
Markforged
Creating a factory floor,
where improvement is built in.

CASE STUDY

Markforged

Yamaha Fine Technologies Co., Ltd.

YAMAHA
Make Waves

Yamaha Fine Technologies Co., Ltd. group company of Yamaha Corporation, manufactures automotive interior components based on its piano finishing technology. It is recognized as one of the leading companies among the few remaining domestic manufacturers of genuine wood interior components.

When the Markforged X7 was introduced to its manufacturing floor, they shifted to more in-house production, particularly of jigs.
Since then, the company has improved its ability to respond quickly to on-site challenges, accelerated improvement cycles, and reduced the risk of downtime. This not only enables the stable mass production of high-quality designs but also serves as a “foundation for transforming on-site improvements from temporary fixes into forward-looking challenges.”

Challenges

A Sophisticated Production System and Stringent Standards

The company's business involves proposing design concepts to various OEMs, establishing processes to turn those concepts into viable industrial products after receiving orders, and ensuring a stable supply of interior components. A unique feature of the company lies in its ability to transform wood—a natural material—into a viable industrial product. Since wood's grain and appearance vary depending on the source and conditions, the core of the company's manufacturing lies in reconciling the dimensional accuracy, visual consistency, and quality stability required of industrial products with the inherent variability ofnatural materials.



Bringing materials with inherent variations into compliance with industrial standards. Manufacturing must be carried out within tolerances measured to the decimal point.

"What we do is very much like craftsmanship, but we have to turn it into an industrial product. That's the difficult part."

Mr. Kuroki is in charge of production engineering. He handles all on-site production engineering challenges, including the introduction and modification of equipment necessary for launching production lines, the design of jigs and fixtures, and measures to stabilize dimensional quality.

"First and foremost, it's crucial to ensure the equipment never stops running."

In mass production, once equipment stops, it triggers a chain reaction—not only involving restoration but also postrestoration quality checks, setup changes, and rework by personnel. While handling wood—a material with inherent variability— the company must not only produce finished products with consistent design quality but also do so in mass production without interruption. This is a production environment where both quality and quantity are demanded simultaneously within extremely strict tolerance ranges.



Mr. Kuroki, in his role as Production Engineer

Challenges Before Implementation

"On the shop floor, every time jigs or auxiliary tools were needed, it generated man-hours and delays both inside a outside the company. It became a workflow—involving design, machining requests, procurement, and waiting for delivery—that we couldn't complete on our own. As a result, the time it took to implement improvements was a major challenge. Even when unexpected downtime occurred, we sometimes couldn't immediately secure replacement parts, causing delays in resuming operations."

Machining requires setup, as well as the preparation and selection of tools and materials, which demands experience and know-how.

Consequently, there are limits to how effectively we can implement the PDCA cycle—testing improvements immediately while avoiding a system that relies too heavily on individual expertise.

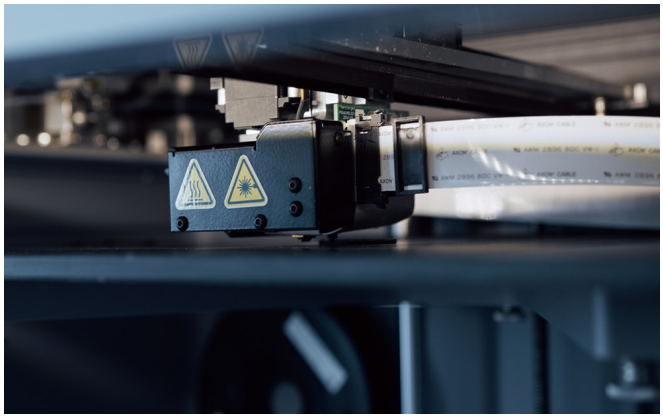
"Even when improvement proposals were made, the long lead time before they could be implemented caused enthusiasm for the improvements to wane. I believe this was not merely a matter of time, but also led to a loss of learning opportunities for the organization as a whole."

Furthermore, to dispel the preconception that 3D printers are only for prototyping, we needed to establish practical proof of concept, including quality assurance and operational design.

