Feature 2

TOYOBO's Way of Manufacturing

The Tsuruga Research and Production Center—the source of diverse products and solutions, and TOYOBO's largest R&D/manufacturing base

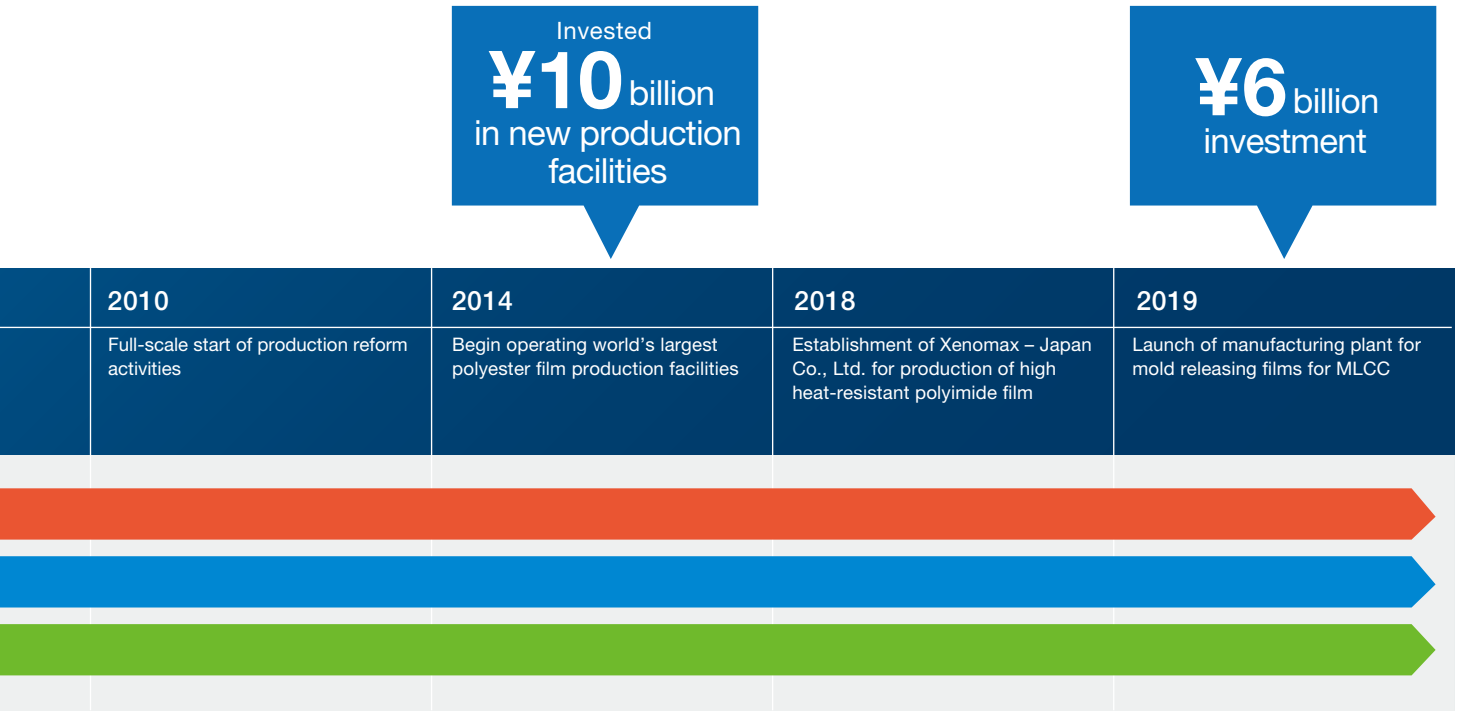
History of the Tsuruga Research and Production Center

1934	1964	1978	1984
Toyo Boseki: Start of operations at the Tsuruga Plant Start of rayon production (The current Tsuruga Plant No. 1)	Kureha Boseki: Start of Tsuruga Nylon Plant operations (The current Tsuruga Research and Production Center) *1966: Merger of Toyo Boseki and Kureha Boseki	Establishment of Tsuruga Enzymes Plant (The current Tsuruga Biochemicals Plant)	Start of Nippon Magphane Tsuruga Plant operations (The current Tsuruga Films Plant)

Bioproducts

Films

Textiles and polymers



Grown to become TOYOBO's core plant, almost 90 years after establishment

The Tsuruga Research and Production Center started life in 1934 with the production of rayon. Since then, it has widened its sphere of operation over many years to include films, biochemicals and high-performance products, meeting the needs of the times. We have developed systems that enable the Tsuruga plant to handle processes from R&D right through to production, and it plays a fundamental role in "TOYOBO's way of manufacturing."

In recent years, we have continued to implement process control standardization using ICT/IoT, while investing aggressively to bolster the plant's production capacity.

