

5 Future Vision

Building Next-generation production systems

As showcased so far, the fundamental approach to manufacturing at Daicel comprises infrastructure improvement, standardization, and systematization steps.

AI has been applied at the systematization step in operational management at chemical plants, leading to creation of the Autonomous Production System built with the PCM (Plant Capability Maximizer) and APS (Advanced Prediction System).

As the next step, the introduction of this approach to production management is in progress.

When formulating production plans for chemical plants, the current situation is that unlike manufacturing many aspects still rely heavily on the know-how of seasoned operators, and a vast number of constraints must be considered. By establishing the information infrastructure needed to assess constraints and distilling the judgment criteria in the minds of seasoned operators into explicit knowledge, a mechanism is being built that is capable of automatically formulating optimal production plans according to market conditions and company circumstances.

Furthermore, this approach can be applied to equipment management at chemical plants.

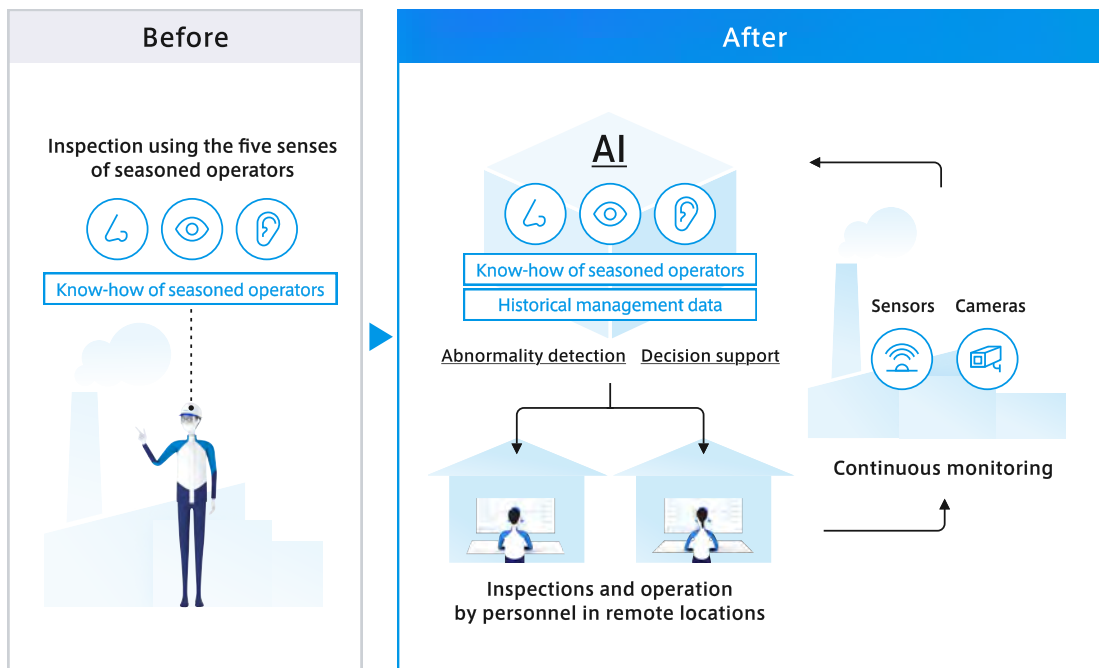
A key challenge lies in how to standardize and systematize processes

that previously relied on the human senses. In equipment management at chemical plants, there are in fact many cases where people monitor conditions and detect abnormalities through the five senses, such as sight, smell, or touch. To address this, decision-support mechanisms are being considered that utilize sensing technologies as alternatives to the five senses, starting with cameras. The resulting data is analyzed to pinpoint the causes of abnormalities and propose appropriate countermeasures.

Currently, we are working to build a mechanism in which AI-operated robots autonomously acquire and analyze inspection data based on the five human senses for daily inspections and maintenance of manufacturing equipment performed by people. This initiative aims to improve the speed and precision of five-sense inspections while accumulating data that captures human expertise. Furthermore, it will confirm whether appropriate inspections and management can be performed remotely without the need for personnel to visit the production floor, thereby ensuring worker safety.

Robots allow inspections to be performed remotely regardless of distance or weather, enabling continuous point management to constantly monitor areas that previously could only be visually inspected once a day by people walking the floor. In addition, with AI assistance, the System makes it possible for everyone to excel, regardless of their level of experience or physical strength. An aim of this technology is to contribute to promoting the employment of people with disabilities and elderly individuals with seasoned skills. This is one of the specific initiatives for realizing the happiness of our employees (Sustainable People) in the Daicel Sustainable Management Policy.

Five-sense inspection



Introduction of the Autonomous Production System approach not only to operational management at chemical plants but also to production management and equipment management will enable manufacturing to evolve further.