Solution

How We Met and Reasons for Selection

The company first encountered Markforged at a trade show around 2019.
"Of course, the fact that the quality was high enough to use jigs in actual production equipment—rather than just for prototyping—was a key factor. But another reason we considered them was that, among generally available products, Markforged was the only manufacturer that offered long-fiber carbon filament," explains Mr. Kuroki.
"The size of the build area and the ease of operation provided by Markforged's proprietary slicer software were also attractive features. "We did consider cheaper, smaller models, but their build sizes were insufficient for jig applications. So, we explained the necessity of the X7 internally and proceeded with its implementation. However, we weren't able to fully utilize it in mass production right away. Rather than using it for jigs immediately, we first made various test pieces and spent about six months repeatedly verifying what could be achieved and how to use the system effectively."

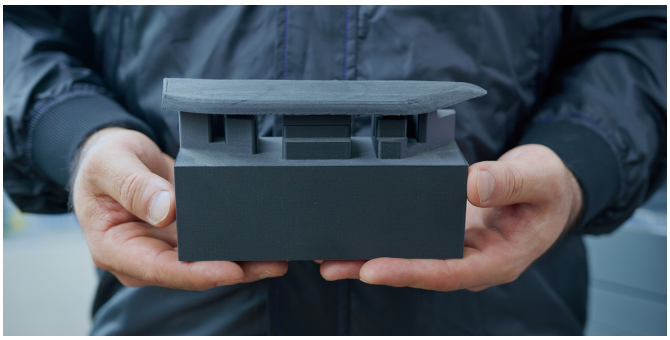


With the X7, the shop floor achieved shorter lead times, lower replacement costs, and faster improvement cycles.

They didn't produce everything on the X7; instead, they optimized its use by accumulating in-house know-how through experiments with monolithic printing, print orientation, reinforcement, and design methods. By establishing design rules for print orientation, wall thickness, and reinforcement, and by combining post-processing, inserts, and metal backing materials as needed, they have mastered the use of the X7.

"We were able to go through this process of trial and error because we could move quickly from identifying the need for improvement to actually testing it."

Since its introduction, the lead time for jig production—which previously took several days to several weeks when outsourced—has been reduced to a level where same-day turnaround is possible in the shortest cases.
This has improved recovery speed during unexpected issues and established a system that minimizes the impact on production lines. The true value of Markforged lies not merely in the ability to produce parts quickly. It lies in the fact that anyone on the shop floor can consistently produce "usable-quality parts" in a short amount of time.
The fundamental value of this implementation was transforming improvement activities—which tend to rely on individual expertise—into a system that can be sustained by the organization as a whole.



To support mass production operations with limited human resources, a hardware partner is essential.

"Currently, the X7 operates for about 2,000 hours a year. While only three or four people can operate it at this time, we plan to increase that number in the future."

The parts actually being produced include positioning jigs, guides, temporary fixtures, inspection aids, protective covers, and wiring/piping guides—components that provide immediate benefits on the shop floor.

"We started with relatively low-risk areas and prioritized applications where the benefits were easy to see and could be scaled horizontally. That way, people within the company could quickly understand the value of the investment."

Anyone can use it and benefit from it.

In addition, the ease of use of the slicer software was a major factor in terms of operation. Markforged's software comes with pre-optimized printing conditions and is designed to produce stable prints without the need for parameter adjustments. Mr. Kuroki notes,

"The fact that you can use it without having to think too much is a major advantage."

He explains that while excessive flexibility in settings can lead to inconsistent conditions depending on the user and result in varying quality, Markforged's system allows anyone to produce parts of consistent quality, making it well-suited for on-site operations.
For the shop floor, the benefits extended beyond mere cost reduction. For example, there was a case where a jig that previously weighed 22 kg was reduced to about 12 kg.

"Lightening the weight of jigs is one of our key goals. Reducing the burden of handling heavy objects directly improves workability and safety. Some metal jigs weigh over 40 kg, so we definitely want to make them lighter."



Intuitive operation makes anyone an operator.

