

Laboratory Automation in the Pharmaceutical Industry

— Transforming Drug Discovery Through Equipment, Software, and Robotics —

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Why This Technology?

As drug discovery research becomes more sophisticated and research instruments more diverse, laboratory automation is reshaping the paradigm of experimental research that have traditionally relied on researchers' tacit knowledge and manual skills. Through the integration of equipment, software, and robotics, laboratory operations are evolving from mechanization to automation and ultimately to autonomy. Automation is expected to improve efficiency and reproducibility, while enabling researchers to focus on higher-value tasks such as hypothesis generation and data analysis. Furthermore, advances in AI are driving initiatives in which the exploration, design, execution, and analysis of experimental conditions are conducted autonomously, fundamentally reshaping the nature of drug discovery itself.

Summary

- Pharmaceutical companies are rapidly expanding their adoption of laboratory automation. Driven by advances in generative and other AI technologies, the scope is evolving beyond automation toward autonomous experimentation.
- In the US and Europe, cloud labs are gaining prominence by providing remotely operated automated experiments and 24/7 experimental infrastructure. Collaboration with AI-driven drug discovery companies is accelerating the drug discovery process.
- The introduction of robotics and smart labs is also accelerating in Japan. While addressing issues related to standards, harmonization, and operations, the role of researchers is shifting toward higher value, data-driven domains.

1. What is Laboratory Automation?

Although the definition of laboratory automation varies by purpose and application, it generally refers to the integration of equipment, software, and robotics that progressively advances laboratory operations from mechanization to automation and ultimately to autonomy. For example, in the screening phase of drug discovery research at pharmaceutical companies, it is necessary to select promising candidates from among a large number of compounds. By linking multiple analytical instruments and automating experimental procedures with robotic arms, processes that previously relied on researchers' experience and technical skills can be performed more efficiently and with greater reproducibility.

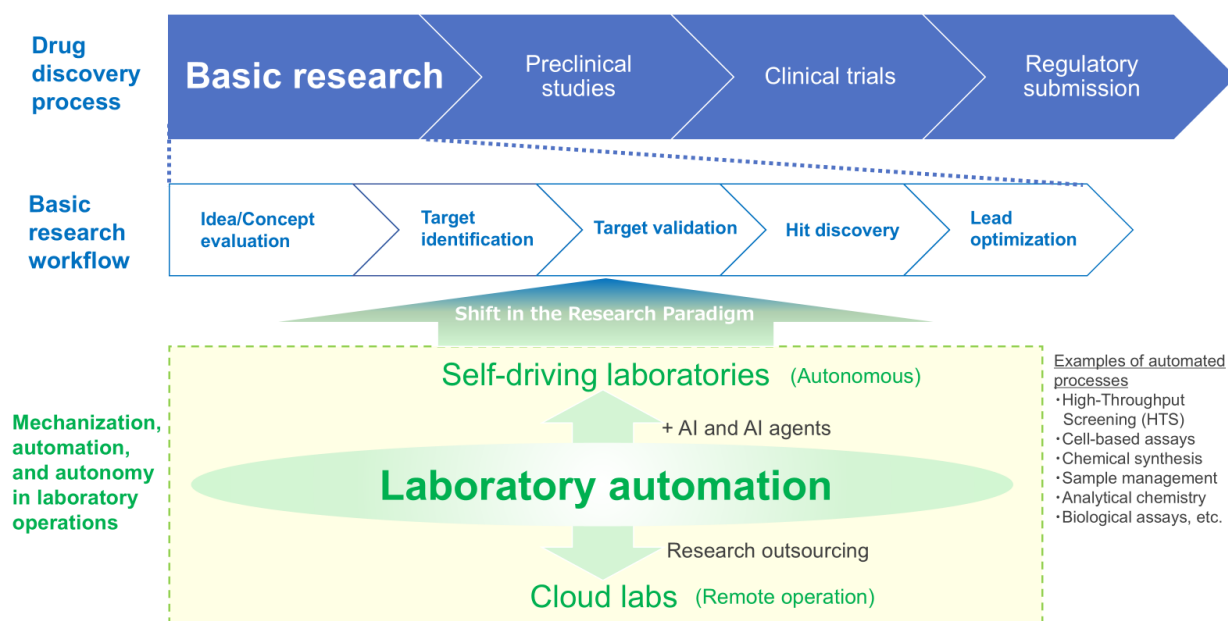
This domain also encompasses concepts such as cloud labs—laboratory systems that enable researchers to initiate and conduct experiments remotely—and self-driving laboratories, next-generation laboratories in which AI autonomously explores, designs, executes, and analyzes experimental conditions (Figure 1).

