve the Goals of the New Midterm Plan

Muraoka Under the Transformation Project stipulated by the new Midterm Plan, our technological research divisions are focused on three objectives: (1) pursuing optimization via close collaboration among manufacturing, sales and technological departments; (2) developing next-generation tires; and (3) expanding the scope of the operations through which we take on new business fields as well as pursuits in our fields of focus by scaling up the business applications of our SENSING CORE Technology. The Transformation Project strives to transcend organizational boundaries via the use of a top-down approach, with officers playing a central role. Thanks to these features, the project has proven highly effective in promoting measures to achieve the above objectives.

First of all, in pursuing optimization via close collaboration among manufacturing, sales and technological departments, we are addressing the major problem of the downward trend in profit despite sales revenue in excess of ¥1 trillion.

Sales departments naturally lean toward securing orders whenever they expect a certain amount of sales and profit. This puts pressure on technological departments, which then look to increase development resources and undertake capital expenditure to meet delivery schedules. They may also have to augment staffing while enhancing efficiency. Although we typically encounter a variety of issues like the above in the course of business, we consider pursuing overall optimization key to successfully resolving such problems.

Our standard for optimization is determined by asking what factors we need to prioritize to genuinely improve the profit margin. When making judgments, we sometimes prioritize requests from sales departments and at other times those from technological departments. At the Sumitomo Rubber Group, however, we also deem it essential to take the Purpose into account as an axis for judgment.

Secondly, with regard to developing next-generation tires, we are well aware of the growing social trend toward EVs. Accordingly, it is essential

to take full advantage of our unique technologies to stay at the vanguard of this trend and create products boasting unparalleled features.

Thirdly, we will accelerate efforts to scale up our SENSING CORE Technology with the aim of expanding the scope of the operations through which we take on new business fields as well as pursuits in our fields of focus. SENSING CORE is built on Deflation Warning System (DWS) technologies that were commercialized by the Sumitomo Rubber Group in 1997, and no other companies were developing similar technologies at that time. This Technology is capable of analyzing tire rotation signals, assessing the status of tire load, tire wear and other factors as well as road conditions, such as slipperiness, and providing vehicles and drivers with such data.

If data collected via SENSING CORE were utilized not only by tire manufacturers but also drivers, vehicles themselves and automakers, the benefits arising from this Technology would grow even larger. Given the recent social trend away from the simple sale of goods and toward the provision of value-added services, we are confident that SENSING CORE is a truly pioneering technology.

By combining SENSING CORE with our next-generation EV tires, we will contribute to a next-generation mobility society in which autonomous vehicles are mainstream. Furthermore, we will strive to realize “TOWANOWA”—a unique business model concept that connects big data utilization with manufacturing to support a circular economy. This is how we endeavor to serve as forerunner in initiatives to realize a sustainable society.

As discussed above, the Transformation Project targets a diverse range of issues, including those that must be addressed by our group at this point in time and those that must be addressed in the future, as well as social issues calling for collective efforts to create solutions.

Matsui As part of the pursuit of optimization via close collaboration among manufacturing, sales and technological departments, we will also strive to reduce the size of our Stock Keeping Units (SKUs).

We will review our current definition of the SKU for each product to make it more efficient.

For example, we can update SKUs by verifying our process for globally distributing products developed using new technologies after initiating the manufacture of such products at our mother factory. Specifically, we will examine the volume of necessary capital expenditure, distribution costs and other expenses by, for example, assessing various options for production

Value Provided by SENSING CORE

SENSING CORE provides extensive value by detecting Tire Pressure, Tire Load, Tire Wear and Road Conditions. In order to further expand the value that SENSING CORE provides, we are now working on the development of a fifth sensor function to detect Warning Signs of Wheel Detachment



locations where we can intensively manufacture such products in an efficient manner, with all Executive Officers in charge of manufacturing, sales and technology taking part in this assessment.

In terms of developing next-generation tires, SILENT CORE Technology, which employs specialized noise-absorbing sponges installed inside the tire, lends us a distinctive strength. The adoption of SILENT CORE is particularly beneficial to EVs as an effective noise countermeasure because, since they generate no engine sound, the noise generated by the tires moving on the road is all the more noticeable. As a forerunner in this area, the Sumitomo Rubber Group has developed patents for this Technology, which it licenses to other companies.

We also consider our IMS (Instant Mobility System) Tire Puncture Emergency Repair Kits to be a source of strength in light of the increasing popularity of EVs. The IMS eliminates the need to carry spare tires. We will further strive to ensure that both SILENT CORE and the IMS are adopted by a growing range of vehicles.

