STATE OF THE 3D PRINTING INDUSTRY SURVEY 2019

AM SERVICE PROVIDERS

MARKET TRENDS, EXPERT INSIGHTS AND INDUSTRY PERSPECTIVES

AMFG / Autonomous Manufacturing

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THE SERVICE PROVIDER MARKET IN 2019

Welcome to AMFG's first State of the 3D Printing Industry Survey. This report takes a look at different sectors within the additive manufacturing industry. This first edition focuses on a vital segment of the industry: 3D printing services.

Manufacturing services have been a cornerstone of the additive manufacturing industry since its inception. The ability for companies to outsource 3D printing production has, in many ways, helped to further the advancement of the technology across industries and broaden the range of applications.

In 2019, the 3D printing service bureau market is arguably more competitive than ever. The number of independent service bureaus is growing, as barriers to entry — particularly the cost of machines — are reduced. At the same time, some hardware manufacturers are offering services as part of their business model.

Online manufacturing platforms, based on a Manufacturing-As-A-Service model, are also helping to shape the services landscape by offering companies access to a global network of suppliers, on demand.

For OEMs, never has there been more choice in the range of potential manufacturing suppliers. On the other hand, all of these factors mean that service bureaus will need greater agility and innovative strategy in order to adapt to a market that is in a constant state of flux.

In spite of the competitive landscape, however, the vast majority of respondents to the survey seem content with the performance of their business and are looking forward to continued growth over the next 12 months.

And there's much to be optimistic about. The 2018 edition of the annual Wohlers Report reports that independent service providers generated an estimated $2.955 billion in revenue worldwide in 2017, up 36% from the $2.173 billion reported for 2016.[1]

Service bureaus continue to innovate product development and production by providing valuable specialisms across a range of 3D printing technologies and ancillary services like post-processing, 3D modelling and 3D scanning.

From a specialisation perspective, prototyping and polymer 3D printing remain key areas of expertise for many of the service bureaus surveyed. However, there are also exciting opportunities in other areas, such as metal 3D printing and the emerging industries that are in the early stages of their 3D printing adoption.

The industry's shift towards end-part production is another a key opportunity for service bureaus to establish their expertise, although this is not without its own challenges — namely quality control and repeatability.

Overall, as the technology continues to mature and the industry continues to grow, service bureaus will be in a strong position to capitalise on their expertise. A recent report by market research firm, IDC, forecasts that spending on 3D printing services will reach $4.8 billion in 2022 [2], indicating a very promising outlook for the sector in the years ahead.

Victoria Akinsowon
Senior Marketing Manager, AMFG

METHODOLOGY

This report is based on responses to an online survey conducted by AMFG between April and June 2019. The survey was sent to independent service bureaus offering additive manufacturing services.

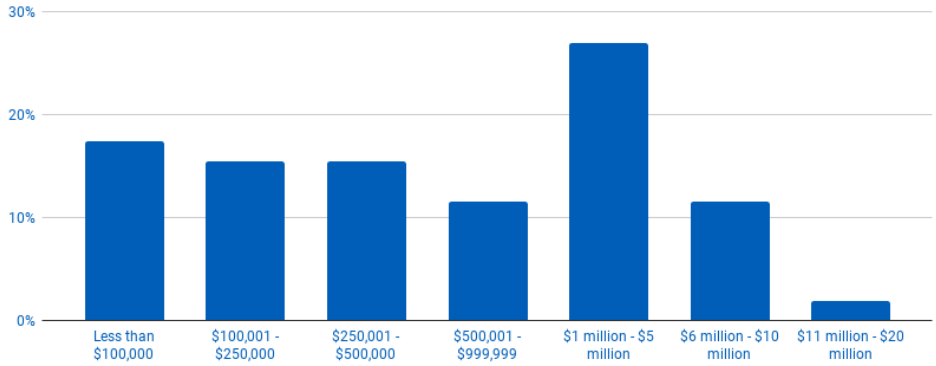
We asked survey respondents a series of questions in order to gain a better understanding of the current market conditions for service bureaus today. These insights, along with four expert interviews, will be explored in the subsequent sections of this report.

WHO RESPONDED?

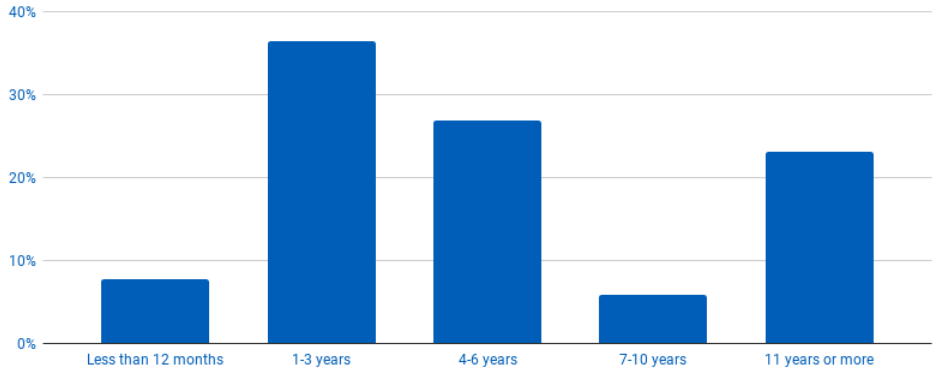
Location

The survey was not restricted by location, and respondents came from around the globe. The countries represented in this survey are: Bulgaria, Canada, Denmark, Germany, Greece, Italy, India, Latvia, Mexico, the Netherlands, Singapore, the United Kingdom and the United States.

Company revenue



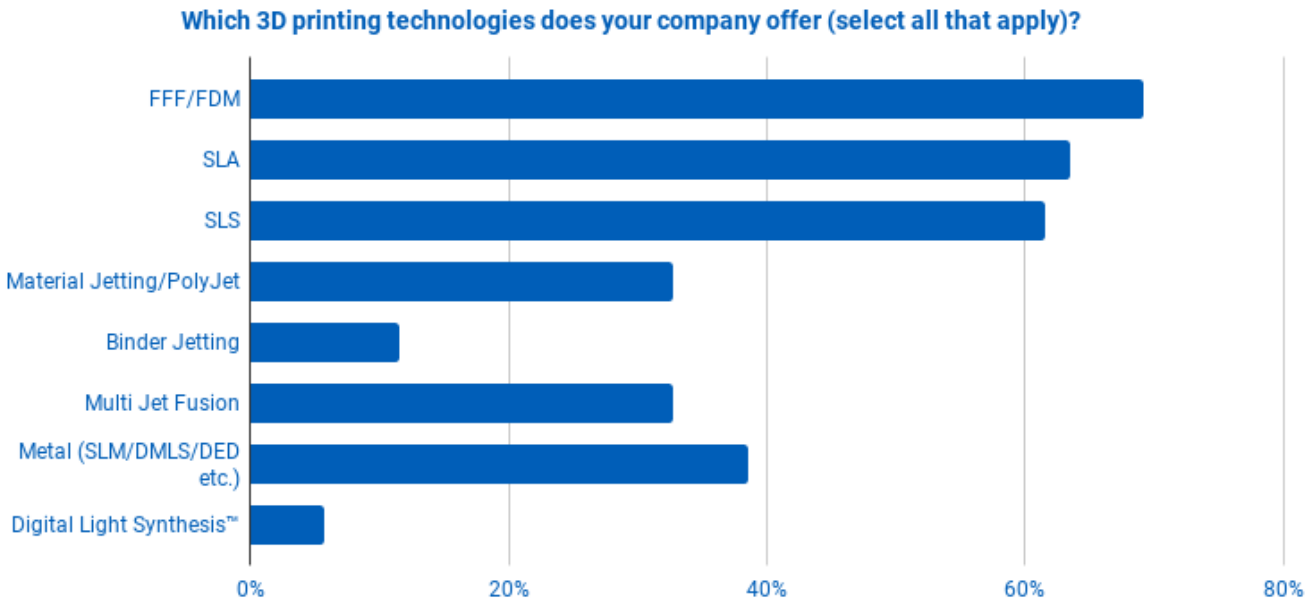
Years in operation



WHICH TECHNOLOGIES ARE SERVICE BUREAUS OFFERING?

