

# Framework Robotics and the power of 3D Printing in Unmanned Underwater Vehicles

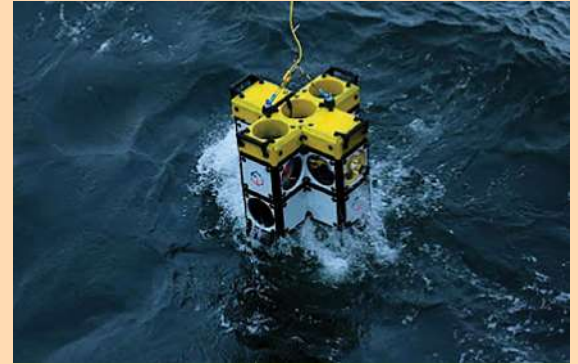
“We use a toolkit of hard-and software to build different shapes of robots for a number of underwater missions.” Explains Robert Balduhn, Technical director, founding team, Framework Robotics. The company’s versatile UUVs cater to a broad spectrum of industries, including oil and gas, defence, and renewable energy. One of their critical missions is to ensure the safe installation of infrastructures, such as wind farms, by detecting and categorizing unexploded ordnances.

Initially, Framework Robotics utilized FDM printing, a common starting point for many companies due to its lower cost. However, the limitations of FDM printing became apparent as the need for higher-grade, reliable final parts grew.



# Introduction

Started in October 2020, Framework Robotics has quickly established itself as a trailblazer in the UUV industry. With a vision to innovate and diversify underwater robotics applications, the company has embarked on a journey to transform the field with the help of cutting-edge HP MultiJet Fusion 3D printing technology, which plays a crucial role in producing the structural parts of their systems. Their solution combines both hardware and software, creating a seamless integration that sets them apart in the industry.



## Industry

Robotics/Drones

## Objective

Leverage HP Multi Jet Fusion 3D printing technology to create robust, high-quality underwater robotic components that can withstand extreme underwater pressures and environments.

## Technology solution

HP Multi Jet Fusion

## Sector

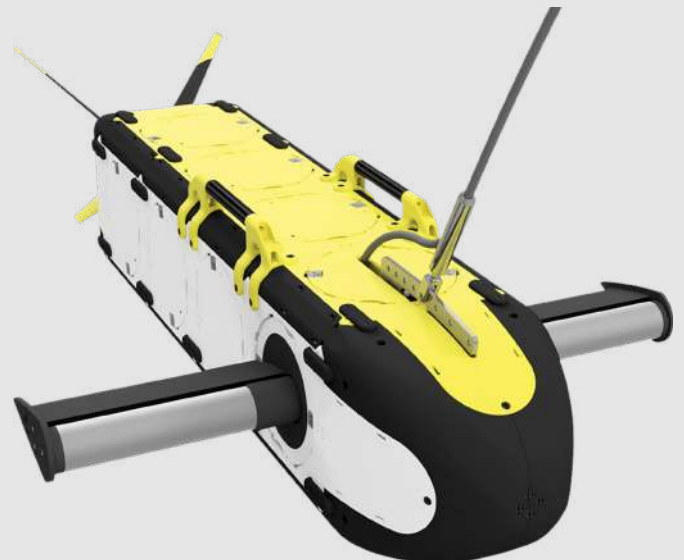
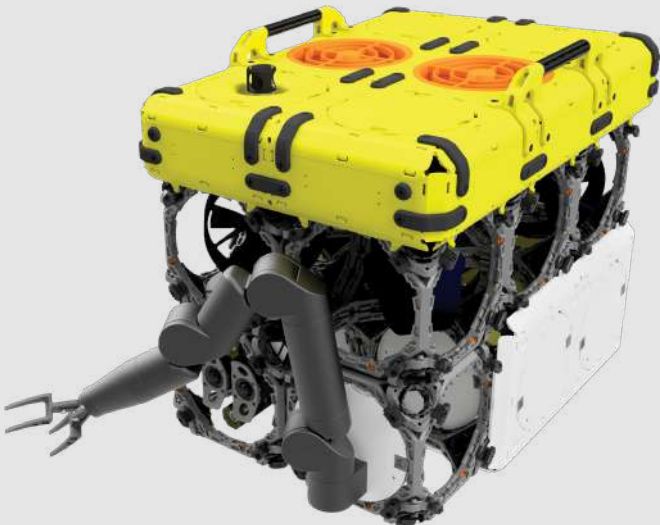
Unmanned Underwater Vehicles (UUV)

## Approach

Transition from FDM printing to in-house HP MJF 3D printing, enabling faster production, enhanced part quality, and greater mechanical integrity suitable for deep-sea operations.

## Material

HP 3D High Reusability PA 12



# Background

---

Initially, Framework Robotics utilized FDM printing. However, the limitations of FDM printing, such as Z-axis delamination, lack of water tightness, and time-consuming print orientation, hindered the production of high-grade, reliable parts.

# Problem

---

The inherent weakness in FDM prints, along with the lack of water tightness and the time-consuming orientation process for print jobs, presented significant obstacles for Framework Robotics. Moreover, the FDM parts were not durable enough for long-term use in underwater conditions, becoming brittle over time.

# Solution

---

Framework Robotics turned to HP Multi Jet Fusion 3D printing technology to produce robust, high-quality UUV components that can withstand extreme underwater pressures and environments. The decision to bring the HP MJF printer in-house was strategic, allowing for rapid prototyping and the production of parts with consistent mechanical properties.

The transition to MJF printing enabled the company to create parts that were not only structurally sound but also customizable to client specifications.

# Benefits

---

Framework Robotics experienced several benefits from integrating HP MJF 3D printing technology:

- **High-quality production:** Parts produced with MJF are "a final product, not just something R&D." This shift from prototyping to producing ready-to-use components was a significant step forward for the company.
- **Customization and flexibility:** The ability to rapidly adapt to customer needs has been transformative. "Before, the customer had to adapt to the existing robots. Now, they come with the requirements of their project, and we build a robot for them."

- **Operational resilience:** The modular design of the UUVs, facilitated by 3D printing, allows for quick part replacement. “Time is money for our customers. They don't want to stand still for a couple of minutes or hours just because one of the robots isn't working. A modular system allows them to replace and fix the robots themselves,” highlighting the robustness of their systems.
- **In-house efficiency:** By producing parts in-house, Framework Robotics can maintain tighter quality control and achieve faster turnaround times, essential for meeting the demanding timelines of their clients.
- **Local and on-demand printing:** The spare parts can be printed globally, giving the end-user flexibility and speed.

## Results

The integration of HP MJF 3D printing technology has led to a significant competitive advantage for Framework Robotics. The company has successfully created UUVs that are reliable, customizable, and efficient, operating at depths of up to 6000 meters. The 3D-printed parts have been well-received by customers, who appreciate the high quality and durability of the components.

Framework Robotics has also uncovered new business opportunities by offering its 3D printing services to other companies.

Learn more about Framework Robotics, visit: <https://fw-robotics.de/>

To discover more about HP Multi Jet Fusion 3D printing technology and how it is helping companies build strong, lightweight and durable solutions, please visit us at:

<https://www.hp.com/us-en/printers/3d-printers/products/multi-jet-technology.htm1>