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2828-116 Corbett Ave.
Portland, OR 97201
503-942-2781
www.rapidmade.com
info@rapidmade.com

Case Study

Additive Manufacturing Solutions

Rapid prototyping has become a standard practice in product development. At the BMW AG plant in Regensburg, Germany, it continues to be an important component in vehicle design prototyping. But moving beyond prototyping, BMW is extending its applications to other areas and functions, including direct digital manufacturing.

The plant's department of jigs and fixtures uses 3D Production Systems to build hand-tools for automobile assembly and testing. According to engineer Günter Schmid, "BMW has determined that the [additive manufacturing] can be an alternative to the conventional metal-cutting manufacturing methods like milling, turning, and boring." Schmid and fellow engineer, Ulrich Eidenschink, have shown that financial advantages include cost reductions in engineering documentation, warehousing, and manufacturing.

Production Method Comparison

Method	Cost ($)	Time (Days)
Traditional CNC machining	420	18
Additive Methods	176	1.5
SAVINGS	244 (58%)	16.5 (92%)

For hand-held devices used on the assembly line, engineers have discovered that there are even greater advantages that arise from the design freedom that it offers. Capitalizing on the elimination of constraints, Schmid and Eidenschink employ the technology to make ergonomically designed assembly aids that perform better than conventionally made tools.

To improve productivity, worker comfort, ease-of-use, and process repeatability, the the plant uses additive manufacturing to enhance the ergonomics of its hand-held assembly devices. The freedom of design allows engineers to create configurations that improve handling, reduce weight, and improve balance. According to Schmid, "The tool designs we create often cannot be matched by machined or molded parts." In one example, BMW reduced the weight of a device by 72 percent with a sparse-fill build technique. Replacing the solid core with internal ribs cut 1.3 kg (2.9 lbs) from the device. "This may not seem like much, but when a worker uses the tool hundreds of times in a shift, it makes a big difference," says Schmid.

Another advantage of direct digital manufacturing is improved functionality. Since the additive process can easily produce organic shapes that sweep and flow, the tool designers can maximize performance while improving handling

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characteristics. "The layered manufacturing process is well suited for the production of complex bodies that, when using conventional metal-cutting processes, would be very difficult and costly to produce," says Eidenschink. An example is a tool created for attaching bumper supports, which features a convoluted tube that bends around obstructions and places fixturing magnets exactly where needed.

The jigs and fixtures department has developed a simple flow chart to determine when using additive manufacturing is a fitting option. The criteria are temperature, chemical exposure, precision, and mechanical load. With ABS material, which the engineers find comparable to polyamide (PA 6), many tools for vehicle assembly satisfy the criteria. For those that do, designers can create devices that capitalize on all the advantages of the additive process.

Both Schmid and Eidenschink believe that no enterprise can afford to do without rapid prototyping for product development. Yet, they see so much more possibility. "[It] is taking on increasing importance as an alternative manufacturing method for components made in small numbers," says Schmid.