Can 3D printing really make service logistics smarter?

Why keep spare parts in stock if you can print them when they are needed? This seemingly simple question led to SINTAS. Professors Matthieu van der Heijden (University of Twente) and Rob Basten (Eindhoven University of Technology) discuss this research project, which explored when 3D printing truly adds value to service logistics.

The idea for SINTAS (Sustainability Impact of New Technology on After-sales Service Supply Chains) emerged at an unexpected moment. During a Service Logistics Forum (SLF) meeting, Van der Heijden had presented research on so-called last-time-buy decisions: how many spare parts should you purchase when a supplier stops producing them? Afterwards, one of the attendees asked a seemingly simple question: “Why not just print those parts when you need them?”



“At first I thought: of course, it’s not that simple,” Van der Heijden recalls. “But on the train home, the question stayed with me. Then I realised there might actually be an interesting research project in it.”

Consortium

Together with Professor Tiedo Tinga (University of Twente) and Professor Rob Basten, a consortium was formed involving organisations including the Dutch Ministry of Defence, Fokker Services, Thales, NLR and Additive Industries. Most of the partners were already connected through the SLF network.
“That certainly made it easier to bring everyone on board,” says Van der Heijden. “The network brought together the right people, companies and real-world challenges. The final meeting, where the knowledge gained from the project was shared with a wider audience, was organised by SLF, even though SLF was not formally a project partner.”

From technology to logistics

Although 3D printing, also known as additive manufacturing, was attracting a great deal of attention at the time, the researchers wanted to look beyond the technology itself. The key question was not whether parts could be printed, but when doing so would actually make sense from a service logistics perspective.

“A lot of research at the time focused on the printer,” says Basten. “We looked at the supply chain instead. Where should you locate such a printer? Which parts are suitable? When do the benefits of shorter lead times outweigh higher production costs or differences in quality?”

To answer these questions, the researchers developed models that allow organisations to evaluate different scenarios. These models take into account not only production costs, but also lead times, inventory costs, downtime, reliability and the quality of printed parts.

A complex reality

The researchers began by identifying parts that could potentially be suitable for additive manufacturing. They then assessed what logistical benefits this could actually deliver. It quickly became clear that reality was more complex than the original idea of simply 'printing on demand'.

"You don't just switch on a printer to produce a single part," says Van der Heijden. "Post-processing is often required, and you generally want to produce several parts at the same time. So there are always trade-offs to consider."

Certification of printed parts also proved to be a significant hurdle, particularly in aviation.

Defence as a testing ground

One of the most compelling practical cases took place within the Dutch Ministry of Defence. During peacekeeping missions, such as the mission in Mali at the time of SINTAS, it can sometimes take weeks for spare parts to arrive. The researchers therefore explored whether simple plastic parts could be printed locally.

"Think of parts such as exhaust bends or steering components. We didn't assume that a printed part would be as good as the original," Basten explains. "The idea was to create a temporary solution so that a vehicle could be operational again until the original part arrived."

This approach meant that the Royal Netherlands Army needed to take far fewer spare parts into the mission area. This reduced transportation, storage requirements and logistical complexity, while increasing equipment availability.



More than printing spare parts

During the SINTAS project, the researchers discovered that additive manufacturing has much broader applications than simply producing spare parts. The technology can also be used to repair worn components by adding material, or to print moulds for conventional manufacturing when the original casting mould no longer exists. This also gives the technology a clear sustainability dimension.

Predictive maintenance

The researchers also identified opportunities in combining additive manufacturing with predictive maintenance.

"If sensors can predict several weeks in advance that a component is going to fail, you suddenly have enough time to print it," says Van der Heijden. "That combination of maintenance data and additive manufacturing could become very interesting in the future."

From pioneering to real-world application

SINTAS was completed in 2019. Both researchers see the project primarily as the start of a broader development.

“At the time, we were still very much in the pioneering phase of additive manufacturing,” says Van der Heijden. “Above all, we discovered where the opportunities lie, as well as the limitations.”

The knowledge developed through SINTAS now lives on in new research programmes focusing on repair, remanufacturing and defence applications. Additive manufacturing technology itself is also developing rapidly, including advances in materials, mobile printers and intellectual property, with digital design files potentially being made temporarily available for local printing.

Basten expects the logistical questions surrounding 3D printing to become increasingly important.

“Technically, more and more is becoming possible. That makes it even more important to think carefully about when to print a part and when simply to keep it in stock. How do you make that trade-off in a particular context? Ultimately, it’s not about the printer. It’s about creating a better service supply chain.”

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