Appendix

What's all this name stuff anyway?

RP Terminology Unraveled

This field has a slight problem: no one knows what to call it...

Additive fabrication technology started out nearly twenty years ago being called "rapid prototyping" (RP). At the time, that was fairly descriptive of what it did. Early machines were used to make things that represented the general physical shape of some final part or other items. Since these parts or objects didn't have the material properties nor probably the accuracy that were required for actual use, they were just prototypes - examples, if you will. You couldn't do much with them, but engineers could pass them around at a meeting and say to one another things like, "Why, yes Fred, you seem to have left off the tubulation on the forambulater and made the trailing bushings too long. Please pass me a donut."

The next meeting would find the corrections added. Maybe another prototype was made, possibly even many - but also maybe not. One prototype might be all that was required. Seeing and feeling something in the approximate form it would ultimately take turns out to be a very good way of short-circuiting the process of going from an idea on paper or a screen, to making something that actually works.

This was one reason why the process of design became faster and put the rapid in "rapid prototyping," but it wasn't the only one. Instead of having to cut a material away to sculpt a part, you could just give a computer file to the machine and it could spit out even a very complicated part fairly quickly. Quickly is relative: Sometimes it took days to make a part, and often it still does. But it might take much longer to make the same thing by cutting material away using subtractive fabrication. So these additive processes were rapid in comparison to that, and that made for another reason to call them "rapid."

Outrageous Interference

Of course, whoever started using the term "rapid prototyping" for these additive fabrication technologies twenty years ago, either didn't know, or didn't care, that others in completely unrelated fields were using it, as well. Some computer programming techniques are called rapid prototyping, as are ways to quickly generate web-sites. Individuals designing advanced control systems for aircraft and similar applications sometimes describe the process as rapid prototyping. Biologists rapid prototype microfluidic systems using a variety of methods such as stamp lithography. Sometimes it isn't easy to tell who's doing rapid prototyping and who's doing additive fabrication.

Confused usage

The name of one technology in particular - stereolithography - is sometimes used as a synonym for "rapid prototyping." A manufacturer of stereolithography equipment might like this a lot. If prospects think rapid prototyping is stereolithography - even though that's only one flavor of additive fabrication - that might be advantageou

learning about the field for the first tim

Pages 202 to 208 omitted in this sample

Glossary

3-Dimensional Printing (3DP). A rapid prototyping process developed at the Massachusetts Institute of Technology (MIT). Layers of powder are bonded by inkjet to form a part. The term is also used generically as synonym for rapid prototyping.

3D printer / 3D printing. Refers generally to the low-cost segment of the rapid prototyping machine market. The output of these systems is typically considered adequate for concept and appearance modeling, but may lack the accuracy or other attributes of more costly systems. This terminology is used extensively in the Wohlers Report, but others may not draw as fine a distinction.

absolute accuracy. Defined as the difference between an intended final dimension and the actual dimension as determined by a physical measurement of the part. In addition to those for linear dimensions, there are accuracy specifications for such features as hole sizes and flatness.

adaptive slicing. The use of variable layer thickness in an additive fabrication process, generally thinner layers being used where part detail is greatest.

additive fabrication / additive manufacturing. Fabrication of a part by adding materials to a substrate or previously formed portions of a part. The most common additive fabrication methods utilize a layered approach, but other geometries are possible. The term is also used generically as a synonym for rapid prototyping.

Advanced Digital Manufacturing (ADM). 3D Systems' trade name for direct manufacturing or direct fabrication. Often used in conjunction with the company's now dormant OptoForm technology.

anisotropic. Refers to the fact that parts may have different physical properties depending on which direction measurements are made, and such differences can also arise if the exact same part is made in a different way. This can happen if the building orientation of the part in the machine is changed, and also from the sequence in which the part's elements are fabricated.

ballistic particle manufacturing (BPM). A rapid prototyping process which deposits materials by means of inkjet technology. At one time the term was used to refer to a specific company's technology, BPM, Inc., now defunct, but prior to that it was an early generic term for inkjet-based RP. The term is not often used at present.

bridge tooling. Tooling which is typically capable of producing quantities of several tens to several hundreds of parts. That is to say, it "bridges" the quantity between very low volume prototype tooling and full production tooling. In some cases bridge tooling may offer sufficient volume to meet production requirements. Most rapid tooling technologies can be considered bridge tooling because they're not yet capable of truly high quantity production.

brown part. A part which has been sintered or had other secondary operations performed on it to bring it from the loosely-bonded, as-formed "green" state. Parts in the brown state are generally dimensionally stable, but are often porous and usually must be infiltrated with another material before use.

chemical vapor deposition (CVD). The use of gaseous precursor molecules to form solid films or powders. The process is widely used in the fabrication of semiconductors.

computer numerical control (CNC). Ref
control, as opposed to manually by an oper

Directory of Selected Industry Resources

The following organizations are discussed or mentioned in the text. Exhaustive listings are maintained on ***The Worldwide Guide to Rapid Prototyping*** web-site. In addition to the categories listed here, on the web-site there are complete commercial listings including a thorough service bureau directory, extensive listings of university and government research programs, in-depth technology resources and a great deal more.

Additive Fabrication Systems & Technology Providers

3D Systems – Headquarters
333 Three D Systems Circle
Rock Hill, SC 29730
803-326-3900
http://www.3dsystems.com/

A1 Technologies
12 Woodland Gardens
London N10 3UA
UK
Tel: 0777 565 1028
smart56@btinternet.com
http://www.a1-tech.co.uk

Accufusion Inc.
800 Collip Circle
London, Ontario N6G 4X8
Canada
519-430-7065
519-430-7010 FX
info@accufusion.com
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Arcam AB
Krokslätts Fabriker 30
SE-431 37 Mölndal
Sweden
+46-31-710 32 00
+46-31-710 32 01 FX
http://www.arcam.com/

CAM-LEM, Inc.
1768 E 25th St.
Cleveland OH 44114
216-391-7750
216-579-9225 FX
info@camlem.com
http://www.camlem.com

Catalyst PDG, Inc.
5201 Park Emerson Dr. Suite M
Indianapolis IN 46236
317-786-4444
http://www.catalystpdg.com/

CMET Inc.
Sumitomo Fudosan Shin-Yokohama Bldg.
Shin-Yokohama, Kohoku-ku,
Yokohama, Kanagawa, 222-0033
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+81-45-478-5561
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http://www.cmet.co.jp

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An der Zeil 8
96215 Lichtenfels
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+49 0-9571 / 949-239 FX
http://www.concept-laser.de/

Cubic Technologies
2785 Pacific Coast Highway #295
Torrance, CA 90505
310-619-9541
310-965-0141 FX
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The rest of the Chapter is Omitted in this brief sample.