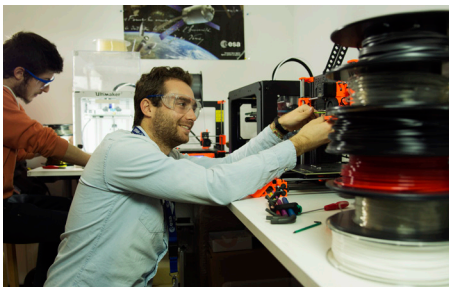
Accelerating ESA's race towards ground-breaking space discoveries

An agency that **explores new materials and technologies** for space applications, requires the freedom to experiment and innovate – without wasting resources in the process. The NEXT has brought this freedom and efficiency to ESA's research and development process.

Client
The European Space Agency (ESA)

Industry
Aerospace



"The NEXT filament maker lets us use the 'prototyping mindset' – making more iterations, but with less resources. It gives us the freedom to understand material properties much better, as compared to just buying filament off the shelf. We now have more control over the whole process, and the flexibility to use exotic materials that are interesting for research purposes."

– Stefan Siarov, Spaceship Team Member at EAC/ESA

Challenges

Acquiring small quantities of 3D printing materials for research and testing purposes. Commercial filament was standardized and could only be purchased in large quantities.

Solutions

The NEXT gave ESA complete control over design and experimentation, enabling custom filament making in-house, and also minimizingwastage.

Impacts

- Freedom to research and explore new material applications.
- Ability to extrude small quantities of filament, thus saving resources.
- Reduced dependence on third-party filament manufacturers, leading to greater control over material research and prototyping.
- Flexibility to modify and customize 3D printing materials in-house.

Meet the European Space Agency (ESA)

The European Space Agency (ESA) is Europe's gateway to space. Its mission is to shape the development of Europe's space capability, and return investment in space to the citizens of Europe and the world. Headquartered in Paris, France, ESA has establishments across Europe, 22 member states, and over 5000 employees. Since 1975, it has been implementing European space programs and supporting the European space industry.

The European Astronaut Centre (EAC), located in Cologne, Germany, houses the European astronaut corps. This operations center has three main pillars: training astronauts for their International Space Station (ISS) missions, offering astronaut medical support, and communicating with them in space.

Recently, a fourth pillar has been added: the young and innovative Spaceship EAC initiative focuses on human space exploration beyond low Earth orbit. The team currently studies the sustainable exploration of our Moon by addressing several challenges, including additive manufacturing for tools and spare parts.

ESA has been using the NEXT in its EAC facility since February 2017. By giving them the freedom to experiment with small quantities of custom filament made from innovative new materials, the extruder allows for greater flexibility and control over material research and prototyping.

The Challenge:
Overcoming the constraints of commercial 3D printing filament

The Spaceship EAC program at ESA's European Astronaut Centre in Cologne undertakes pioneering research and 1-3 TRL (technology readiness level) innovation on a day-to- day basis. It explores new and revolutionary ways to enhance the current capabilities of ESA's spaceflight programs. The facility's 3D printing capabilities contribute heavily to this exploration. Researchers at ESA prototype a variety of ideas for different projects, as well as specific applications of 3D printing in space.

ESA's international partners have identified 3D printing itself as a promising in-space manufacturing and recycling tool. Astronauts could use it for on-demand creation of fragile custom components and spare parts in outer space. This has the potential to significantly reduce the amount of material that spaceships currently need to carry to space, which in turn can amount to considerable time and cost savings.

However, despite the undeniable benefits and creative freedom that 3D printing offers, researchers at the Spaceship EAC program had a unique challenge to deal with. For their testing and prototyping work, they required very small quantities of 3D printing filament, typically made of new materials with very specific properties. Up until February 2017, Spaceship EAC would mainly use commercial filament, which they bought from 3D printing companies. This presented several hurdles.

Acquiring 3D printing filament bearing ESA's exact specifications was difficult because of the low commercial demand for these materials. This meant that ESA would need to get standard printing filament customized at an external facility – a process that relied on third-party expertise and could potentially increase lead times.

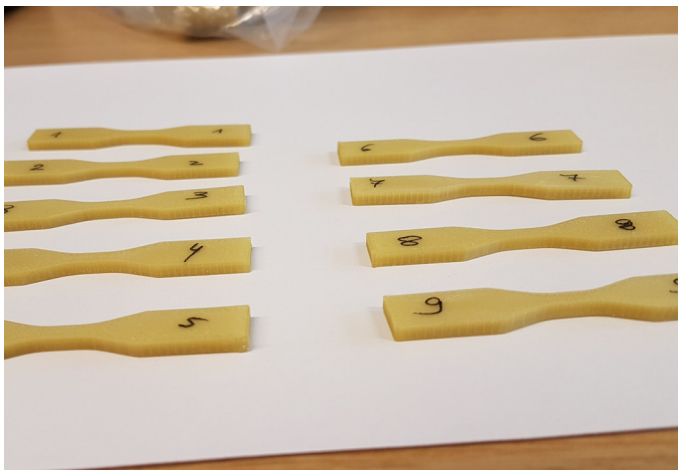
In early 2017, ESA's Spaceship EAC team was looking to 3D print with new materials that they could not find in filament form. They were also looking for high-quality, consistent filament that would yield good results. In short, ESA needed a product which would offer them more flexibility and address their specific challenges.