Today, the range of 3D printing technologies on the market is more diverse than ever. Hardware manufacturers are developing new systems and processes for both polymers and metals, with an eye towards manufacturing. But what impact is this having on service bureaus?

To find out, we asked survey respondents to indicate the technologies offered by their company and to identify which of those technologies was the biggest source of their annual revenue. Both of these factors are an important indicator of the technologies that are currently driving business revenue and those with the highest demand within the wider additive manufacturing industry today.



Fused Filament Fabrication (FFF)* came out on top as the technology most commonly offered by service providers, with 70% of respondents offering this technology. Second was Stereolithography (SLA) at 63%, followed by Selective Laser Sintering (SLS) at 62%.

70%

offer FFF/FDM

Metal 3D printing** came fourth, with 39% of respondents offering some form of metal 3D printing.

64%

offer SLA

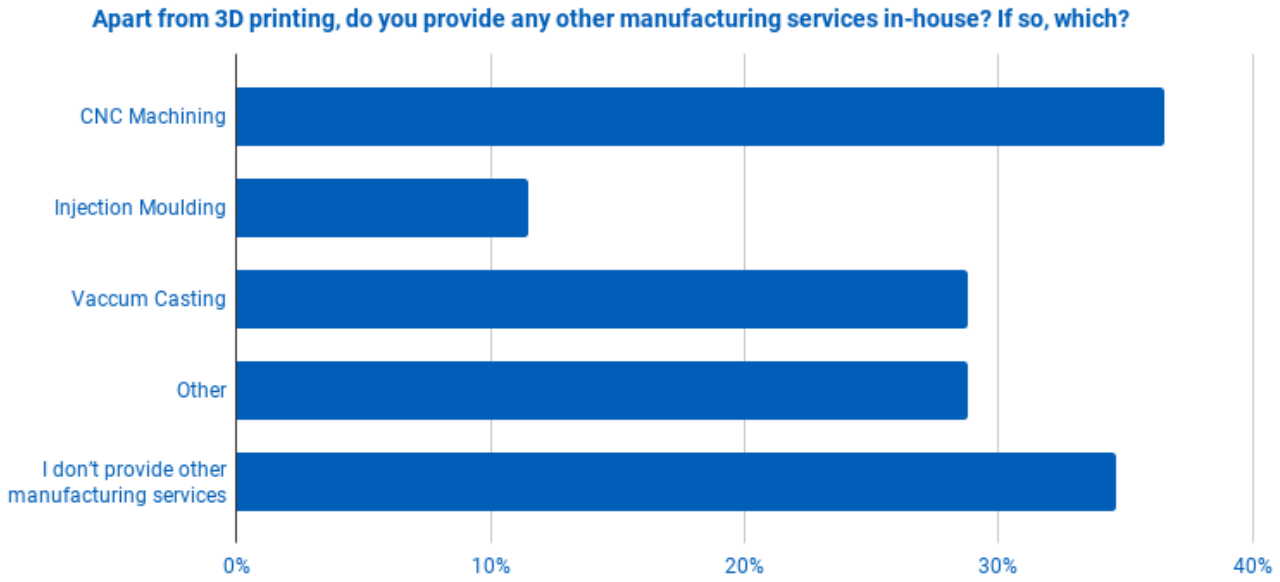
That the top three most commonly offered 3D printing technologies are also the most established is, in some ways, unsurprising. FDM was first commercialised by Stratasys in 1991, SLA by 3D Systems in 1987 and SLS developed and patented in the mid-1980s.

39%

metal 3D printing

**Both the trademarked Stratasys process (FDM) and similar material extrusion processes (FFF) were grouped together.*

***The 'Metal' option covers all metal 3D printing processes, including Selective Laser Melting (SLM), Direct Metal Laser Sintering (DMLS), Directed Energy Deposition (DED) and Metal Filament Fabrication.*



In addition to 3D printing services, some service bureaus may provide other manufacturing services. This diversification not only provides additional revenue streams, but could also offer a point of differentiation for businesses.

When asked whether they provided other manufacturing services in-house alongside 3D printing, the majority of respondents said CNC machining.

Notably, this was followed by those who don't offer other manufacturing services. This could well be explained by the scope of this report, which focused exclusively on businesses whose primary service was AM.

Rounding off the list were vacuum casting (29%), followed by injection moulding (12%).

Services mentioned in the 'other' category included:

- Heat treatment
- Laser cutting
- Metallurgical analysis
- 3D scanning
- Sand casting
- Dimensional control
- 3D modelling
- Sheet metal fabrication

37%

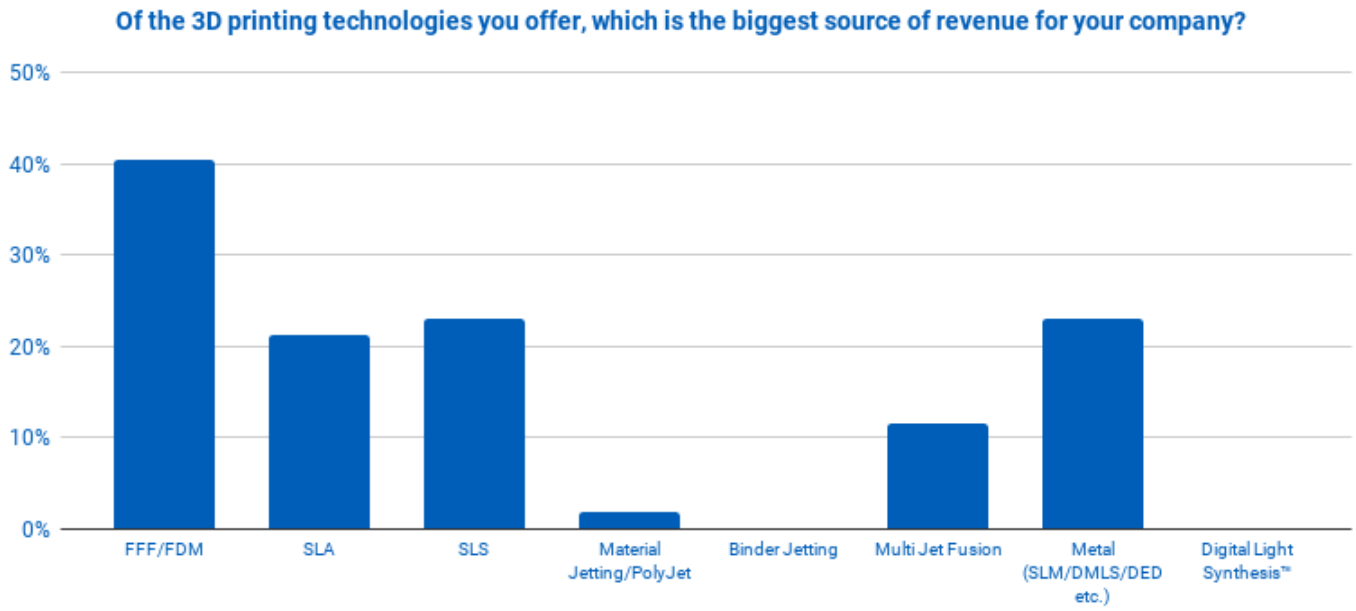
offer CNC machining services

35%

offer AM services only

29%

offer vaccum casting



The majority of respondents — 40% — selected FFF/FDM as the technology contributing the most amount of revenue to their business.

