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# Will Digital Manufacturing Transform Production Processes and the Supply Chain?

## The Technology is Still Emerging, but Further Along than Many People Realize; Invisalign Uses DDM to Transform the Dental Supplies Market

**SCDigest Editorial Staff**

The idea and goals have been around for some time, but is "digital manufacturing" closer than we might think in terms of going mainstream?

The answer appears to be Yes.

What is digital manufacturing? The basic idea is to use digital information and specialized equipment to create parts, components or complete products on-demand, generally in low volumes, in a way that makes economic sense. In Europe, the technique is generally known as "rapid manufacturing," while direct digital manufacturing, or "DDM," is the more popular term in the US.

The technique has been used for many years in "rapid prototyping" of new parts or products, with machines creating parts from 3D digital design files using one of several specific technologies (see below). In a sense, some of the recent practices in media related business are a form of "digital manufacturing," such as on-demand book publishing and the idea some music stores had at one point of burning music CDs on-demand at retail outlets, a concept that never really took off even though it did illustrate the fundamental concept of DDM (low volume, on-demand, geographically distributed production).

Now, DDM has the potential to usher in a new industrial revolution for the digital age.

### Technology Advances Expand Product Range

Enhanced digital manufacturing technology could lead to dramatic improvements in costs and delivery, especially for items with relatively small demand. According to **Dr. Phil Reeves**, managing director of the U.K. consulting firm Econolyst, many advances have recently been made, and more are coming.

***Just as in the dental supply industry, DDM has the potential to be a highly disruptive technology, with a dramatic impact on supply chain practices and existing companies and business models***

In the most recent issue of CSCMP's ***Supply Chain Quarterly*** magazine, Reeves says the core of DDM is use of a technology called Additive Layer Manufacturing (ALM). While ALM has been around for about two decades, according to Reeves, "Recent advances in ALM and materials now allow the rapid manufacture of end-use parts for a variety of production applications in materials such as metals, polymers, and ceramics."

Of course, the ALM process starts with a digital, 3D design drawing of the part to be produced. That file is imported into different types of specialty machines, which can use one of several different processing techniques to actually make the final product. The software in these machines slices the full image up into hundreds or more two-dimensional "profiles," which are then created by the machine layer by layer until the product is complete.

According to Reeves, "Some [ALM] systems use thermal energy from laser or electron beams, which is directed via optics to melt or sinter (form a coherent mass without melting) metal or plastic

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powder together. Other systems use ink-jet-type printing heads to accurately spray binder or solvent onto powdered ceramic or polymer."

In fact, it is the ability to use a wider variety of materials in the DDM process, including metals, polymers, and ceramics, that is one of the most important of the advances in the overall technology.

Regardless of which techniques and materials are used, the end result is the same: a solid, tangible representation of the original computer data. Importantly, this is achieved without mold tooling, machining, jigs to hold the work in place, fixtures, or much manual intervention – all the things which would dramatically add to costs if traditional manufacturing processes were used to produce these low volume parts.

In addition to the cost and speed benefits for making low volume parts, DDM has several other advantages. In many cases, the parts can be made in a distributed way geographically, close to the actual need.

Second, Reeves says that DDM "enables the production of highly complex geometries that would be impossible to make as single items using traditional manufacturing processes. As a result, manufacturers can consolidate formerly separate parts, thus reducing manufacturing, assembly, and inspection costs."

There are also a number of "green" supply chain benefits as well.

Finally, DDM advances in general would give an advantage to Western manufacturers in their own home markets, versus outsourcing production in what obviously have to be large volumes to offshore manufacturers, or competing with offshore manufacturers shipping into those home markets.

While some companies may purchase their own DDM technology/machines, which range in cost from a few tens of thousands of dollars to nearly $1 million or more at the high end, now and in the future it will often be smart to outsource DDM work to service companies that have invested in that equipment and skill sets.


### The Future is Closer than Many Think

While DDM is still an emerging technology with much room for additional development to be broadly practical, a high level of on-going R&D investment in the technology should lead to continued technical progress, and even at today's levels DDM is starting to have a real market impact.

For example, Reeves cited the example of U.S.-based Invisalign Inc., which uses DDM to manufacture forming tools over which disposable, transparent dental braces are individually formed in sets for each patient. This approach has enabled Invisalign to become a global force in the dental-supply sector, reaching $206 million in sales in less than five years using this approach.

Just as in the dental supply industry, DDM has the potential to be a highly disruptive technology, with a dramatic impact on supply chain practices and existing companies and business models – think, for example, of all the tool and die shops which currently produce molds for manufacturers.

"Could DDM become to tangible product manufacturing what the download has been to the music industry — an opportunity for early adopters but a threat to traditionalists?" Reeves asks? "Just as iTunes disrupted the music industry and changed how music is purchased and delivered, the emergence of home manufacturing could collapse supply chains as RM transforms how certain types of products are purchased, produced, and delivered."