At present, the primary focus is on automating operations that have traditionally depended on human

intervention, including high-throughput screening (HTS)¹, cell-based experiments, chemical synthesis, sample management, analytical chemistry, and biological testing. The scope of automation is expanding beyond individual experimental steps to encompass the linkage of multiple processes and the integration of entire workflows, and the approaches adopted are becoming increasingly diverse.

Against this backdrop, this report reviews the latest trends and future outlook for laboratory automation, covering not only initiatives within pharmaceutical research facilities but also the use of external resources such as cloud labs.

Figure 1: The role of laboratory automation in the drug discovery process



Source: Compiled by MGSSI based on various sources

2. Key Trends

2-1. Leading international Examples

As drug discovery research becomes increasingly sophisticated, pharmaceutical companies in the US and Europe are strengthening high-throughput capabilities to conduct large numbers of experiments in parallel and are seeking to standardize processes and improve data quality. As a result, alongside the automation of experiments within research facilities, the use of external resources such as cloud labs is accelerating. In particular, the demand for research systems that allow experiments to be conducted remotely increased sharply during the COVID-19 pandemic.

Against this backdrop, Eli Lilly (US) collaborated with Strateos (US), a pioneer in laboratory automation, to establish an automated laboratory that enables experiments to be initiated and executed remotely. This initiative attracted significant attention both within and beyond the pharmaceutical industry as an advanced effort to

¹ High-throughput screening refers to the rapid identification of novel drug candidate compounds (hit compounds) by biochemically evaluating large numbers of compounds in a short period of time using highly systematized methods. Nikkei Biotechnology & Business website, January 26, 2023, article "Overview: Welcome to the Science of Screening," <https://bio.nikkeibp.co.jp/atcl/column/16/052700070/011800014/> (Last accessed December 10, 2025)

streamline and structure experimental workflows.² Subsequently, Eli Lilly sold the automated laboratory to Arctoris (UK) in September 2024 (Figure 2). The transaction is understood to have been a strategic decision made after evaluating the potential and scope of automated experimentation.

Figure 2: Arctoris automated laboratory



Source: Arctoris website, press release dated September 12, 2024, <https://www.arctoris.com/arctoris-acquires-eli-lilly-life-science-studio-laboratory/> (Last accessed December 19, 2025)

As a partnership research organization (PRO), Arctoris offers a proprietary automated drug discovery platform, "Ulysses," in which robots autonomously conduct drug discovery experiments and generate high-quality data through an end-to-end process. This acquisition expanded the company's research facilities and strengthened its capacity to process large numbers of experiments in parallel. In addition to pharmaceutical companies, Arctoris collaborates with AI-driven drug discovery firms such as Insilico Medicine (US) and 310.ai (US). Under this framework, these companies design drug candidates using supercomputers, while Arctoris automates and performs the experimental processes required for candidate production, purification, and evaluation. For example, Insilico Medicine partnered with Arctoris during the development³ of a JAK inhibitor⁴ for COVID-19 and obtained analytical data on candidate molecules within 24 hours.

Emerald Cloud Lab (ECL) is a leading cloud lab provider in the US and is used as a research outsourcing partner by major pharmaceutical companies such as Biogen (US), Bristol Myers Squibb (US), Amgen (US), and GSK (UK). ECL's laboratory facilities operate 24 hours a day, 365 days a year. Researchers can initiate experiments from anywhere in the world with a single click through the "ECL Command Center" (Figure 3). Through this model, pharmaceutical companies seeking to externalize research functions can seamlessly connect geographically dispersed researchers online and conduct research efficiently using shared experimental infrastructure. ECL operates more than 200 research instruments⁵ and focuses particularly on biotechnology and pharmaceuticals, supporting experimental needs across a broad range of fields including analytical chemistry, biology, and materials science.

² According to Arctoris's press release dated September 12, 2024, the 11,500-square-foot Lilly Life Sciences Studio operated by Strateos was conceived and designed by Eli Lilly, which invested USD 90 million as part of its plan to expand its research presence in San Diego, US. <https://www.arctoris.com/arctoris-acquires-eli-lilly-life-science-studio-laboratory/> (Last accessed January 20, 2026)

³ Arctoris website, <https://www.arctoris.com/arctoris-automated-platform-accelerates-drug-discovery/> (Last accessed January 26, 2026)

⁴ A pharmaceutical that inhibits the activity of Janus kinase (JAK), an enzyme involved in signaling pathways that trigger immune responses and inflammation.