SLS and metal 3D printing came a joint second at 23%, followed by SLA at 21%.

Interestingly, HP's Multi Jet Fusion technology was offered by 33% of respondents, with 12% indicating that this technology was the highest revenue source for their business.

Key Takeaways

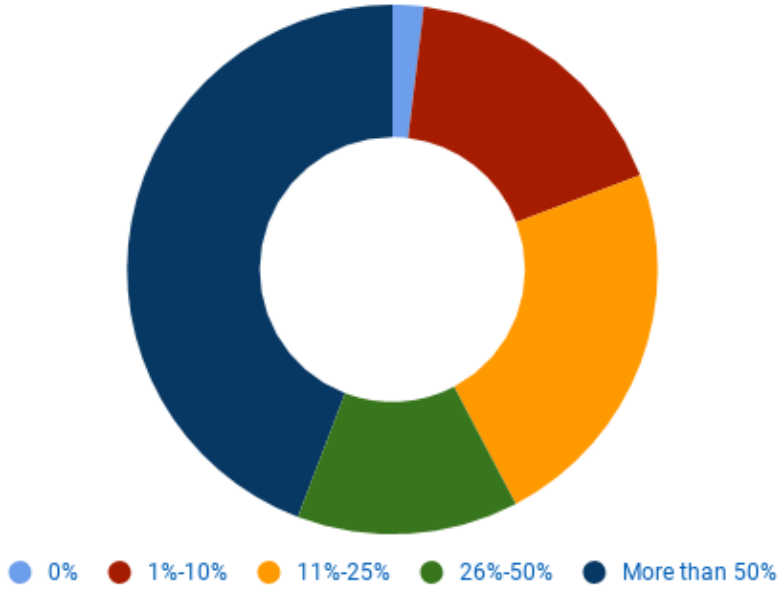
When it comes to the 3D printing technologies driving business revenue, the results are clear: polymer 3D printing continues to dominate the services market in 2019. That said, as the technology continues to mature, we expect revenues from metal 3D printing to increase.

A recent report from market research firm, SmarTech Analysis, predicts that metal 3D printing by service bureaus will generate a total of $6.7 billion in revenue by 2023, driven by the higher level of complexity of the metal 3D printing process [3]. With metal 3D printing being more complex for companies to take in-house, service bureaus could benefit by offering their specialism. However, this comes with a caveat, according to the same report: while service bureaus may see growth with metal 3D printing, reports it may be less profitable than polymer 3D printing in the long run [4].

WHICH APPLICATIONS ARE DRIVING REVENUE?

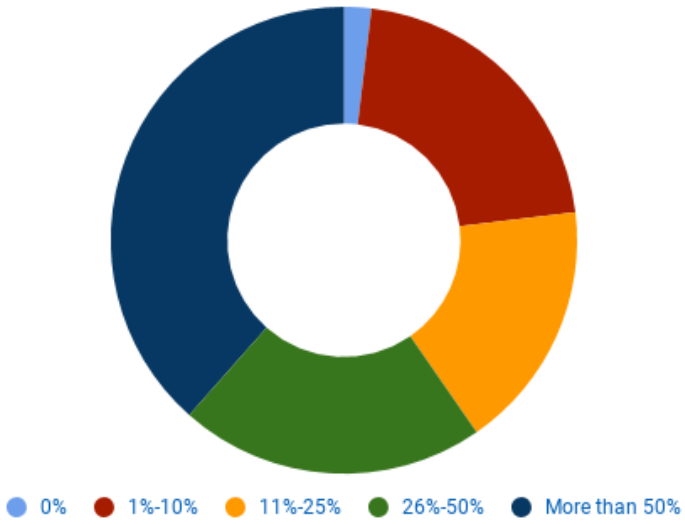
While rapid prototyping remains the primary application of additive manufacturing, there has been an increasing shift towards end-part manufacturing in recent years. With the industry moving towards production applications, we wanted to understand the impact of this shift on service bureaus, as well as the applications offering the greatest opportunity for the services market.

Of the 3D printing services you provide, what percentage of your revenue comes from rapid prototyping?



For the majority of respondents (44.2%), rapid prototyping continues to generate over half of company revenue. Surprisingly, 17% stated that rapid prototyping comprised 10% or less of their company revenue. One reason for this could lie in the increasing number of OEMs taking their rapid prototyping and product development processes in-house. When it came to end-part production, 39% of respondents reported over half of their revenue coming from this application, a slightly smaller proportion than rapid prototyping.

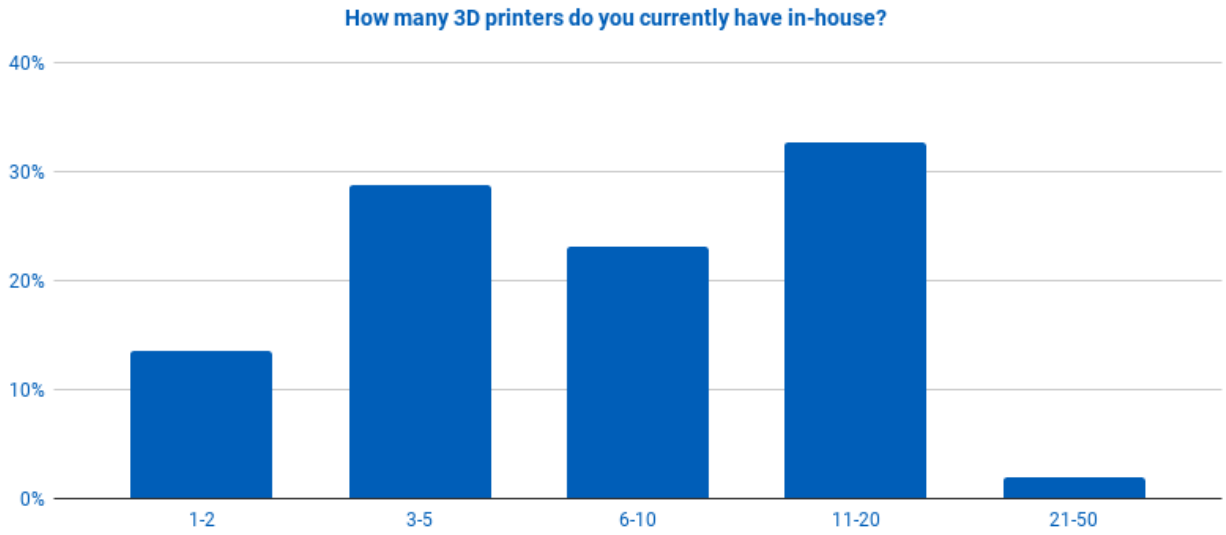
Of the 3D printing services you provide, what percentage of your revenue comes from small series (end part) production?