At Daicel, we will expand the Autonomous Production System beyond the boundaries of our own product chains.

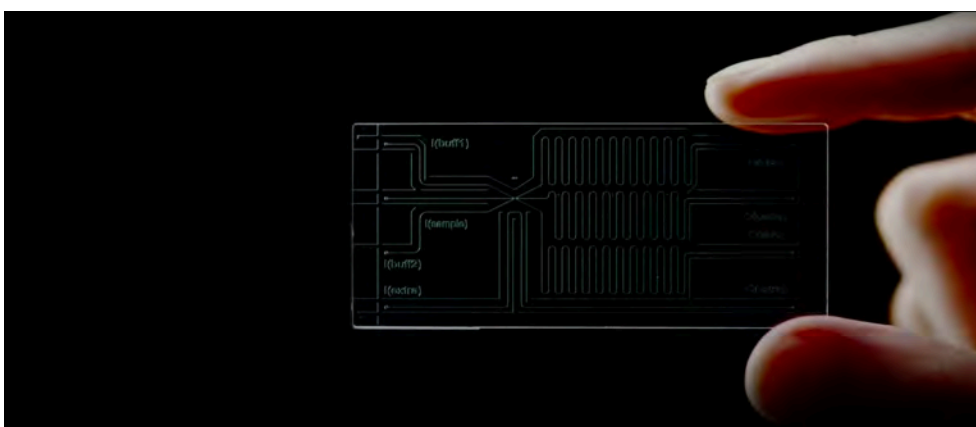
The Autonomous Production System will continue to evolve into the next generation of production systems as a means of transforming manufacturing by reading market and customer needs and translating them into a form that can be implemented on the production floor.

Micro Plants that achieve ultra-efficient manufacturing

by reducing massive chemical plants to
desktop scale

Daicel is also pursuing technological innovation for chemical plants themselves.

One such innovation is Micro Plants, a microfluidic device technology that realizes massive chemical plants at desktop scale.



1 Ultra-miniaturization of production equipment

A single unit is constructed by connecting together business-card-sized glass plates. Any chemical product can be handled by combining different glass plate flow path designs, and production can be scaled up by adding parallel units. Furthermore, when industrializing laboratory results, reproducibility can be achieved simply by increasing the number of glass plates, which accelerates the transition to commercial-scale startup.

2 Ultra-low energy

In ultrafine flow paths, it is possible to generate targeted reactions with pinpoint precision and speed, with uniform temperature and pressure. Since wasteful reactions are less likely to occur, product purity is high, eliminating the need for downstream processes to separate undesirable components. When implemented in a resist polymer manufacturing plant, it is expected that both energy consumption and CO₂ emissions can be reduced by more than 90%.

3 Flexibility of production facilities

Because it is possible to construct ultra-small, ultra-low-energy, low-cost equipment, the Micro Plant drastically increases the flexibility of production facilities. By locating production facilities near raw material sources, local production for local consumption becomes easier, and the cost and energy required for transportation can be reduced significantly.

**We will continue to be a company
where both people and chemical plants keep growing,
unbound by conventional assumptions.**

Standardization

This refers to establishing a set of common standards that can be used by anyone to maintain an orderly state for anything that would otherwise become diversified, complex, or disorganized. By unifying work procedures, rules, and other practices so that everyone can perform tasks in the same way, it contributes to stable quality, improved efficiency, and training of successors.

PCM

Plant Capability Maximizer. This is one of the proprietary AIs used in the Autonomous Production System. It predicts indicators for safety, quality, production volume, and costs in real time, deriving optimal operating conditions to maximize each of these indicators.

Know-how

This is a collective term for the knowledge, skills, and ingenuity gained through practical experience and on-site operations. These elements are essential for performing tasks safely and efficiently, and by organizing them into words or data, they become easier to share and pass on to others.

Chemical plants

These are plants and facilities designed to mass produce chemical products and materials by processing raw materials through various processes, including chemical reactions. Such facilities require safe and stable operations as well as optimized energy efficiency.

APS

Advanced Prediction System. This is one of the proprietary AIs used in the Autonomous Production System. During production implemented in accordance with the operating conditions planned by the PCM, deviations from the plan can occur due to equipment failures or various environmental changes. To suppress these deviations, the APS detects early signs of abnormalities and adjusts the operating conditions to ensure operation as planned.

Explicit knowledge

This is knowledge expressed in words, diagrams, or data so that it can be understood by anyone. It facilitates the sharing and passing on of tacit knowledge.

Five senses

These are the five basic ways that humans use to perceive the world: sight, hearing, touch, taste, and smell.

Continuous point management

This is a multi-traceability system for continuously monitoring and analyzing production processes, leading to the early detection of issues and improvements.

Sensing

This is the process of automatically measuring, recording, and analyzing states and changes, such as temperature and pressure, using sensors and machinery.