KPI Summary – Impact of Markforged X7 Adoption

KPI	Before	After	Improvement
Jig & Fixture Lead Time	Approx. 7 days	1 day	85% reduction
Jig & Fixture Cost	100%	Approx. 25%	75% reduction
Improvement Cycle	Weekly basis	Daily / Next-day Ver.2	Accelerated PDCA cycle
Emergency Response	Waiting for outsourced parts	Immediate printing of replacement parts	Improved recovery responsiveness
Application Scope	Prototyping / Low-risk fixtures	Components used in 24/7 production lines	Expanded into real production applications

Future

Regarding future developments, the company plans to shift its focus from “making things quickly” to “reproducible operations.” Specifically, the goal is to establish design standards, material selection criteria, and evaluation methods for each jig category, creating a framework that can be applied across the board.

Additionally, for parts with low annual production volumes— such as optional components—the company is considering using resin printing instead of the traditional method of creating expensive molds.

“In the coming era, I believe there are alternatives to spending millions of yen just to make molds. In such cases, it would be ideal if we could partially replace them with 3D printing,” he says.

Regarding the vision for the future beyond that, he states,
“We want to enable people on the shop floor to create the exact shapes they envision and bring them back to the shop floor for improvement.”

The aim is not to have the production engineering department bear the sole responsibility for improvement, but to make it easier for front-line workers themselves to give shape to their improvement ideas. At the same time, he notes that this does not mean leaving things unchecked; the production engineering side must provide support while monitoring risks related to quality and variability.

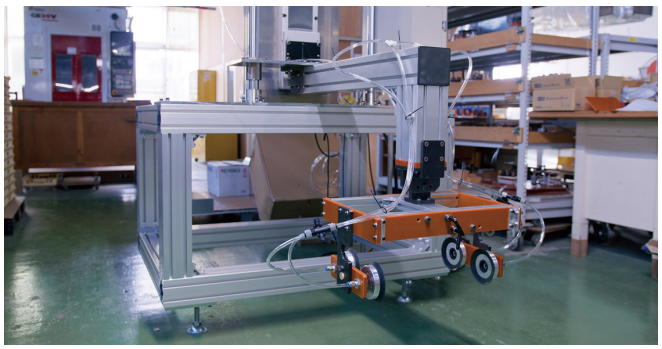
“Anyone can make something, right? But taking it to the design level —where combining parts increases rigidity or strength—is not something everyone can do. That’s why I hope to see more people who can lead on-site improvements.
It’s difficult to suddenly come up with ideas based on experience— like knowledge of mechanical structures, or how to divide and stack components. In that sense, I believe that as people with a certain level of knowledge and experience emerge, we’ll be able to expand these improvements across the board.”

The introduction of this system has also brought about a shift in the design philosophy for jigs. Previously, the design was based on the premise that the jigs “must not break” during the manufacturing period, in order to minimize the risk of sudden downtime. However, in response to machine malfunctions and improvement suggestions arising on the shop floor, the company now has a system in place to release updates on the same day.

“We’ve shifted from designing with the assumption that it won’t break to a mindset where parts that are prone to wear are designed to be easily replaceable from the start.”

From “not to break” to “easy to improve.”
The X7 changed fixture design.

Furthermore, the company has begun exploring changes to the very shape of the jigs themselves—something that hadn’t been significantly revised for nearly 25 years. They are currently verifying the feasibility of these jigs for production use by leveraging the design freedom unique to AM.



A new device enabled by the fixture.

“As lead times for automotive development as a whole grow shorter, the supply chain is required to quickly adapt to design and process changes. To address such unexpected external changes, maintaining a state where jigs and auxiliary tools can be quickly remade even during normal operations has become a critical factor in supporting quality, delivery times, and the stability of mass production.”

Finally, we asked Mr. Kuroki about what drives him.

“I want to create a situation where people can focus their energy on the decisions and quality that truly matter, resulting in stable quality and opportunities for new work. To achieve that, I am not afraid to adopt new technologies.”

The introduction of the Markforged X7 was not merely a capital investment. It was the establishment of a “manufacturing foundation” that enables the shop floor to think for itself, bring ideas to life immediately, and continuously drive improvement.
A shop floor that never stops, and improvement that never ceases. Yamaha Fine Tech’s initiative is setting a new standard for the future of manufacturing.