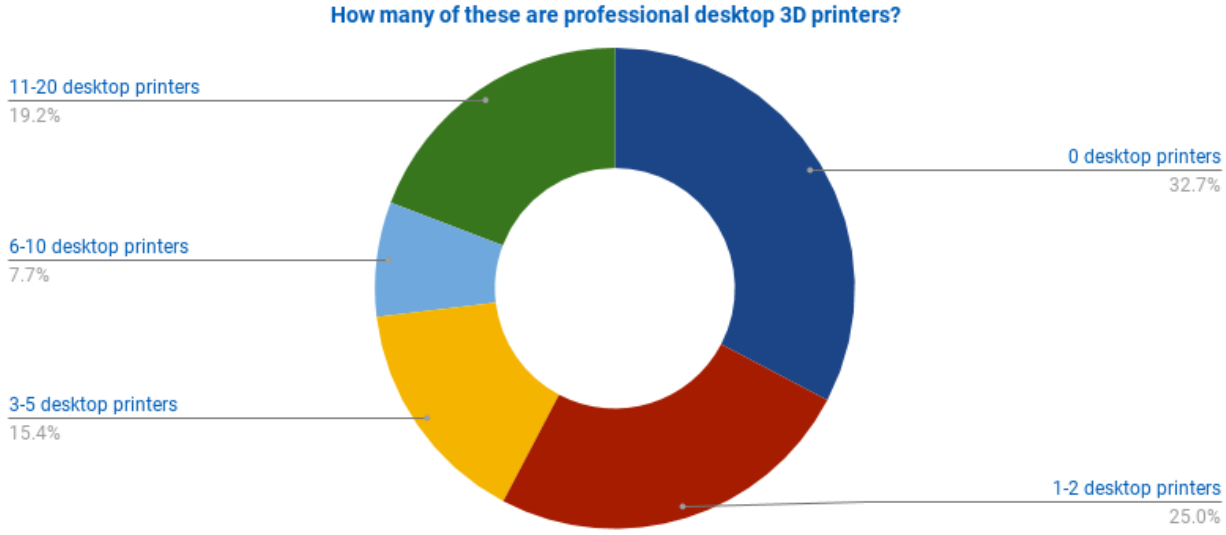
Key takeaways

The results for this section indicate an almost even split between revenues from rapid prototyping and end-part production. However, we expect the proportion of revenues coming from end-part production to increase over the next 24 months, in line with the industry's focus on production applications.

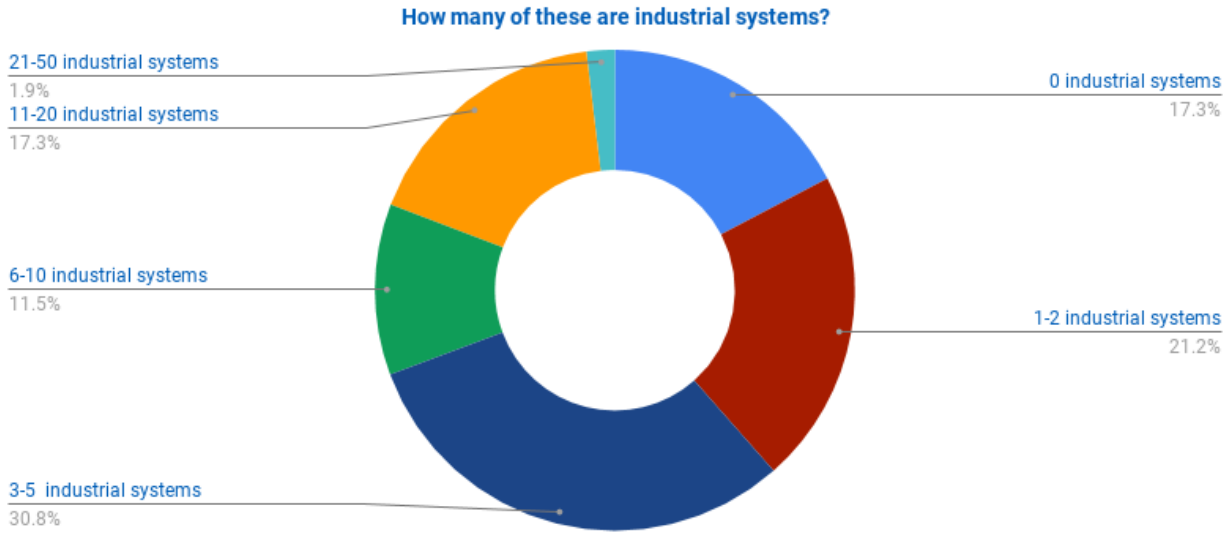
HOW MANY MACHINES DO SERVICE BUREAUS HAVE IN-HOUSE & WHAT ARE THEIR PRINTING VOLUMES?



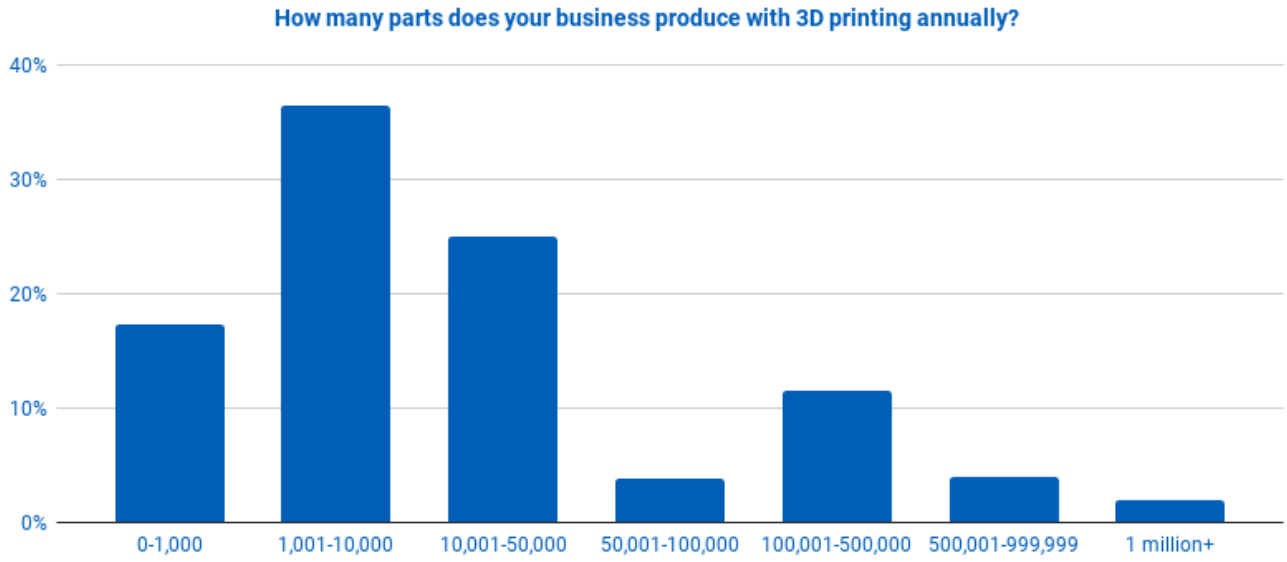
A third of respondents reported having between 11 and 20 in-house 3D printers. This was followed by the 29% who have between 3 and 5 3D printers. On the other end of the spectrum, only 2% had between 21 and 50 machines, while none reported having more than 50 machines. Since this question didn't specify which types of machines respondents own, there appears to be no correlation between the number of machines owned and the amount of revenue generated.



