



3D printed armrest with three extra buttons for the control system.

Siemens Customizes Production

STRATASYS FDM 3D Printing
Enables Extended Customer
Service Offering and
Streamlined Supply Chain

Executive Summary

Faced with the challenge of meeting increased customer demand for one-off customized parts, SIEMENS' Mobility division required an alternative manufacturing solution to overcome the time and cost barriers associated with traditional low volume production. This was particularly exemplified during a recent project for German transport services provider,

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Customizing low volume production parts using FDM 3D printing has been transformational for our customer service offering, as well as our supply chain. Not only are we taking orders on-demand, 3D printing has also given us the flexibility to meet customer requirements faster with no obsolete parts created in the process.”

Michael Kuczmiak

**SIEMENS Head of Additive
Manufacturing – Spare Parts**



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the SWU Verkehr GmbH. With the integration of a Stratasys Fortus 900mc 3D Printer into its production process, SIEMENS was able to address these challenges by 3D printing on-demand, customized parts rapidly and cost-effectively, reducing inventory costs for SIEMENS and customers. As a result, the Mobility division is now able to respond more quickly to low volume customer demands, while boosting its manufacturing flexibility – leading to an increase in client satisfaction.

Benefits/Value

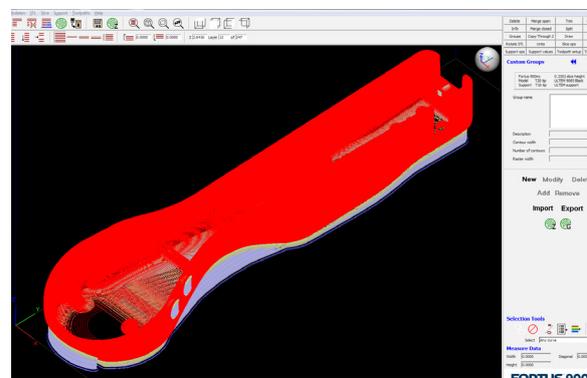
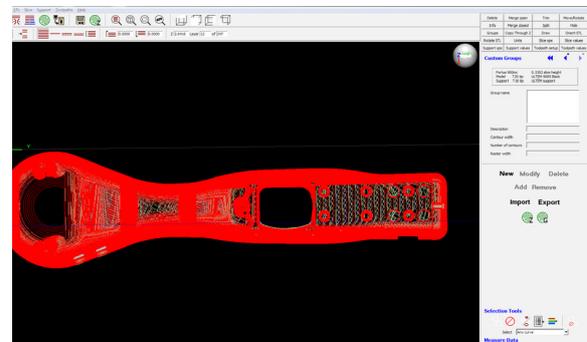
- Successful integration of FDM 3D printing into production has seen the SIEMENS Mobility team overcome limitations of traditional manufacturing methods for low volume production
- Significant reduction in lead times for customized final production parts, with turnaround times decreasing from weeks to days with FDM 3D printing
- In-house Stratasys Fortus 900mc 3D Printer improves SIEMENS' production flexibility and responsiveness to customer demands, with no unnecessary inventory costs in the process
- Advances in part repeatability, customization and availability sees increase in customer satisfaction within SIEMENS transport customer base

Known for its innovative technologies and technical know-how, SIEMENS AG is widely regarded as a global leader in engineering and technology solutions, with customer service and reliability integral to its success. Located in Erlangen, Krefeld, Berlin and Munich, Germany, the SIEMENS Mobility branch develops technology for vehicles and infrastructure for transport machines, while continually innovating and optimizing its services to meet complex customer demands.

This was exemplified by SIEMENS' work for one customer in particular – the SWU Verkehr GmbH. Since the year 2000 SIEMENS Mobility has worked with the city transport service provider. "SIEMENS is a reliable and consistent partner for us. Due to the long duration of our projects, investment stability is a key

aspect for us. SIEMENS mobility offers us all of this together with a comprehensive advice and service package as well as the customized manufacture of our series products," says Jürgen Spät, Head of Rail Vehicles at SWU Verkehr GmbH.

The SWU Verkehr GmbH offers transport services across 10 trains in the inner city of Ulm. The SIEMENS Mobility division was recently approached with a challenge to recreate and optimize an armrest for the driver seat of a city train. The SWU Verkehr GmbH needed three extra buttons on the armrest for a control system. With other recent customer requests for one-off customized parts, SIEMENS turned to Stratasys FDM 3D printing as a solution to the cost and lead time barriers associated with traditional low volume production.



Insight Software: Optimization of armrest orientation and tool paths.

