

Canon Inc.

Production efficiency and quality are improved by in-house production of jigs and tools for ultra-precision products.



No.	The Challenge	The Solution
01	The machining and assembly of ultra-precision products are difficult to automate, relying heavily on the specialized techniques and know-how of skilled employees.	Bringing the production of jigs, tools, and repair parts in-house improved production efficiency and quality.
02	Handling extremely large and high-cost components places a significant psychological and physical burden on on-site workers.	The ability to quickly implement new ideas led to more improvements, generating a return on investment that exceeded the equipment's purchase price within one year.
03	Outsourcing the production of custom jigs, tools, and repair parts resulted in high costs and long lead times.	The company reduced lead times and costs while also fostering innovation and supporting employee skill development.

Background and Issues



Canon's manufacturing processes for ultra-precision products, which are difficult to automate, presented a significant challenge. A key goal was to reduce the psychological and physical workload on their on-site workers.

“Please tell us about the challenges you faced in your business before introducing the 3D printer.”

"The parts for our exposure systems, which form circuits and wiring on wafers, demand ultra-precision at the nano-level. This means we inevitably depend on the intuition, know-how, and specialized skills of our experienced employees."

"Because of the wide variety of component shapes and the sheer number of parts, automation is limited, and many precision processes are still done by hand. Furthermore, the products themselves are massive—measuring approximately 2m×5m×3m—and use very expensive components. This placed a significant psychological and physical burden on our on-site workers."



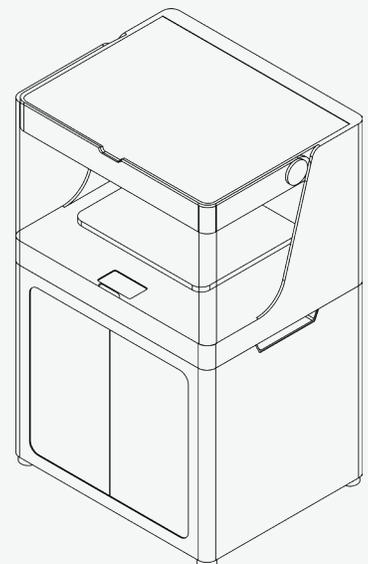
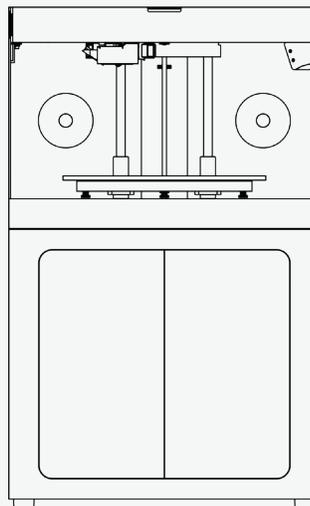
“Please tell us about the background of introducing the 3D printer.”

"Canon has been using 3D printers in some departments for years."

"Around 2020, our R&D department introduced them, and we decided to do the same to improve our on-site manufacturing processes. Our main objective was to reduce the time it took to turn ideas, like new tooling components, into reality.

Previously, even a great idea for an improvement had a long delay before it could be implemented. After finalizing the specifications and design, placing an order with an external supplier meant a lead time of over a month.

This made prototyping difficult and required meticulous, careful design from the start. So, we began by introducing an inexpensive FDM 3D printer that cost around 100,000 yen. We started by making simple items like tool cases and covers to prevent our products from being damaged if a tool was accidentally dropped on them."





Selection & Introduction

Moving Beyond the Limits of Basic 3D Printers
Accuracy, Strength, and Reliability as Decisive Factors

“What was the goal of introducing the Markforged X7, and what were the deciding factors in your selection?”

"As we gained experience with the inexpensive printer, we began to see the advantages of 3D printing and became convinced of the potential for broader applications."

"However, we were dissatisfied with the accuracy and strength of the parts we could produce. When we started looking for a higher-end 3D printer, we learned that our R&D department had already installed a Markforged X7, so we went to see it. I was amazed by the print quality and the material's strength."

The parts we handle are ultra-high precision, so the tools we use to protect them from scratches must be made of resin, not metal. The Markforged printer's ability to use Onyx, a high-strength resin, and reinforce it with carbon fiber was a perfect fit. It allows us to create resin parts with strength comparable to aluminum.

This technology was the perfect fit for our needs. Additionally, the software receives free updates, so we always have access to the latest features."

“Please tell us about the implementation process.”



"We first approached Markforged Japan to confirm the detailed specifications and see a demonstration print. I learned there was a one-month trial program and applied immediately. Since the trial period was limited, we planned ahead and decided which sample parts we wanted to create.

Specifically, we tried replacing metal tools like vises with resin versions, and we also created shafts and gears that required strength and precision—parts that our inexpensive printer couldn't handle. Through this, we verified the applications that were feasible with the X7."