"The NEXT has met our expectations and the buying experience was quick and easy. It makes me happy to see that you've made even more improvements and come a long way in less than a year."

– Stefan Siarov, Spaceship Team Member at EAC/ESA

The Spaceship EAC team at ESA's European Astronaut Centre undertakes research and innovations for human space exploration beyond the low Earth orbit.

Spaceship EAC regularly uses 3D printing for product and system protoyping. Here, a 3D printed specimen is ready for analysis.



The specimen is 3D printed and tested multiple times, to arrive at ideal material composites. Developing materials with very specific properties is a key part of Spaceship EAC's research process, which is why buying 3D printing filament off the shelf is not realistic for them.

The Solution:
Efficient and customized material development, in-house

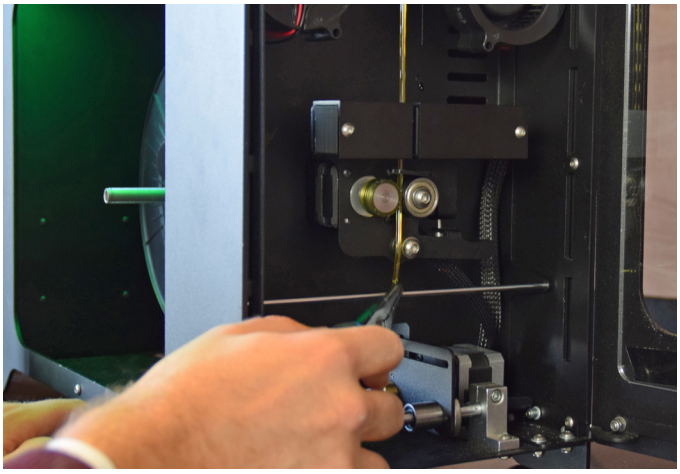
Adding the NEXT to the setup at ESA/EAC allows the development of 3D printing filament in-house. Because the desktop extruder supports experimentation with small quantities (2-5kg) of polymer, it served as the perfect solution for ESA's small-scale testing and prototyping work. It reduced the Spaceship EAC team's dependence on the expertise and availability of third-party filament suppliers, and gave them the freedom to create new filament by modifying basic materials. This equated to shorter lead times, along with greater flexibility to innovate with materials that are non-standard or scarce.

"Communication and support from 3devo has always been very good. Anyone I've spoken to from the team is kindand extremely helpful."

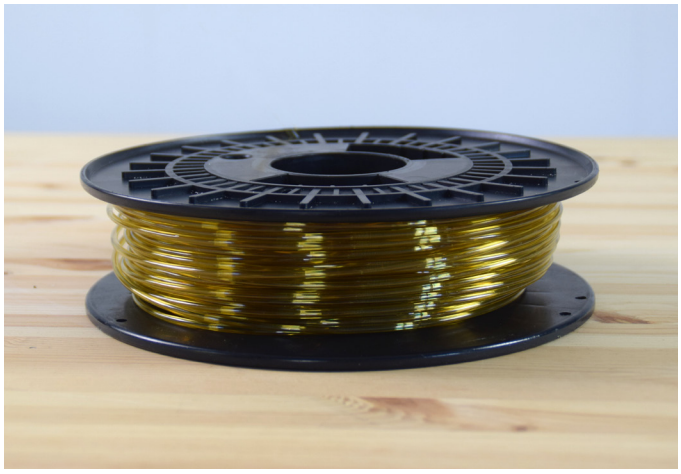
– Stefan Siarov, Spaceship Team Member at EAC/ESA

The Impact:
Intellectual freedom, greater control, and shorter lead times.

Since becoming a part of the European Astronaut Centre's lab equipment in February 2017, the NEXT has been instrumental in their prototyping processes. ESA researchers have successfully used the extruder to develop custom quantities of PLA-based filament for research and development iterations, and are conducting trials with other polymers such as engineering thermoplastics.
The NEXT has equipped ESA with the ability to produce filaments in-house. This in turn has minimized the organization's dependence on external filament manufacturers. Scientists at the Spaceship EAC program now have more intellectual freedom, and the flexibility to conduct material research and prototyping on their own terms.
ESA scientists use the NEXT to produce tailored batches of filament for specific tasks. They are able to experiment with small quantities of material at a time, creating innovative new composites for future space applications. In the process, ESA retains control over all the stages of research and prototyping, as well as the intellectual property rights to the materials and techniques developed.



The NEXT at work, extruding tailored batches of PEKK filament for ESA. To design space-ready products, ESA scientists need to experiment with small quantities of custom materials. The NEXT allows them the freedom and flexibility to do that.



A custom-made roll of PEKK filament, efficiently extruded by the NEXT. Before buying the NEXT, ESA's Spaceship EAC team sourced filament from third-party suppliers. Now, they make their own materials in-house, thus reducing lead-times and retaining control over research and prototyping.

About 3devo

3devo is a Netherlands-based tech company on a mission to empower innovators and creators with accessible, high-quality products. Its revolutionary products include the NEXT, a desktop filament maker that extrudes custom 3D print materials, and SHR3D IT, an innovative plastic processor that recycles old plastics into high quality printing granulate. Originating in 2012 as a startup founded by young engineers, 3devo has gone on to acquire an extensive customer base throughout Europe.

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