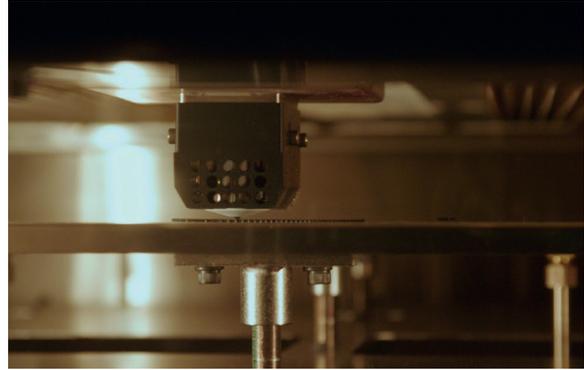
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Customized Low-Volume Production with FDM 3D Printing

Creating an armrest for an Ulm city train driver seat does not sound too complex at first, but the conventional manufacturing process is not that simple. If the part is not in stock, SIEMENS needs to purchase the machinery or tools to manufacture it, incurring large costs for the production of a one-off single part. Outsourced, the component is typically manufactured with the use of expensive tools and on the machines from glass fibre plastics, using traditional processes such as injection molding, welding and milling. Shipped to SIEMENS, the part is then tailored and treated to the exact specifications of the customer, who receives the final production part several weeks later. This is not only a lengthy process, but from a cost-perspective SIEMENS would be limited to only taking orders above 10 parts, with lower volumes unable to justify the production cost.

In a bid to overcome these limitations and offer its customers one-off parts, the Mobility division invested in a Stratasys Fortus 900mc 3D Printer.

“Our production services for end-use parts have become much more flexible and tailored to our customers’ needs since we introduced the Fortus 900mc into our manufacturing process,” explains Tina Eufinger, Business Development, SIEMENS Mobility Division. “Before we integrated 3D printing into production, we were limited to higher quantities of parts in order to make the project cost-effective. For small volume part demands from customers, we would store excess parts until they were used, discarded or became too outdated to use. With the Fortus 900mc, we can now create a design that is 100 percent customized to specific requirements and optimized several times before it is 3D printed. This takes our production time down from weeks to a matter of days, in a way that we can now produce a single customized part cost-effectively in low volumes.”



3D printing of the “Ulmmer StraBenbahn” armrest on the Fortus 900mc with Stratasys’ flame, smoke and toxicity compliant thermoplastic material



Much more flexible production services for end-use parts with the use of the Fortus 900mc in the manufacturing process

Bringing 3D printing in-house was a game-changer for the Mobility team at SIEMENS, enabling them to improve production flexibility and their responsiveness to customer demands. “Customizing low volume production parts using FDM 3D printing has been transformational for our customer service offering, as well as our supply chain,” says Kuczmik. “Not only are we taking orders on-demand, 3D printing has also given us the flexibility to meet customer

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requirements faster with no unnecessary inventory costs created in the process.”

Enjoying the ability to print larger production parts on the Fortus 900mc, SIEMENS particularly values the performance of Stratasys’ flame, smoke and toxicity compliant thermoplastic material to align with necessary fire protection requirements. After testing and finishing them, this enables SIEMENS to employ the 3D printed parts – which serve as lightweight and durable transport parts – directly into the trains in Ulm.

Servicing customer needs with repeatability and precision

Beyond the armrest for the driver seat, SIEMENS has supported the SWU Verkehr GmbH with the production of a housing cover for the ‘coupler’ (the cover of the link between two train carriages), while the Mobility team is currently working on developing a part for the train nose. A criterion from the SWU Verkehr GmbH was the need for an exact fit of the nose part to the train, which previous materials such as glass fibre plastics, could not provide.

“Previously we used glass fibre plastics, which start to collect water when laid down for a while. This resulted in the part changing its shape, which had a dramatic effect on how it fitted onto the train,” explains Kuczmik. “With our Fortus 900mc, the precision is ideal for these applications. We are 3D printing parts within one-tenth of the exact measurement of the design, which enables us to produce parts to the exact measurements desired by the customer. This is simply not achievable to the same degree through other traditional manufacturing methods.”

According to Kuczmik, with the team’s Fortus 900mc, SIEMENS can control and perfectly optimize part geometries as and when required by the SWU Verkehr GmbH and the transport industry. “Repeatability is key for us, as customers often need a part adapted or modernized at a later date. Our Fortus 900mc 3D Printer

enables us to produce these parts exactly the same, every time, which is crucial to consistently delivering

the quality of parts our customers have come to expect from us,” Kuczmik continues.

Andreas Düvel, SIEMENS Mobility Sales Representative -Customer Service, explains: “Customers such as the SWU Verkehr GmbH see ‘availability’ as the most important asset to their business – trains and services need to be available and run constantly throughout the day in order for the transport company to be profitable. We at SIEMENS are regularly faced with this challenge, however the ability to quickly and cost-effectively 3D print customized parts specific to customer requirements, enables clients such as the SWU Verkehr GmbH to be closely involved in the design and production of its own parts.” According to Düvel, this level of



Front view of the driving “Ulmer Straßenbahn” with the 3D printed housing cover for the ‘coupler’



Installation of the 3D printed housing cover

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direct involvement has seen an increase in customer satisfaction.

“Through customized additive manufacturing we are achieving maximum customer satisfaction, because the client is actively participating in the creation and optimization of its parts. This would not be possible with mass production,” he explains.

Beyond offering 3D printed production parts for customers in the transport industry, SIEMENS Mobility division has expanded its business branch

online, with customers able to shop for customized 3D printed parts. Customers who need replacement parts or need to make changes to existing ones can go online now, request the part they need and order to be 3D printed by SIEMENS Mobility to 3D print. This has seen the birth of an on-demand production business model, whereby customers can have part requirements met – how they need it, when they need it.

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