With the aim of expanding the scope of the operations through which we take on new business fields as well as pursuits in our fields of focus, we are scaling up the business applications of our SENSING CORE Technology. In this area, we expect that functions for detecting early signs of truck wheel detachment will be the first to be commercialized. In Japan, annual statistics on traffic accidents include more than a hundred such incidents involving wheel detachment. Previously, it was assumed that incidents of this kind would be preceded by such signs as vibrations that could be felt by the driver. However, our research revealed that detecting early signs of wheel detachment is extremely difficult for the average drivers. This finding prompted us to develop a technology that would allow the vehicle itself to detect the early warning signs of these incidents.

This technology thus came to fruition as a 5th sensor function, with our proposal targeting truck makers garnering favorable reviews and resulting in its ongoing development. We forecast that vehicles equipped with this function could be released in several years. In addition, our development team has become ever more spirited as their efforts thus far are expected to result in the commercialization of a groundbreaking technology that will, in turn, resolve a social issue.

Going forward, we also intend to develop 6th and 7th sensor functions while expanding the scope of customers who will benefit from them. Through these endeavors, we aim to secure business profit of around ¥10.0 billion from SENSING CORE-related operations in 2030.

What Is “TOWANOWA”—the Sumitomo Rubber Group’s Unique Business Concept Supporting a Circular Economy

Muraoka The transition to a circular economy has become a pressing issue requiring the response of not only the tire industry but all other



industrial sectors.

The Sumitomo Rubber Group has taken a progressive approach to the utilization of sustainable raw materials ahead of other companies. For example, in 2013 our group released the world’s first 100% fossil resource-free tire made from all-natural materials and, in 2019, became the first in the world to release tires incorporating Cellulose Nanofiber, a biomass material. However, we had not forecast that the shift toward a circular economy would gain momentum as rapidly as we are seeing today. We feel that the pace of transition has drastically accelerated.

Basically, initiatives undertaken by manufacturers to support a circular economy seem to be largely similar, because they share a somewhat similar perspective as manufacturers. You will see them naturally gravitate to questions about such issues as what materials they should use, how to procure energy for manufacturing and how to treat manufactured products. Against this backdrop, it is a major struggle to set ourselves apart from others in this area.

On the other hand, as the trend toward a circular economy is now becoming mainstream in society, moving our group in another direction would be untenable, even if we wish to differentiate ourselves.

These thoughts led us to identify the utilization of big data as a technological concept for better leveraging the Sumitomo Rubber Group’s strengths. Specifically, we have decided to develop a built-in mechanism supporting our value creation initiatives based on the full use of our strengths in sensing and AI-based technologies and the mutual coordination of various data, which has previously been utilized in a piecemeal manner. The data gleaned from tires could possibly offer a variety of insights that, in turn, could help us deliver benefits to a broad range of customers if this data were effectively connected with other types of data across society. This big picture will, I believe, set our business concept—

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we call it "TOWANOWA"—apart from those of other companies.

Although we expect other companies to announce similar concepts going forward, we would like to definitely maintain our position as a forerunner. In this light, securing connections with diverse range of external corporations as well as service users will be key to success. Our strength in this field will therefore hinge on how far and fast we can expand the scope of external data connections.

Matsui The creation of the TOWANOWA concept started with an across-the-board assessment of the status of circular economy-related business endeavors now under way that enabled us to distinguish areas of co-creation from areas of competition. This, in turn, helped us define the new business model.

For example, the recycling and reuse of tires already involves collaboration with other companies. We cannot roll out such an undertaking on a global basis with the power of the Sumitomo Rubber Group alone. Accordingly, these are considered areas of co-creation.

On the other hand, the development of data connections will be an area of competition. Fortunately, no other tire manufacturer is in possession of a technology like our SENSING CORE. However, if this technology becomes widespread in society, our endeavors in this area will naturally shift toward co-creation.

If this happens, we will then be called upon to tackle the issue of what services we can deliver through the utilization of data gleaned via SENSING CORE and how to create value that has never been before via connections with business fields that had never before been in the Sumitomo Rubber Group's radar.

Mizuno We expect that, once realized, TOWANOWA will enable us to significantly increase the speed of our development efforts to better accommodate customer needs.

Currently, we are striving to survey the market to verify the severity of damage incurred by the rubber of a tire in the course of regular use, to this end recovering tires used in various conditions and collecting samples from them to assess and analyze resulting changes in the rubber's physical properties. Although these tasks are extremely time-consuming, we leverage collected data to provide feedback that informs our development activities via the use of simulations and other analytic methods.

However, if the above data could be automatically collected and utilized to generate feedback on driving conditions, development departments would greatly benefit from the fresh data input and be empowered to achieve their development targets in significantly shorter periods of time.

