3D 'Printing' Market: A market driven by Buzz?

With headlines like the May 11, 2013 one "White House Looks to Invest $200 Million in 3D Printing" on Twitter, blogs, and other internet web-sites you know that the mass market hype has made 3D printing a buzzword that particularly has financial investors salivating. (Note how social media can spread word quickly with little incentive to verify or qualify information). To add some clarity, I.T. Strategies offers the following insight on 3D printing.

Terms of Reference

The general market has adapted the convention of calling this technology 'printing.' In reality be aware that only some products are derived directly from printing technologies. For many products this is not formally speaking printing at all but is rather layered additive manufacturing, even in some cases subtractive. Many different technologies are used with great variations in performance and cost.

Technologies

This is a matrix issued by Wohler's Associates describing technology categories against their use of different raw materials (or consumables in this market):

	Material extrusion	Material jetting	Binder jetting	Vat photopoly-merization	Sheet lamination	Powder bed fusion	Directed energy deposition
Polymers, polymer blends	x	x	x	x	x[1]	x	
Composites[2]		x	x	x		x	
Metals		x	x		x	x	x
Graded/hybrid metals[3]					x		x
Ceramics			x	x		x	
Investment casting patterns		x	x	x		x	
Sand molds and cores	x		x			x	
Paper					x		

Source: Wohlers Associates, Inc.

This is a layman's quick guide to the meaning of the technology terms used above:

Technology	Description of Function
Material Extrusion	Solid materials liquefied by heat for extrusion in a pattern in successive layers
Material Jetting (usually Inkjet)	Jetting of drops of liquid materials in a pattern in successive layers which are cured (often by UV radiation) as they arrive at their designated position (Commonly uses Inkjet Printing Technology)
Binder Jetting (usually Inkjet)	Jetting of drops of liquid materials in a pattern in successive layers onto a substrate which becomes bound (fixed to solid format) in reaction with the liquid materials (Commonly uses Inkjet Printing Technology)
Vat Photopolymerization	Vat-contained liquid materials which are bound or fixed to a solid format in a successive layered pattern at the surface of the liquid by external action (usually radiative)

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Sheet Lamination	Successive lamination of solid materials, which are melted, to adhere to a prior laminate layer and then cut with removal of waste (usually by laser) to the correct shape for the current layer.
Powder Bed Fusion	Solid materials in powder form solidified in successive layered patterns by the action of an external chemical or radiative agent
Directed Energy Deposition	Materials converted by an energy source prior to patterning in successive layers to an amorphous form which are curable at their designated position

Market Size and Basic Segmentation with core Applications

The market for so-called 3D systems was in 2011 a market for about 75,000 systems worldwide. Of these about 50,000 systems were placed in the industrial sector, with an average price of $75,000 per systems, generating revenues for hardware, materials and services of around $1 billion. About 25,000 systems were placed in the consumer sector with an average price around $1,500, generating revenues of about $26M. The industrial sector grew at about 15% per year, and the consumer sector grew at over 25% per year. A further $640M was generated by service providers integrated more or less with systems suppliers in providing final product to users who do not wish to generate their own 3D prototypes or parts.

This is the rough split of revenues for the industrial sector:

	2011 $ M of printing equipment/supplies mfr. revenues and manufacturer provided Print-for-Pay service revenue
Hardware	$482
Material	$262
HW Service/Software/ Other	$327
Sub-total	**$1,070**
Printing Services for finished 3D output	$643
Grand total	**$1,713**

This is a split of revenues by application courtesy of Wohler's Associates for 2011. We have projected the markets forward with our own estimated total market growth rates:

		2012	2013	2014	2015	2016	2017
GR			18.00%	12.00%	10.00%	10.00%	10.00%
Motor Vehicles	19.50%	$334.04	$395.34	$421.39	$448.24	$494.17	$544.68
Aerospace	12.10%	$207.27	$245.76	$262.38	$279.52	$308.57	$340.53
Industrial	10.80%	$185.00	$219.48	$234.44	$249.88	$275.97	$304.67
Consumer	20.30%	$347.74	$411.51	$438.58	$466.48	$514.23	$566.75
Madical/Dental	15.10%	$258.66	$306.40	$326.84	$347.92	$383.81	$423.29
Academic	8.00%	$137.04	$162.89	$174.28	$186.04	$205.75	$227.42
Covernment/Military	6.00%	$102.78	$122.46	$131.30	$140.44	$155.59	$172.24
Architecture	3.00%	$51.39	$61.82	$66.84	$72.04	$80.35	$89.48
Other	5.20%	$89.08	$106.29	$114.11	$122.20	$135.52	$150.17
GT	100.00%	$1,713.00	$2,022.52	$2,151.16	$2,283.64	$2,513.11	$2,765.52