“The X7 is an expensive device. How did you get the purchase approved?”

"First, we started small with the inexpensive 3D printer. We built our case by documenting its benefits, such as cost reductions and shorter procurement times. Then, we patiently explained how a high-performance 3D printer would deliver even greater results and allow us to achieve things that were previously impossible."

"While cost and time reduction are important, they aren't the only goals. I believe that setting and achieving easily quantifiable targets helped us demonstrate the tangible benefits and gain management's support. We also provided concrete examples of how it would improve quality and contribute to profits. Crucially, upper management also understood that 3D printers contribute to intangible areas like fostering innovation and developing our employees' skills."

Details and Results of Utilization

Improving Efficiency and Quality with in-house Jigs and Parts
Accelerating the Pace of Innovation and Improvement



From left in the upper row: a tool for removing a deep counterbored bolt, a jig for measuring parts, and a bolt-tightening tool.

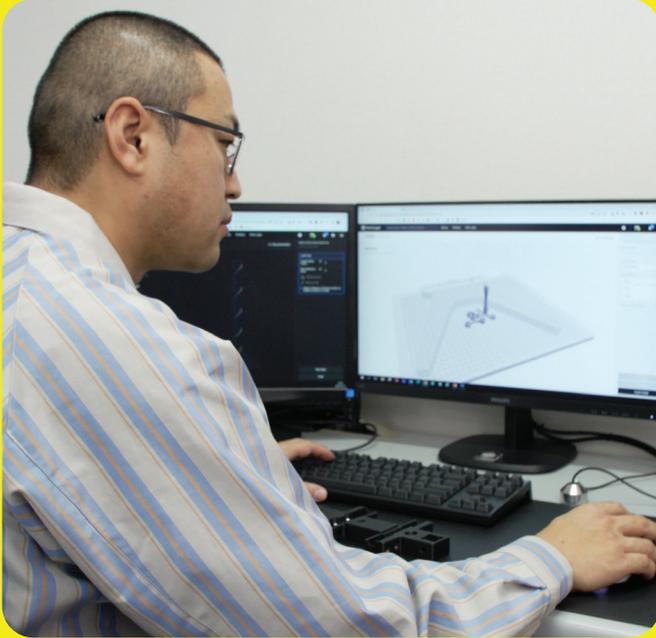
From left in the lower row: a workholding tool and a reciprocating mechanism.

“Please tell us about the specific uses and benefits of the Markforged X7.”

"If a roller, switch, or stay on a processing machine breaks, that machine is down until a replacement part arrives. Now, by measuring the broken part and printing a new one on the spot, we have significantly shortened our equipment restoration time."

"Additionally, our ultra-precision machining process for ceramics and metals requires extremely careful handling. With metal jigs, even a slight bump could crack or scratch a part. We solved this by replacing metal jigs with parts printed on the X7. For example, the tools used to measure the flatness of metal parts are now printed, making the measurement process both safe and easy. We've also replaced metal tools like hex keys with X7-printed versions, or attached protective covers to them when a replacement isn't possible, which has greatly reduced the risk of damaging our products."

"Previously, if we needed a custom jig or tool that wasn't in a catalog, we had to create a drawing, place an order, and have it machined as a one-off item. With the X7, we can design and print non-standard parts and have them in one or two days. Because we can create shapes that aren't possible with conventional machining, we can now manufacture jigs and tools we once thought were unfeasible. We have even printed gears and ball screws, allowing us to develop and build automated machines using just our production floor team, whereas previously we had to rely on our engineering department."



“How do you evaluate the software?”

"The software is intuitive, and I appreciate that it's streamlined so we don't have to adjust unnecessary settings.

Other 3D printers can be confusing with too many parameters. With Markforged, you can focus on adjusting only the critical areas for trial and error, but you still have detailed control where you need it.

I feel it's a well-designed and elegant solution from the manufacturer."

“From an administrator's point of view, what has been the effect of using the Markforged X7?”



In 2022 alone, we reduced the cost of purchased parts for our improvement projects to one-fifth of the original amount, and cut the procurement time to just one-twentieth."

"Beyond cost and time savings, the 3D printer allows us to bring ideas to life almost immediately and to iterate quickly.

The ability to refine jigs and tools through trial and error is another major advantage. This not only results in more effective tools but also leads to the professional growth of the employees who propose and design them.

Because the barrier to creating improvement tools is so much lower, we now see many more ideas coming from workers on the shop floor, and the number of implemented improvements has increased significantly.

These achievements have been highly recognized within the company, and we received the 'Chie-tech Award' at our 'Chie-tech Exhibition,' which showcases outstanding examples of karakuri (clever, low-cost automation) tools designed and built across our global divisions."