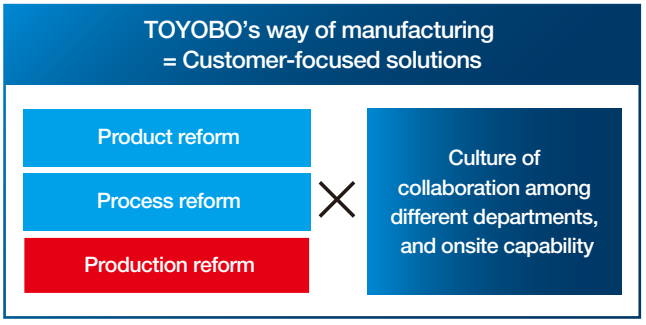
Production reform activities in support of manufacturing

In our production reform activities, we seek to resolve issues by boosting the onsite capability throughout the plant, based on an understanding of the "customer's perspective" and "what is needed the most," which are the most valued aspects of "TOYOBO's way of manufacturing." We have carried out production reform activities at the Tsuruga Research and Production Center continuously for 10 years, and have created a culture in which knowledge is shared across departmental boundaries.

Customer needs are always subject to change. It could be product quality, information and solutions, resilience towards natural disasters and other emergency situations in recent years, onsite capability to respond to customer feedback, and the actual reliability of our onsite operations. Supplying outstanding products that give our customers joy, providing customers with accurate information, and building systems using ICT/IoT, are also key topics in our activities.

In addition, whenever a department is the first to identify or uncover new information, this is shared with the other departments. An important characteristic of the Tsuruga Research and Production Center is the way in which various issues are tackled in an integrated manner—cross functionally—to produce synergies.

Approach to TOYOBO's Way of Manufacturing



Feature 2

TOYOBO's Way of Manufacturing

Process control by artisans, utilizing ICT/IoT

Production reform activities at the Tsuruga Research and Production Center commenced in fiscal 2011. Since then, we have been standardizing our process control to provide safe and stable onsite working conditions. This has been achieved by tackling issues such as complaint handling, cost competitiveness, and technology & skill transfer, all of which are common among many departments.

After 10 years of constant efforts, we have managed to reduce more than 90% of the problems throughout the plant. This has been achieved by identifying potential problems during daily adjustments to manufacturing processes and voluntary maintenance work, and then making the appropriate improvements. The vast implicit knowledge of the organization, particularly of our most experienced workers, has been useful. Identifying and standardizing their knowledge becomes a major strength. This means that in relation to the elements of process control—monitoring, judgment, and action—the knowledge and expertise gained from past experience can be put into practice by anyone, whether a new employee or an experienced professional. In this sense, our employees become master artisans conducting process control.

Monitoring Identifying changes

The knowledge and experience of artisans

Our artisans can draw on their experience to quickly and flawlessly identify changes in equipment or processes that may result in product abnormalities.
They can do this because the points and standards they need to check are clearly identified.

Workflow for realizing artisans' process control

Visualizing the artisan's standards	Strengthening the monitoring structure	Support provided by ICT/IoT
● **Clarifying points and standards** The following items are surveyed in detail: What do I see, hear and feel? How is it different from the normal state?	● **Ensuring time for monitoring** We reduce the time spent on searching and wandering around by reviewing work processes and the placement of people as well as objects.	● **Deploying and developing monitoring tools** Various tools and systems are used for monitoring: position sensors and image analysis are used for visual monitoring, while vibration sensors are used for auditory and touch-based monitoring
● **Documenting and mechanizing points and standards** These are reflected in standardization manuals and alarms, onsite notices, etc.	● **Strengthening patrol inspections** Security and disaster prevention as well as other items are reviewed and adjusted to the artisan level	● **Developing analysis systems** Indications of changes are detected, and workers are notified

Judgment Action Quickly and securely restoring normal operation

The knowledge and experience of artisans

Our artisans can quickly and securely restore changes in equipment or processes back to normal operation.
They can do this because they have the logic (in thought and procedures) along with the skills to identify the cause and take action quickly and properly.

Workflow for realizing artisans' process control

Visualizing the artisan's logic	Enhancing knowledge and skills	Support provided by ICT/IoT
● **Clarifying logic** We organize the thought and procedures for identifying causes, and the types of action appropriate to each cause	● **Extending training and drills** We create systems that facilitate efficient learning of the knowledge, technology and skills required for an understanding of logic and an approach akin to that of an artisan	● **Developing support systems** We promptly provide documents detailing the information, logic and methods required from cause identification to action
● **Documenting logic** Standards and Procedure manuals that describe solutions and techniques are created to enable prompt and accurate action		

Security and disaster prevention initiatives

In September 2018, a major fire occurred at the Tsuruga Research and Production Center. In order to learn from this event, we gathered the direct feedback of those who experienced the fire, collated the problems raised and shared these within the plant. Based on this, we carried out a review of the plant's systems where we conducted inspections and made improvements at each onsite location, installed new equipment for the entire plant, and improved the firefighting system as well as activities.

The system adopted in our production reform activities has been useful here. Meetings were held to make decisions for the Group, but before that, sectional meetings thoroughly discussed the following topics: 3S (Sort, Sweep, and Standardize), problem mitigation, training, quality and smart operations.

Our customers as well as the people from the surrounding area suffered significant damage, and we caused great inconvenience to them. To ensure that such a fire never occurs again, the memories and experiences we have collated will be passed down through our production reform activities.

Moreover, we have incorporated the lessons of the Tsuruga plant fire in our company-wide disaster prevention guidelines and our investments in disaster prevention equipment.

Key results

Spunbond nonwoven fabric production

Raw material losses
35% reduction

Product defects
75% reduction

BREATHAIR® production

Raw material losses
40% reduction

Product defects
70% reduction

*Initiatives from FY2011 to FY2019