As regards applications, often the systems in the market generate true prototypes that do not always have to be functional. Some 3D-generated products are functional in simple ways, and some of the higher-end systems can truly generate workable spare parts or prototypes for insertion into larger systems. But in general today the market is only involved in manufacturing of final products for use in specialized relatively manageable markets like dental or simple architecture for example. Rapid Prototyping has not yet

prototypes for insertion into larger systems. But in general today the market is only involved in manufacturing of final products for use in specialized relatively manageable markets like dental or simple architecture for example. Rapid Prototyping has not yet reached a scaled position as a substitute for mainstream manufacturing technology either in functional, cost or technology terms.

Inkjet's Part of the Market

Stratasys and 3D Systems represent 74.1% of all 2011 3D unit systems placed worldwide. These companies also represent a similar, probably larger, share of all Inkjet systems placed. We've split their revenues to segment out ink jet specific 3D printing revenue. The inkjet systems in the market are, in the sense of the market as we describe it today, mainstream industrial products. Some of them are capable of generating truly functional products. Inkjet is a strategic approach to technology in this market, but it is in a very technologically competitive market having not more than around 20% of the total market of systems and materials in 2011.

2011	Hardware	Materials	Services/Other	Total
Stratasys Total	$86.00	$42.00	$30.00	$158.00
Stratasys Solidscape	$6.00	$2.00	$0.00	$8.00
Objet (independent)	$70.00	$60.00	$20.00	$150.00
3D Systems Total	$67.00	$70.00	$93.00	$230.00
3D Systems Z Corp	$29.00	$22.00	$7.00	$58.00

2012 est.	Hardware	Materials	Services/Other	Total
Stratasys Total	$179.70	$117.49	$57.59	$354.78
Stratasys Solidscape	$6.91	$2.30	$0.00	$9.22
Objet (now part of S-S)	$80.63	$69.11	$23.04	$172.78
3D Systems Total	$98.17	$102.57	$136.27	$337.00
3D Systems Z Corp	$42.49	$32.23	$10.26	$84.98

= Inkjet

Source: I.T. Strategies & various

General Remarks

Fragmented but Established Market with Established Dynamic

The 3D printing market is not new and has been evolving for 20 years with real products and real clients. So there is an existing organic 'dynamic' that should be the baseline for our analysis. That baseline suggests a specialist market evolving quite gradually to a market whose total revenues are less than $2B by 2011. That market is divided into many specialist applications among which dental, medical/surgical, design, consumer, novelty goods, military etc. There are in turn a variety of value chains involving dealers, service bureaus, and shared value creation in software terms. This all indicates solid real markets but with no real J-curving killer apps. In fact, this kind of specialist market set almost excludes J-Curve type markets.

Terms of Financial Debate Sometimes Misleading

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The public discussion is greatly distracted by financial modelling which seems unrelated to real market experience, none of which suggests by implication the real fragmented nature of the markets and the access models, at least so it seems to us. That is compounded by a heavy dose of non-objective cheerleading. The icing on the cake is now that the discussion has passed to journalists whose knowledge and understanding generally surpasses in its lack thereof that of any other group. Our sense is that there is an over-focus on physical product. It is true that the physical product is the core revenue generator, so fair enough, but its rate of adoption is related to the infrastructure and services around it all of which need to be developed in their own right – software, protected product rights, third parties to manage the complexity of integration etc.

Importance of Services

The revenues of this industry as a whole are heavily oriented towards services. This is a true indicator of market complexity. It says that much more than a printer is needed and it also can mean (and does here) that the user needs help to leverage the asset. (Note: it is not easy to design well in 2-D unless one is a graphic artist; imagine designing in 3-D)

High Investment Requirement

Another issue with fragmented and specialist markets is that they often suggest high investment requirements for customized systems both from the acquisition side and from the manufacturing side.