⁵ HPLC, FPLC, GC, mass spectrometry, NMR, PCR, qPCR, ddPCR, ELISA, SPR/BLI, Western blot, flow cytometer/FACS, etc. <https://www.emeraldcloudlab.com/> (Last accessed December 2, 2025)

Figure 3: Emerald cloud lab facility



Source: Emerald Cloud Lab website
<https://www.emeraldcloudlab.com/> (Last accessed December 22, 2025)

2-2. Leading Domestic Examples

At present, no companies in Japan have fully commercialized cloud lab services for pharmaceutical companies comparable to those offered by Arctoris or ECL. However, the development of experimental automation leveraging Japan's strengths in robotics and automation technologies is advancing in both the public and private sectors. As part of its *AI for Science* initiative, the Japanese government is planning projects to significantly enhance the efficiency of research data creation and utilization through automation, autonomy, and remote operation, with a budget of approximately JPY 2.6 billion.⁶

A notable commercialization effort is Cellafa Bioscience (Japan)⁷, a joint venture established in September 2025 by Astellas Pharma (Japan) and Yaskawa Electric (Japan). The company aims to develop and provide manufacturing platforms for regenerative medicine products, including those based on iPS cells, by utilizing the general-purpose humanoid robot Maholo⁸ (Figure 4). Experiments involving living cells require not only precise manipulation but also stable operation over extended periods, and practical implementation cases remain limited both in Japan and overseas. Cell culture is particularly sensitive to environmental changes, making the assurance of reproducibility a major challenge for automation. Maholo is characterized by its ability to explore optimal conditions for cell culture and obtain target cells with high efficiency.

Chugai Pharmaceutical (Japan) is advancing laboratory automation in drug discovery research at its Chugai Life Science Park Yokohama research center through the use of robots and AI.⁹ Automated transport carts move freely within the facility, and efforts are underway to improve efficiency across the entire research process, including automation of experimental tasks using robots. Meanwhile, Daiichi Sankyo (Japan) established a Smart Research Lab in the US in January 2025 and is developing a 24-hour automated drug discovery infrastructure that integrates robots, automated equipment, and cloud platforms.¹⁰

⁶ Ministry of Education, Culture, Sports, Science and Technology, Key Points of the FY2026 Budget Request, https://www.mext.go.jp/content/20250826-ope_dev02-000044427_12.pdf (Last accessed December 2, 2025)

⁷ Yaskawa Electric press release, <https://www.yaskawa.co.jp/newsrelease/news/1424695> (Last accessed December 2, 2025)

⁸ A laboratory humanoid robot specialized for life sciences research, developed by Robotic Biology Institute (RBI), a subsidiary of Yaskawa Electric (Japan). In December 2025, the cell culture automation system utilizing Maholo received designation as an Advanced Manufacturing Technology (AMT) from the Center for Biologics Evaluation and Research (CBER) of the US Food and Drug Administration (FDA).

⁹ Chugai Pharmaceutical website, <https://note.chugai-pharm.co.jp/n/n080d564f8e32> (Last accessed December 2, 2025)

¹⁰ Daiichi Sankyo press release, https://www.daiichisankyo.co.jp/files/news/pressrelease/pdf/202501/20250121_J.pdf (Last accessed December 2, 2025)

Figure 4: Maholo humanoid robot for cell culture automation



Source: Cellafa Bioscience, press release dated October 1, 2025, <https://cellafa.com/news/20251001>(Last accessed December 22, 2025)

3. Future Prospects

While automation continues to advance, human involvement remains indispensable for tasks such as responding to equipment malfunctions and replenishing reagents. Moreover, the burden of initial investment, changes to operational processes, and the development of standards and harmonization to ensure seamless integration among multiple instruments and software systems remain important challenges.

At the same time, as laboratory automation becomes more widespread, its impact is expected to extend beyond improving the efficiency of drug discovery research. Automation enables the systematic accumulation of vast amounts of experimental data, potentially opening new research areas that were previously difficult to explore. Furthermore, the spread of cloud labs will allow diverse experiments to be conducted without the need for companies to own expensive equipment and facilities, potentially expanding access beyond large pharmaceutical companies to biotech startups.

Looking ahead, the use of AI and AI agents may enable a shift beyond automation to the next stage of autonomy—a research paradigm in which robots autonomously perform processes from experimental design to data analysis. As a result, the roles expected of researchers are likely to expand into higher-value, cross-functional domains, including data-driven hypothesis generation, experimental design, and research conducted with an awareness of connections to clinical development. At the same time, data management and the protection of confidentiality will become increasingly important. If cross-departmental data utilization is achieved, processes spanning research, development, manufacturing, and clinical stages could be organically connected through data. This could enhance the sophistication of decision-making and accelerate development timelines, ultimately driving digital transformation across pharmaceutical companies as a whole.

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