Matsui We anticipate that our approach to joint technological development involving automakers will evolve going forward along with the updating of our approach to in-house development. Traditionally, we have engaged with automakers' chassis development divisions and jointly developed tires with them. In contrast, development projects associated with SENSING CORE will position us to engage with vehicle and business planning divisions and others tasked with upstream design processes. In short, joint projects of this kind will enable us to take part in the creation of new vehicles and new businesses from the early stages of concept building, instead of limiting our role to merely a producer of a

component for a single vehicle type. We are therefore confident about SENSING CORE Technology's potential to lend us a profound strength in the context of how to navigate our Tire Business into the future.

To secure our abilities to fulfill our expanded roles in these development endeavors, we intend to nurture teams of technicians equipped with expertise in DX and other leading-edge fields and capable of providing automakers with proposals related to the utilization of the Sumitomo Rubber Group's technological solutions. These teams will be developed at our bases around the globe.

As part of specific initiatives to this end, we have launched a new Technical Response Task Force while establishing the Advanced Technology Development Department. Aiming to commercialize the SMART TYRE CONCEPT, the latter will act as a business unit independent from other departments and specialize in promoting advanced development projects with an eye to achieving tangible results by 2030. To this end, engineers from business units charged with creating truck, bus and light truck tires as well as passenger car tires will join the ranks of development staff.

Muraoka Today, development divisions are being called upon to meet radically evolving needs at an ever-faster pace. Because of this, we need to undertake the drastic reform of conventional development processes. Ultimately, it is desirable to have an overarching framework that connects various processes ranging from the planning to manufacturing stages through a database or ensures data coordination among such stages.

Furthermore, automakers do not request the preparation and verification of prototype tires at every stage. They put our tires on their vehicle models to verify if they fit. If our tires are good, they will tell us to deliver the same tires a week later. This means that we must be ready to launch mass-production only a week after proposal and verification. As such, we are called upon to develop tires at an extremely swift pace. Accordingly, we need to allocate more resources, including human resources, via the use of a forward-looking approach that takes the required pace of development into account.

We have identified SENSING CORE, Active Tread, Performance Sustaining Technology, Airless Tires and Tire Life Cycle Assessment (LCA) as five key elements of the SMART TYRE CONCEPT—our technological development concept announced in 2017. All of these are technologies unmatched by any other company, and four of the above five are at the commercialization stage.

We will place particular focus on developing SENSING CORE into an even larger business. On the other hand, we have always known that the SMART TYRE CONCEPT would one day cease to be a pioneering concept. It is time to consider developing the next technological concept.

Recently, we shifted many of our employees at technological research divisions to forward-looking development projects. Although the remaining members tasked with the development of existing products are facing extremely harsh conditions due to this transfer, we intend to promote DX and enhance operational efficiency with the aim of better motivating the entire workforce through a shift to a more creative mode of manufacturing.

To that end, we need to create an exciting work environment for engineers. We will therefore strive to provide a place for young engineers to acquire robust technological insights at the early stages of their careers and help them discover a sense of excitement in taking on the challenge of manufacturing that leverages diverse ideas. We expect our engineers to achieve personal growth through these pursuits.

Mizuno Under my supervision, the Material Research & Development HQ is doing its best to promote operational streamlining.

Previously, our recipes for rubber compositions had been prepared at experimental facilities through trial-basis compositing and kneading while confirming the various aspects of the resulting rubber's physical properties. It had thus taken several weeks to complete each recipe. Several years ago, however, we introduced software capable of immediately calculating predicted values of physical properties once the data on the proposed rubber composition was entered into a personal computer. This software relieved us from kneading every composition, enabling us to reduce the associated workload at experimental facilities by approximately 30%. Currently, we are striving to further improve this software. In these and other ways, we are working to thoroughly streamline our operations so that greater resources can be allocated to teams tasked with forward-looking development.

Futuristic Tires That Optimize Their Performance Based on Road Conditions and Temperature

Mizuno We are assiduously developing Active Tread as part of the SMART TYRE CONCEPT. In anticipation of the popularization of autonomous vehicles, we believe that for us to ensure driving safety, it will be essential to ensure identical tire performance irrespective of external conditions. In this regard, Active Tread is currently drawing immense attention. We are confident that Active Tread, along with Performance Sustaining Technology, will be an optimal and essential tire technology supporting autonomous driving and car sharing.

Rubber's physical properties change in response to changes in the external environment, including air temperature and road conditions. Based on the composition of a tire's rubber, Active Tread proactively adapts these physical properties to support driving safety.

