

Grain Weevil

Customer Case Study



GKN Additive (Forecast 3D) Prints Parts for Life-Saving Robot

Grain Weevil Harnesses MJF Capabilities for Its Unique Geometries

Chad Johnson and his son Ben wanted to find a safer way to aerate the grain that farmers store in grain bins after harvesting. So in 2020, they began designing a robot to replace a person entering the grain with a shovel or rake. They named their robot Grain Weevil, and in 2024 GKN Additive (Forecast 3D) started printing key parts of this revolutionary Unmanned Autonomous Vehicle (UAV) using HP Multi Jet Fusion (MJF).

Grain Management Poses Risks

After harvesting, one of the early steps of treating grain is storing it in a grain bin. That stored grain requires periodic aeration to cool and maintain uniform temperatures and moisture, which reduces the chances of mold and insect development.

Farmers and their children have traditionally carried out the chore of aeration and breaking up clumps of grain by stepping into a grain bin with a rake or shovel; this is dangerous business. Some workers develop farmer's lung — a pulmonary illness caused by inhaling mold from hay, straw, or grain — which can lead to lifelong respiratory problems. Going into a grain bin also results in dozens of deaths each year due to suffocation or heart attacks. Unfortunately, about one in five accidents involve a teenage child.

Grain Weevil's Mission: No More Boots in the Grain

The Johnsons are dedicated to making grain management safer with the Grain Weevil robot, which weighs about

50 pounds, measures about 20 by 20 inches across, and moves through grain with a pair of motorized augers: spirals that bore through the media (such as corn). The augers allow the robot to move through the media and propel itself forward. A human can direct the robot using a remote control as needed. The system is able to navigate and perform its tasks autonomously using onboard sensors.

Grain Weevil's Senior Product Design Engineer Travis Vanderheyden explains how the robot assists farmers:

"We like to say that, if we had competition, it is truly a farmer with a shovel or rake," he claims. "You would send a few family members into a bin, and that would take an entire workday. Our robot can do more work than a person."

He adds, "The key point is that these robots are autonomous — without significant human intervention. They are pulled out and recharged automatically. This robot is able to do work in environments you can't work in. Because it has a remote control, you can retrieve it and don't have to go into the grain bin to get the robot."

Robot Efficiency Is Crucial

Before GKN AM (F3D) got involved, the Grain Weevil team had been testing different prototypes of the augers, first using off-the-shelf parts and then injection molding. Because of the robot's unique geometries, the tooling cost was quite high using traditional manufacturing methods. What's more, the robot was not moving quickly enough and kept getting stuck.

About Grain Weevil

Founded: 2020

Headquarters: Omaha, Nebraska (USA)

Product: Grain-bin management robot

The Grain Weevil needed to meet the following objectives:

- Enable new designs for the auger flighting to yield a longer run time.
- Decrease wear and tear on the robot.
- Reduce cost.

"The big thing that we were fighting against was lack of efficiency on a farm," Vanderheyden says. "Customers want to use these robots; aerating is heavy and hard work to do. So we wanted to enable end users — farmers and industrial facilities — to use the robot in a way that was more effective."



Grain Weevil robot augers printed with HP MJF using PA-12 material in natural gray (left) and with a black vapor polish finish (right).

“The parts we are printing with GKN AM (F3D) are performing better than we ever imagined.”

— Travis Vanderheyden, Senior Product Design Engineer
for Grain Weevil

MJF Offers Speed, Efficiency, Cost Effectiveness

Vanderheyden took what had started as a garage-built passion project and formalized the robot's design process. He'd had prior experience with additive manufacturing, so he recognized the possibilities in having GKN AM (F3D) print prototypes of the augers using MJF.

The augers represent four of the 25 unique parts of the robot and its supporting components. After preliminary testing, Vanderheyden reported the following results:

- A 30 percent increase in speed and efficiency
- A significant improvement in mobility in different granular materials

“We immediately saw improvements in efficiency and speed,” he says. “The robot got stuck less often, and the price has been well within reason for what we need.”

He continues, “The geometry of this part massively affects how this robot performs. The parts we are printing with GKN AM (F3D) are performing

better than we ever imagined. In addition, the flexibility and speed have been monumental. We've faced incredible lead times on other products, but haven't dealt with any delays or interruptions for the augers.”

Next Step: Safety Certification

The Grain Weevil project serves as just one example of how GKN AM (F3D) leverages its capabilities to print parts for unmanned ground systems. GKN AM (F3D)'s manufacturing

certifications have also helped as Grain Weevil pursues the safety certification process through Underwriters Laboratories (UL).

Because grain bins are hazardous locations, the robot must adhere to strict compliance requirements. These compliance requirements are based on the hazardous environment, which is Class II Division I, where combustible dust may be in the air. Grain dust that is suspended in the air can explode, so the Grain Weevil has to undergo thorough testing to ensure that it doesn't produce sparks or extreme heat.

“Once we achieve our certification, we will be one of the first robots in the world that are considered explosion-proof,” Vanderheyden concludes. “It will be groundbreaking if we can achieve that.”



The Grain Weevil robot uses two sets of augers — one pair on the right of the robot and one pair on the left — to move through grain.

Find out how GKN Additive (Forecast 3D) can take your product from prototype to production. Visit forecast3d.com today or contact us directly at (877) 835-6170 or hello@forecast3d.com to learn more.

Front Cover

The Grain Weevil robot assists farmers by performing the dangerous work of aerating grain in grain bins.



GRAIN WEEVIL

DOING THE WORK THAT NO HUMAN SHOULD™

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