Next, we asked how many of those 3D printers were desktop machines. A third reported having no desktop printers in-house, while a quarter reported having between 1 and 2 desktop printers.



In contrast, only 17% of respondents indicated having no industrial systems in-house (industrial being defined as anything not desktop). 31% reported having between 3 and 5 industrial systems, while 21% have between 1 and 2 industrial systems in-house.

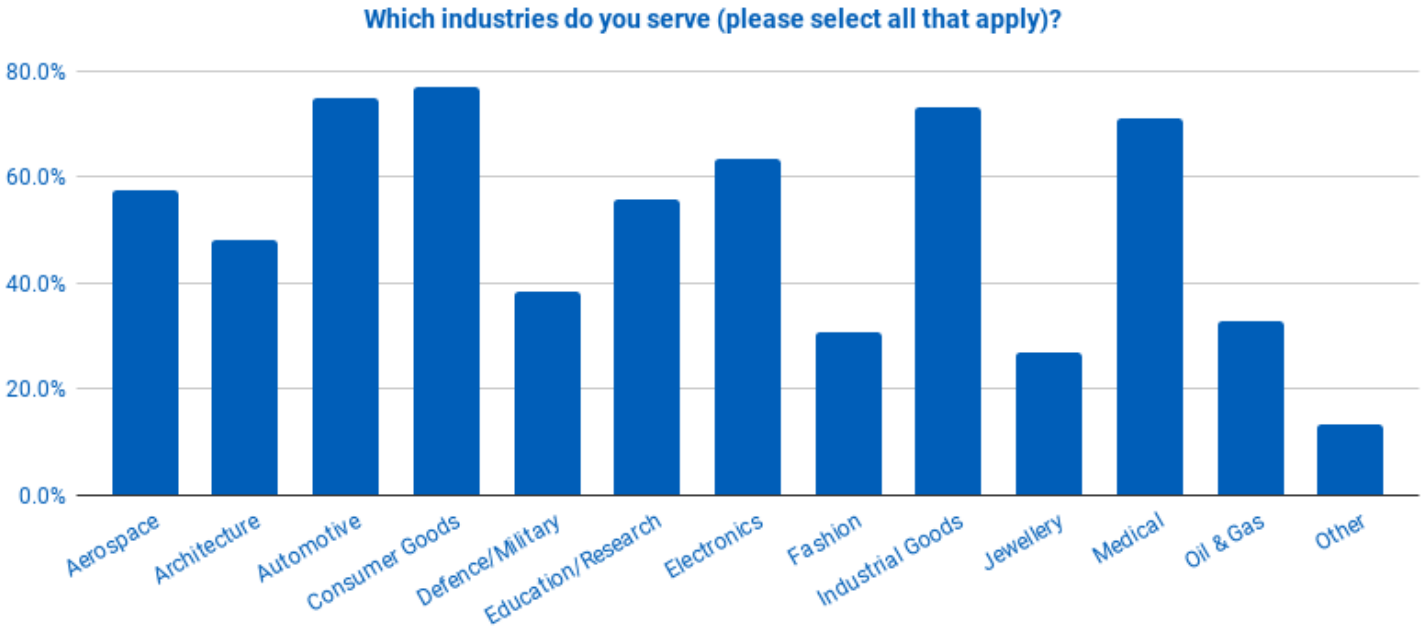


To gain an understanding of the volume of parts being printed, participants were asked to indicate the approximate number of parts they produce for customers on an annual basis.

Over a third of respondents (37%) reported producing between 1,001 and 10,000 parts annually. This was followed by a quarter who reported producing between 10,001 and 50,000.

WHICH INDUSTRIES ARE DRIVING 3D PRINTING DEMAND?

The following section explores the industries that drive revenues for the service bureau market today. The results provide an interesting insight into the sectors that could be the most profitable for service bureaus, as well as those currently outsourcing the most amount of 3D printing jobs.



By a narrow margin, consumer goods emerged as the industry most commonly served by the service bureau market, with a sizeable 77% of respondents selecting this option.

This was followed closely by automotive, which received 75% of responses and industrial goods, with 73%. Medical narrowly missed out on the top three, with a still impressive 71% of respondents serving this sector in some way.

Other industries served included:

- Robotics
- Alternative Energy
- Sports
- Food & Beverage
- Bioanalytics

77%

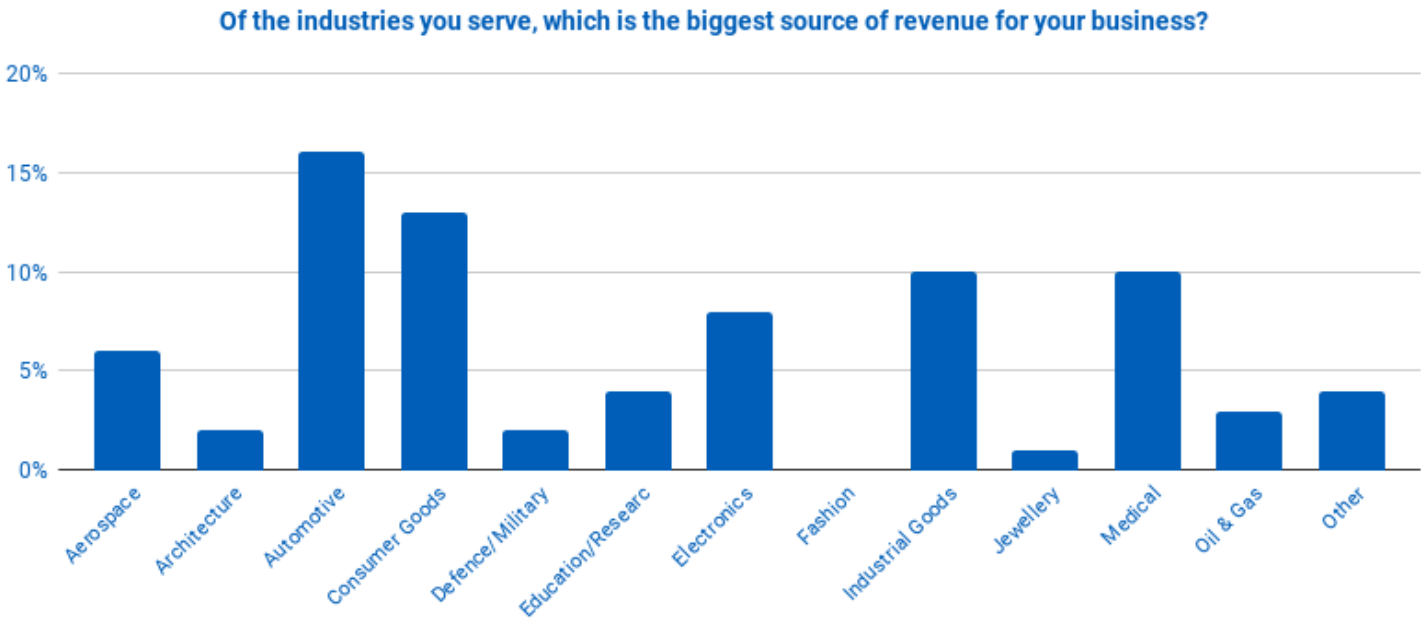
serve the Consumer Goods industry

75%

serve the Automotive industry

64%

serve electronics



This follow up question aimed to identify which of the industries chosen were the biggest source of revenue. This, of course, could be in terms of the sheer volume of parts produced or, more likely, the value of orders received.

