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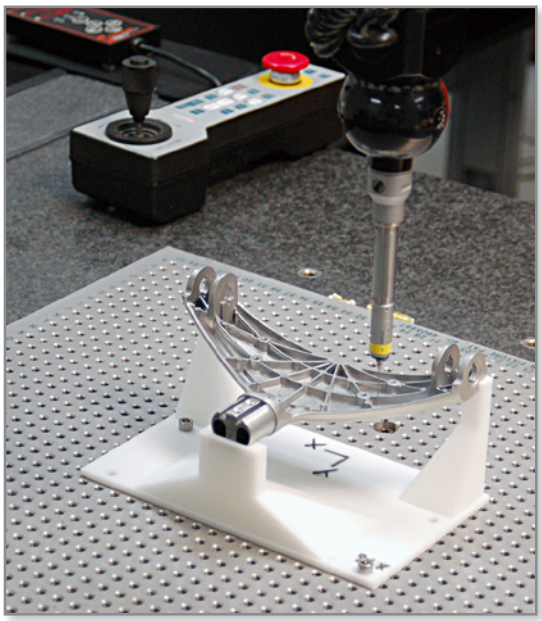
WHITE PAPER

IS NOW THE TIME TO TRY DIRECT DIGITAL MANUFACTURING?

You can Reap Major Savings With This Growing Trend. Take Your First Small Step Today.

By Scott Crump

Over the past 20 years additive manufacturing technology has migrated from use in rapid prototyping to a full-fledged manufacturing solution, which is referred to as "direct digital manufacturing" (or rapid manufacturing). Increasingly, companies are applying it to manufacturing applications, and with each success, they prove that it is a viable alternative. While the general concept of additive manufacturing is the same as when it was introduced 20 years ago, the change is in its intended use: production, not just prototyping. So while the concept has been around for a while, in the minds of many, direct digital manufacturing (DDM) is a new thing and difficult to understand.



Oreck uses direct digital manufacturing to create production aids, such as this fixture, which secures a component during CMM inspection.

ADDITIVE MANUFACTURING

Additive manufacturing is the generic name given to processes that create a part by building it up in layers – as opposed to milling or machining, which are subtractive processes. Additive manufacturing was developed as a way to automate the creation of prototypes, and it was therefore originally known as rapid prototyping. It also goes by various other names, including 3D printing, which is one of the most popular.

DDM is the process of using CAD or other data to drive an additive manufacturing machine that makes usable parts. Examples are the components that go into sellable products, pieces of production machinery, replacement parts, or manufacturing tools, such as jigs and fixtures. Besides CAD data, which is the overwhelming majority of data used, other types of data may be used to drive additive manufacturing machines. Among others it includes 3D scan data (for reverse engineering) and DICOM data (for making a physical representation of 3D medical imagery).

Direct digital manufacturing eliminates molding, machining, casting and forming. Instead of material removal or shaping, a company's finished goods are produced by adding material one layer at a time. Other than a few minutes of pre-processing to prepare a production run and some light post-processing to clean up a part, DDM progresses directly from CAD data to final part. Eliminating the up-front and back-end operations common to traditional methods means that there is no extraneous time, cost, or labor.

ONE PROCESS, MANY TECHNOLOGIES

DDM is a process, not a technology. And it can be performed with various additive manufacturing technologies with diverse capabilities. The additive manufacturing technologies that perform DDM share the fundamental technique of producing parts directly from a CAD data file. They do so by adding material layer-by-layer. However, the many processes vary greatly, so in order to determine if DDM is suitable for a project, it must be evaluated with respect to a specific technology.

Whichever technology is chosen, DDM offers unique and powerful advantages that distinguish it from traditional manufacturing methods. The most often cited are:

- Eliminate investment in tooling.
- Eliminate lag time between design and production.
- Eliminate design constraints.
- Eliminate penalty for redesign.
- Eliminate lot size minimums.

Collectively, these benefits translate to efficiency, flexibility, responsiveness and affordability. DDM is a manufacturing process that introduces alternatives in product design, manufacturing methodology and business operations. As an added benefit, many additive manufacturing technologies are fairly "green" processes. They have very little waste material as compared with milling processes because only the needed material is used. No unnecessary inventory is produced because there is no benefit to building more than you need at any time. Most additive processes require no harmful chemicals and vent no harmful fumes into the environment. Among a list of other green benefits, is the relatively

small amount of electricity that is required to produce parts via additive manufacturing.

DDM essentially rewrites the rulebook for making manufacturing decisions. In many instances, it is a polar opposite to conventional production methods. This makes it a disruptive technology and makes it more difficult to appreciate and comprehend.

APPLICATION DIVERSITY

In the manufacturing environment, DDM often performs one of two roles. Companies will use the process to manufacture the products it sells or to make the devices that aid in the manufacturing of the products.

When first introduced to DDM most people envision the production of finished goods. The word manufacturing conjures images of high-volume production of consumer products. People often jump to the definition "the making of goods on a large scale," even though manufacturing also means "the making or producing of anything."

DDM is suited for low-volume manufacturing – not mass production, but before you think "We can't use it because we do mass-production," keep in mind every manufacturer has low-volume needs in the production of manufacturing tools, such as jigs, fixtures, gauges and hand tools.

Producing manufacturing tools presents the ideal opportunity to try DDM. These tools are deployed to make manufacturing and assembly fast, efficient, repeatable and cost effective. In this manufacturing context, DDM becomes a low-risk, high-return alternative to standard practices. Because the tools are used by the company, not the customer, and the time and cost to produce them is small, an unsuccessful attempt has little consequence. But when successful, DDM has a major impact on productivity, quality and the cost of producing parts. Performing DDM of manufacturing tools is currently more popular than DDM for end-use parts. That's partly because it's such a low-risk opportunity, and partly because every manufacturer has a need for such tools.

Manufacturing can also be a bit of a misnomer when the entire spectrum of industries using DDM is considered. Some of the greatest successes are not in the manufacturing industry. Because of the inherent need for custom fitting devices, the medical and dental professions have been early adopters of DDM. Orthotics, prosthetics, hearing aids and dental bridges have all benefitted from DDM. Companies have discovered that DDM is a powerful alternative, rather than a direct replacement, to the conventional manufacturing processes.

DDM presents a nearly limitless range of opportunities. Companies have only begun to uncover all that it can do. It is exciting to realize that the scope of opportunities and potential is enormous. It is also good news that there are so many technologies and materials from which to choose.

IN SUMMARY

DDM is a fundamental shift in the approach to making parts. It is a process that employs additive manufacturing to make end-use parts directly from CAD data. DDM is a promising manufacturing alternative that

accelerates production and reduces costs while creating new possibilities and new business models. It is unique because it avoids molding, machining and forming, and it eliminates the constraints that these conventional manufacturing methods impose.

Most likely, your company's product development department has either an in-house additive manufacturing system for rapid prototyping or it outsources prototypes to a service that uses additive manufacturing. In either case, talk with the design engineers in product development, and ask about a sample project. Ask if they will build you a simple manufacturing tool like a small jig, fixture, or gauge. And compare the cost to what you would spend having the tool produced via traditional means. If you find a simple entrance into direct digital manufacturing this way, you will join the many leading companies who discovered DDM via the same path.

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