The ROI of New, Not Substitute

Model is not to substitute, but to do something new, which brings ROI at higher unit costs. Now that is a really hard concept to get over to real-life buyers, and takes years to prove until a magic moment is reached when it 'becomes' the received wisdom. That is usually a slow development curve. It looks today more like stage 2 of this model where we are beyond individuals or single companies experimenting, but have reached the 'multiple industry communities' stage of market development. It is all more real, and there is an assurance of ROI. But it is ROI for very specific value propositions within customized systems. There are also going to be many who drop the technology.

Market's Infrastructure Dependence

3D printing is going to stay expensive and will not foreseeably replace manufacturing. It will create a specialist market for customization. Even mass customization may come, but it will be years in coming depending, as it will, on an infrastructure of information management: information that the 3D manufacturers themselves will only partially control. By the way, for manufacturing you have to have materials and performance equivalence. In reality while there are a lot of functional materials and these will be OK for some apps, they will probably not at this stage be OK for mainstream apps. Metal sintering is a bit of an exception and is pretty well understood, but it is done outside of the rapid prototyping or 3D printing world already (for example in the manufacture of gas turbine blades), so that what the new market does is not necessarily fully equivalent.

Established Growth, but Probably Moderating

Fundamentals of this market are good in direct proportion to the diversity of the market and its years of establishment (approaching 20) given that such complex infrastructural models do grow slowly and gradually. We think that a growth rate around 10% would be normal if the business truly is established (and less if it is not, but we do not doubt its establishment). This would bring the market to more than double its present size in 5 years.

Professional Parallel and Consumer Markets

All the sectors are essentially specialty markets and not substitute markets, and they will have a finite size that will evolve in this sense as new markets or parallel markets. Special care should be given to analysis of consumer printer numbers. If less than 100,000 3D printers have been sold so far that is not a shocking number, but it should not be confused

have a finite size that will evolve in this sense as new markets or parallel markets. Special care should be given to analysis of consumer printer numbers. If less than 100,000 3D printers have been sold so far that is not a shocking number, but it should not be confused with the consumer ink jet printing market, which reaches in the hundreds of millions of ink jet printers installed. This market is more likely to be for the serious hobbyist. It is a market of perhaps hundreds of thousands for sure and the 3D opportunity may be compared to the serious hobbyist photographer who has bought low hundreds of thousands of printers for similar prices to the 3D systems being offered.

Non-scaled Market Growth – An Analogy from Printing

We feel that for the primary market of hardware and supplies (as opposed to the secondary market for finished 3D products made by manufacturers on a print-for-pay provider basis) to grow ten times bigger than our 2017 projection (meaning it would reach $20-30B instead of $2-3B), it would require scaled systems not essentially on offer from this industry at this time. An analogy with similarly priced systems might be the wide format graphics market. After 20 years there are about 200,000 systems installed generating vendor revenues for hardware and supplies of about $4.5B. These revenues are from service bureaus as a rule and they in turn generate about $30B of revenue for finished product. Systems are sold for between $5,000 and $1M, with an average of about $20,000.

The model for 3D printing does seem to be developing in the direction of sales through service bureaus for the simple reason that 3D printing is a multi-stage process whose physical and economic management are a skill in their own right. Also, as long as the market remains relatively localized, small-scale and fragmented while that is a strength for stability, at the same time, it raises the cost of distribution as each year goes by.

Bottom Line

The 3D printing market is real, and it is growing. Only 20% of the hardware and supplies is derived from ink jet technology, the rest is based upon other “non-printing” technologies. Growth is a large part that will be dependent upon “print-for-pay” services, and the creation of finished products on behalf of customers.

This is a checklist of the characteristics of the 3D printing, or more accurately described, the Rapid Prototyping market, as we see it today:

- Established for 20 years
- Has real customers
- Is fragmented, small-scale in user and technology terms
- Is defensible
- Is infrastructure-dependent
- High cost of distribution
- Generates mostly new markets, not substitutive = slows development
- Growth is now assured
- Growth will be strong but likely around the 10% range
- No major corporations involved

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