Answers to this question varied widely. Automotive was the biggest source of revenue for 16% of respondents, followed by consumer goods at 13% and industrial goods and medical, both of which received 10%.

Key Takeaways

When it comes to the industries driving the services market, the consumer goods, automotive, industrial goods and medical industries lead the way.

Somewhat surprisingly, of the 58% of respondents who reported serving the aerospace industry, only 12% selected aerospace as being the biggest source of their revenue, despite the aerospace industry being one of the biggest users of additive manufacturing. However, this could be explained by the strict requirements and regulation within the industry, which makes becoming a supplier an often long and challenging process.

Interestingly, 64% of respondents offer 3D printing services for the electronics sector, a figure higher than we anticipated. Indeed, while an emerging market, electronics is proving to be a promising application for 3D printing, both for consumer and defence/military applications.

WHAT ARE THE BIGGEST CHALLENGES FACING SERVICE BUREAUS TODAY?

With the additive manufacturing landscape constantly evolving, service provides need to be more agile and flexible than ever. In the following section, we asked participants to share what they viewed as the single biggest challenge facing their business today.

1. "Lack of 3D printing knowledge" emerges as the biggest challenge facing service bureaus today

By far the most common challenge participants cited is the lack of 3D printing knowledge, and the need for greater education.

Despite an increase in awareness of and media attention around additive manufacturing in recent years, surprisingly, misconceptions about the technology still persist. This includes misconceptions about the capabilities of 3D printing, the range of technologies available and the types of applications that would be best suited to the technology.

Design for additive manufacturing also emerged as a major knowledge gap. Here, participants cited a lack of awareness about the need to approach designing for additive processes differently from traditional manufacturing methods.

According to the responses received, service providers are often faced with clients seeking to substitute a number of traditional manufacturing methods with 3D printing, regardless of whether this would truly be the best approach.

Some more individual responses:

“Customers need to learn to design for additive manufacturing and not just CNC.”

“Customers need to understand that for 3D printing to bring value to a product, it has to be designed for the process. It’s not just a case of using 3D printing to reproduce a part that was previously made conventionally. So when a customer asks, ‘Can you make this cheaper?’, I say, ‘No, but we can make it better!”

“Price, part quality and consistency are the areas where most of the time people fail to understand the differences.”

2. Competition is increasing

The second most common response was in relation to the increasingly competitive landscape. On one hand, a number of machine OEMs now offer production services alongside selling their machines. On the other hand, the relatively low cost of professional desktop 3D printers has led to a rise in the number of new service bureaus being founded.

One respondent commented, “As some bigger players in the AM machinery circle of OEMs continue to push themselves on the service market, there has been a massive increase in competition for service bureaus from that side.

“Following this trend, as a countermeasure, service bureaus are lumping their capacities in hub-like structures in the hopes of keeping the balance. The initial perspective of 3D printing bringing decentralised and highly local production is being increasingly undermined by the machine OEMs themselves.”

On the other end of the spectrum, a number of participants reported feeling the pressure from competitors using desktop machines to offer lower prices.

One stated, “The market is saturated with low to mid-range quality service providers. This creates the wrong perception for most clients as to what can be expected from high-end service providers and machines.”

3. Balancing Pricing and Operational Costs

Running a successful service bureau requires a delicate balance between providing services at a competitive price and ensuring profits are made and operational costs covered.

This was reported as the third key challenge for service bureau owners. Costs related to machine maintenance, materials and labour costs (particularly for post-processing, which remains an overwhelmingly manual process) must be reflected in the prices charged to customers.

However, this is easier said than done. One issue lies in customer expectations around prices.

As one participant noted, the reality of costs can often be misunderstood:

“Process stability and waste-free production [with 3D printing] is something everybody automatically wants, but only a few are willing to pay for. And yet, in conventional manufacturing there is no discussion about quality assurance measures, everybody is clear: that costs money.”

4. “Investing in the Right Technology”

With 3D printing technologies developing rapidly and new machines being announced virtually on a monthly basis, knowing which technology to invest in can be a fine art.

For service bureaus, the key challenge lies in the need to invest in technologies that will support customers’ needs as well as the long-term growth of their business.

5. Managing Quality Processes

Additive manufacturing remains an emerging industry, and challenges relating to quality processes and standardisation are industry-wide.

However, achieving the right certification for 3D-printed parts remains a challenge for service bureaus today, particularly when it comes to highly-regulated industries like medical, aerospace and defence.

Adding to the challenge is the fact that regulations and standards vary across industries. Being ITAR certified, for example, will almost certainly be a must for the aerospace and defence industries.

As one respondent noted, “Standardisation and quality assurance must be as closely watched as the newest developments in 3D printing technology along any service bureau’s journey into the future of industry 4.0.”

6. Marketing

Finally being able to effectively market their business emerged as a challenge among a handful of respondents. This, they said, had a significant impact in terms of being able to penetrate the market and earn new clients.

WHAT DO THE NEXT 12 MONTHS HOLD FOR THE SERVICE BUREAU MARKET?

Outlook From Service Providers Is Generally Positive

When asked about their outlook for their business over the next 12 months, the majority of respondents reported a general positive outlook for the year ahead. This was often either in relation to the anticipated growth of their business, or of the overall market.

Some cited experiencing a rising demand for services, particularly for production parts. Others aimed to double or even triple their revenues over the next 12 months. Below are a selection of responses:

“We'll see more and more parts being produced with AM, and customers ramping up with flexible and local production. AM will be increasingly used as an alternative for — and extending beyond — turning, milling and injection moulding.”

“We are keen to provide more solutions for low to mid volume production runs.”

“We aim to continue to grow, but with more of a focus on education.”

“We will be launching new fire retardant materials so main outlook will be on the aviation and railway industries.”

“We have seen steady growth year on year, and I don't see that changing in the next 12 months. I think awareness is steadily growing and we are yet to peak.”

“The 12 month outlook seems to be strong. There are new materials and many more companies adopting additive manufacturing for production parts.”

“Optimistic. We are planning to expand our line of services and push into higher paying markets.”

Prices & Lack of Automation Could Hamper Growth

For a small percentage of respondents, there is some ambivalence about the year ahead, with some citing challenges for their business. Among these challenges, being able to set the right prices for customers, the need for education and ambivalence with regards to market growth were recurrent themes.

Some responses:

“It will be a race to the bottom on pricing, so it will be more about what other services can be provided outside of 3D printing.”

“The service provider market will continue to grow but not as fast as it should. Additive manufacturing's future clients need a lot of education as well as convincing examples. The majority of companies, besides the developed countries, are not spending money that easily. So we have a long road ahead to properly convince them.”

"We are facing challenges to provide each day better products, with better materials, bigger parts, and more quality. One of the main aspects that we will need to consider is automating the workflow as much as possible, as well as increasing the amount of equipment we have installed.”

Additional comments

“Aerospace demand is growing at the moment, which for us and several of our partners mean that primary income is going to come from this industry, even if it is not right now.”

“With the biggest squeeze on the automotive sector, service providers whose income is dictated by this will be progressing along two lines of strategy: there will be a big push on market penetration to maintain or increase market share; and there will be a secondary push on market development - pushing their existing services into new sectors/markets. However, those with solid market share and significant competitive advantage will be looking to invest in new tech to push to their existing markets.”