For example, when the vehicle transitions from a dry to a wet road, Active Tread reacts to the presence of the water and adapts the physical properties of the tires' rubber to exert greater wet grip performance. In this way, Active Tread ensures identical grip performance on both dry and wet roads. In this way, we are endeavoring to realize futuristic tires that boast an unprecedented feature.

Matsui It will also be possible to create all-season tires that provide greater grip performance in low-temperature settings, such as when driving on snow or ice, via the use of Active Tread.

In low-temperature environments, the energy efficiency of EVs decreases due to deterioration in battery performance, while tires' rolling resistance increases. However, if we can control the stiffness of rubber at lower temperatures via the use of Active Tread, we will be able to create EV tires capable of curbing deterioration in energy efficiency in low-temperature environments.

Mizuno We plan to disclose concept tires equipped with technologies to ensure identical performance on both wet and dry roads in 2023, and to release these tires on the market from 2027 onward. Moreover, in 2024, we aim to release tires employing similar technological concepts to achieve improved performance for driving on ice in extreme low-temperature conditions. These tires will be the first successor series of the "ALL SEASON MAXX AS1." In 2027, all-season tires could be standard for EVs.

Muraoka Active Tread will bring direct benefits to drivers. We are aiming for the ultimate form of tires that drivers can use with confidence driving the way they would on a dry road even when it's raining or snowing. Although this may result in lower sales of winter tires, we believe that the provision of tires of that kind is a matter of greater significance, both to the Sumitomo Rubber Group and society, considering our long-held conviction that we should efficiently use the Earth's limited resources and, therefore, our tires should be used over the long term.

Transitioning from Dependence on Human Techniques to AI-Based Development Blazes a Pathway toward a New Future of Joy and Well-Being for All

Muraoka In the course of developing motorcycle tires, test riders try out the prototype tires and provide comments on driving comfort, response, stiffness and other factors, a process also known as sensory assessments. Design engineers then improve prototypes in response to these comments. However, such comments often include highly individual vague, often onomatopoeic, expressions describing the sensations of stiffness, softness or other tire properties. Engineers trying to identify areas requiring improvement and then update tire designs based on their interpretations, had to rely on their accumulated experience, know-how and human intuition.

To accomplish development targets, engineers thus repeat a cycle of identifying issues based on sensory assessments, discovering the root causes of such issues, developing hypotheses, creating improvement



measures and verifying them in actual driving tests. The more engineers gain experience, the fewer rounds of this cycle they need to undergo to finish projects. In sum, the development of tires has long been dependent on human perception.

Today, we are facing the pressing need to pass down the techniques, experience and know-how of seasoned design engineers to the next generation. AI now plays an essential role in providing functions previously fulfilled only by veteran engineers with years of experience in interpreting results of sensory assessments.

In general, it is thought that machine learning and the ability to analyze enormous amounts of data enables an AI to generate correct answers. However, if a technological theory is absent, we cannot tell whether AI chose a specific answer based on correct reasoning or it did so by chance. Accordingly, we have striven to visualize a veteran design engineers' thinking process.

We have categorized and organized the items used in sensory assessments as well as the improvement measures created based on such assessments. Through these and other efforts, we have endeavored to improve the AI's learning data. As a result, our AI has become able to link sensory assessment results with design parameters. This is, we believe, a remarkable technological advancement.

To become able to interpret the comments provided via sensory assessments, engineers had to undergo on-the-job (OJT) training furnished by veterans capable of passing down necessary techniques. It usually takes five to 10 years to nurture professionals in this area. Although we do believe that our conventional ways of passing down techniques from veterans to younger engineers are worthy of preservation, we also consider enabling the latter to acquire these techniques at even earlier stages an integral part of our mission.

As part of the above-mentioned steps for visualizing the thinking processes of veteran design engineers, we have also developed mechanisms for predicting their choice of solutions from among multiple options for addressing the root causes of issues discovered in prototype tires and what improvements to make so that young engineers can learn from studying the paths taken by their predecessors and quickly realize their shortfalls or failures. This has made it possible to equip young design engineers with proficiency at earlier stages of their careers, achieve higher development efficiency and concentrate on more sophisticated technological development.

The utilization of data regarding the results of sensory assessments undertaken by actual humans is not only instrumental to tire development but also beneficial to other business operations conducted by our group. In particular, the analysis and utilization of data regarding people's widely differing modes of behavior and sensory responses could be of great help in our Sports business and nursing care services.

Acquiring technologies like those described above will help us secure a profound strength going forward while empowering us to create "a future of joy and well-being for all" in line with our group's Purpose. Therefore, let all of us pull together to do our best in these development endeavors.