Key Takeaways

Service bureaus must continue efforts to educate customers.
In spite of the increased awareness of 3D printing, there is a need for more education around the capabilities and limitations of the technology. Service bureaus have an opportunity to lead the charge by leveraging their expertise to provide educational material for their customers. This could take the form of workshops, one-on-one consulting, webinars or case studies, in addition to blog posts and brochures.

Competition may be increasing, but opportunity is rife.
There is a clear opportunity for service bureaus to differentiate themselves from competitors by leveraging their unique expertise. It is important to have a clear understanding of your industry segments and provide customers with a clear value proposition.

Plan investments into new technologies wisely.
While it can be tempting to invest into the latest technologies, it's important to first assess whether that investment will be beneficial in the long run. To do this requires having a thorough understanding of your customers' needs, as well as your long-term business goals. Sampling parts is one way to test the suitability of a given machine.

Qualification processes remain an industry-wide issue.
This is one challenge that can't be tackled by service bureaus alone. It is a statement on the general state of the 3D printing industry - the industry has a long way to go before there is a common standardisation and certification process in place. This should remain a key priority for the industry, in order to further the adoption of and demand for 3D printing.

Ultimately, the service bureaus that will succeed will be those with a clear value proposition, target markets and specialised expertise.

ASK THE EXPERT

Scott Dunham, SmarTech Analysis

Scott Dunham is the Vice President of Research at SmarTech Analysis, a leading market research firm that offers industry analysis and market forecasts for the additive manufacturing industry. Scott gave us his thoughts on the biggest challenges facing service providers today and where the industry is headed.

We think there's a couple of archetype roles that define the service bureau segment today. While they probably share some challenges, they definitely have their own unique issues based on their business model, competencies, the technologies they offer and level of expertise.

The 'pureplay' model

What we call the 'pureplay' rapid prototyping firms still tend to offer, for the most part, classic polymer printing technologies to support prototyping. This is in conjunction with perhaps some metal printing and typically short run injection molding, machining, and other relatively limited manufacturing services to serve the market for prototypes.

These firms are probably seeing business volumes for 3D printing growing pretty slowly, or possibly even declining, if they haven't been very proactive over the last several years.

The significant increase in accessibility for in-house 3D printing has probably also challenged these businesses. These businesses need to stay on the cutting edge of printing technology and material updates because that's where their customer's attention is likely to be pulled. If they aren't experts in offering the latest and greatest, it will impact them in a highly competitive market.

The "integrated print-service provider segment"

These companies have a lot of the same challenges as the 'pureplay' bureaus because they typically operate in much the same way.

However, there's the added complication of running a business that is also driven by selling printers directly to some of the same customers you may be printing parts for. It can be a fine line not to significantly impact one or the other.

I would say the biggest challenge facing this segment is that it's an increasingly complex business to navigate as the market expands.

However, not everyone in this category sells printers — some companies develop materials for printers and also operate printers to print parts in these materials so that customers can gain confidence in them first before developing applications.

These companies typically struggle because they ultimately want to focus on the materials, and finding customers for parts in a market where you can access networks of service providers all over the world can be pretty hard. It's always a very collaborative relationship which takes a lot of effort. Usually, these types of integrated providers are leveraging their existing client base and serving their specific interests in 3D printing.

Specialist 3D printing service bureaus

Specialist 3D printing service bureaus are those which only create parts using 3D printing, and specialize in providing parts to one type of client (i.e. medical devices, or aerospace parts). These aren't as common today but we see the opportunity here growing over time.

We've seen a lot of these businesses become acquired by other companies at an early stage if they've become good at leveraging a certain type of outsourced printing because there's a big demand for expertise in print process operation.

The biggest challenge here is simply creating awareness and "buy-in" for 3D printing within a given industry so that these businesses can exist in the first place, which is why today we mostly see specialist bureaus existing purely in healthcare.

There are exceptions to this, and over time we expect there to be much more diversity with automotive printing specialists, aerospace and so on.

"Service providers are key to the industry's development."

Scott Dunham, SmarTech Analysis

Contract manufacturers

Lastly, there are companies that have been serving the needs of one or more industries in the past, and have gradually added 3D printing capabilities to their offerings.

They typically don't operate in the same way as a ‘pureplay' service bureau, and often closely resemble a 'specialist' bureau. The key difference is that these businesses started with traditional manufacturing, and have slowly begun to leverage 3D printing as a means of production as their clients have become more aware of its benefits or requested these services.

These businesses also tend to skip the prototyping business model and want to focus only on production. In my opinion that is the main issue this segment faces — integrating various printing processes through the lens of production. I think everybody knows this is a challenge today, and for contract manufacturers, it's a critical one.

A typical OEM can often afford to have underutilized printers or can leverage them in many ways to generate value internally. A contract manufacturer pretty much lives or dies by machine utilization, so if they aren't quickly ramping up their printers to a high level of utilization, they are going to be losing money.

On how the market will evolve

Service providers are key to the industry's development.

I see a squeezing of the 'middle ground' providers in the industry over time, while those operating at the extremes are most likely to flourish.

If you think of the four provider types mentioned above on a spectrum, on one end you have a relatively narrow scope of offering but high level of specialization, and at the other end you have a very wide services offering but lower levels of specific, deep expertise. I think those in the middle of this spectrum will be most challenged.

That's not to say that all segments won't have their own specific challenges, but rather I think business models will probably polarize a little more. I see this as inevitable with the industry's overall growth out of prototyping into manufacturing.

The specialists who can cultivate unmatched expertise in a specific area of AM (like metal additive manufacturing specifically of titanium alloys for medical applications, for example) should see a return on that investment in expertise.

On the other end, those companies offering an array of printing technologies to make parts for customers, as well as supporting post-processing and design services for each, should also eventually rise to the top.

Those two areas may be challenging, but in the long run, there isn’t a lot of value in being a business in the middle of the road.

I would say that 'pureplay' service providers' and 'integrated providers' are most likely to be caught in the middle and will most readily have to adapt in the future.

INDUSTRY SPOTLIGHT: GRAPHITE ADDITIVE MANUFACTURING

Jonathan Warbrick, Business Development Manager

Graphite Additive Manufacturing is a UK-based company offering industrial 3D printing solutions. With strong ties to the world of UK Formula One and motorsports, Graphite's solutions include production parts, tooling, concept models and prototypes.

What is Graphite's mission?

Our aim at Graphite is to help our clients find the best solutions using additive manufacturing, from prototyping all the way to production. This includes helping them understand which technology and materials will best suit their applications. We differ from a lot of other service bureaus in that we manufacture our own materials as well.

The UK very much leads the world in terms of innovation within motorsports, and additive has been playing a key role in that. So in the early days, our main industry focus was Formula One and motorsports.

Since then, we've taken steps to diversify and take the knowledge we have into the broader market.

Big wins for us in recent years have been applications for industries like automotive, marine, aerospace and defence. We still do a lot of work within Formula One field motorsport — it's our heritage — but we're now also trying to get into some more steady production volumes.

What is it like running a service bureau today?

Business has been really positive and we ended last year on a high. We've had sustainable growth of about 20% over the last three years and we'll see this grow by 20-35% again this year.

The challenge, as always, is understanding which markets we want to attack and which clients we need to be working with, while strengthening the relationships we already have with our existing clients.

One of the driving forces behind our recent growth is us moving from prototyping into more production.

Within motorsports, we tend to find that the volumes are fairly low and the lead times are very short.

In terms of building a sustainable business plan and growing going forward, we recognise that we have great solutions for our Formula One and motorsports clients. But we shouldn't bank on it and plan for business growth in that sector. The key for us is to get a really good balance between fast turnaround for the urgently needed projects and the nice steady low to mid-volume production runs.

This transition comes with a number of challenges, such as quality, standards, inspection, traceability and the paperwork side of things. These have been something that we've been actively taking steps to address, from taking on new hires to moving into a slightly larger facility last year as well. So we finally have some room to grow into, which is great.

Another challenge we've faced in recent years is the lack of automation for managing some of our lower value orders. These were taking up lots of time, in terms of sending emails to clients and scheduling jobs. Workflow software has been a huge benefit for our business, enabling us to make our workflow far more streamlined and automated.

For many service bureaus, the temptation is to try and be all things to all people. With so many different materials and technologies out there, it's more important to specialise in certain areas and work with really good partners in the areas where you're not so strong, so you still offer a really broad range of technologies and services to your clients. We realised early on that we don't need to try and do it all by

ourselves under one roof.

A good example of that at the moment is metal 3D printing. When you see a new and innovative technology, the tendency is to buy a new machine.

But we have to be very careful to ensure that the growth we enjoy is sustainable. This means we make those investments in line with both the current needs of our clients, as well as the needs that they will have in 6 to 12 months' time.

How do you weigh up whether or not to invest in a particular technology?

It's very much about introducing these new technologies and materials to your clients, understanding the limitations and capabilities of a particular technology and being confident that there's a demand for it.

For us, this means being really data-driven. We try and understand each new technology, and we print test parts to get a sense of what it can and can't do before making that jump.

So it comes down to being close to your clients, introducing new technologies as they come out and ensuring that before you make any big investment into a machine, whether it be SLS, SLA, MJF or FDM that there's actually a demand there.

For example, we've been introducing HP's Multi Jet Fusion technology to our clients for the last two years, making sure they fully understand the limitations and capabilities of that technology.

We don't actually have one of those machines in-house yet, but our approach has been to fully understand that technology before we make that jump.

Companies are starting to do more 3D printing in-house. How do you think that will impact the service bureau market?

It'll be very similar to what happened with technologies like injection moulding and other forms of manufacturing, particularly within industries like automotive. In essence, the automotive OEMs don't manufacture anything, they assemble parts on big production lines.

With such a new technology like additive manufacturing, companies will take it in-house to make sure that they're getting the best benefits and cost savings. But that doesn't necessarily mean they need to make all those parts in-house themselves.

At the moment, there's a real drive to buy machinery and to upscale. In time, that will dissipate again, just as it does with almost every other technology used in automotive. They will be outsourcing parts and making sure that they get deliveries on time.

Ultimately, there will be a balance. Take Volkswagen as an example. They have a large number of FDM machines printing parts on the workshop floor to support their manufacturing process. But they're still outsourcing huge volumes of printed parts to other service bureaus.

Now, there's a temptation to bring all AM production in-house, but that will change as companies realise you need a large number of machines to fulfil production demands going forward, with implications in terms of personnel, workshop space and cost. In the end, you'll always need the support of good service bureaus.

How would you describe the landscape for AM service bureaus, both now and in the future?

There's a wide range of different types of service bureaus out there at the moment. But because the barriers to entry for 3D printing are so low, you can spend a few thousand pounds on a couple of desktop FDM machines, and suddenly you have a service bureau.

But I think overall, that's a good thing for the industry. Competition is the key to pushing the industry forward, as it drives development and innovation.

There are some very well established, excellent bureaus out there. But there are very few bureaus, if any, that are doing what Graphite is doing. We're quite unique in terms of producing our own SLS powders.

Going forward, I think there will be a lot of mergers and acquisitions over the next few years. For some of the larger manufacturers of 3D printing materials, it will be a natural move to have a service bureau attached to their business. There's a real opportunity for the other manufacturers to do deals or to buy up service bureaus to promote their particular materials.

INDUSTRY SPOTLIGHT: PARTS ON DEMAND

Neil van Es, Founder

Founded in 2014 and based in the Netherlands, Parts on Demand is a 3D printing service bureau that specialises in series production, tooling, moulds and the production of machine parts.

We spoke with Neil van Es, Founder of Parts on Demand, to discuss the company's decision to specialise in end-part production, the technological developments to watch out for and the particularities of the Dutch manufacturing market.

"As a business, we're very focused on 3D printing for production," says Neil. "There are a lot of 3D printing companies that have their roots in model making and prototyping and have stayed in this space. Parts On Demand, on the other hand, is focused on end-part production. We strive to create better and more efficient products by leveraging the complexity of 3D printing for the parts we produce.

"Some of the parts we 3D print include components for production lines, tooling for the automotive industry and bridge manufacturing."

Neil shares the common view that the additive manufacturing industry is steadily moving towards production applications, shedding its reputation as being solely a prototyping technology.

"I think we're definitely past the consumer 3D printing hype that took place a few years ago," he says. "We're now gradually getting to the point where 3D printing is being adopted as a production technology rather than just a means of prototyping."

However, this transition requires a shift in attitudes, as well as the need to educate the market on the possibilities and limitations of the technology — a key challenge faced by many service bureaus.

"While we're seeing more production applications with 3D printing, this transition requires a lot of education — creating trust and showing what's actually possible with 3D printing if you use it in the right way," says Neil.

"The main challenge lies in educating customers and engineers on how to make proper use of the freedom in complexity you have with 3D printing. As a business, we have to be able to demonstrate to customers how 3D printing can help them create better, smarter and more efficient products."

This also includes highlighting the benefits that can be gained with 3D printing. "A lot of the manufacturing today is driven by technology like 3D printing.

"Production series are getting larger, so product development needs to be quicker if companies are to create more value," says Neil."Product life cycles must, and are, getting shorter and shorter. We now have some customers making dynamic products which are, in essence, evolving with each production run.

"All of this is made possible thanks to 3D printing. If you receive feedback from clients and ask your engineering and product development teams to translate this feedback into a revision of your product, there's no longer the need to wait months and years before a relaunch — you can simply relaunch the product in the next batch you produce.

"This is an example of how 3D printing is enabling dynamic product development, rather than the static approach to production we've become accustomed to over the years."

The shift towards production also makes process repeatability and quality control more important than ever, although this remains a challenge for many companies. "The majority of service bureaus have their roots in prototyping. They may be really good at manufacturing a single part or a prototype but struggle with consistency and

quality," says Neil. "That's something that will need to be addressed for the market to evolve and grow, and to make 3D printing a more stable production technology."

Metal 3D printing is another area that requires further development. "I think the metal AM market in the Netherlands is sluggish because there aren't that many companies that can make proper use of metal 3D printing. 3D printing metals is much more expensive than polymer 3D printing, so we've been a bit cautious to adopt it. At Parts on Demand, we mainly focus on Selective Laser Sintering just because it's a good way to efficiently make parts."

Challenges aside, there is a lot of excitement within the industry, particularly when it comes to new technologies. For service bureaus and OEMs alike, this offers an exciting opportunity to experiment and test the limits of 3D printing.

"I'm particularly excited about the new LaserProFusion technology announced by EOS," says Neil. (EOS first announced its new technology for polymer 3D printing in November 2018.) "If the technology works like the company says it will, I think it could be a real game changer. For us, that would certainly be a technology to look out for and invest in."

But while much of the focus has been on the 3D printing systems, Neil suggests that greater potential may, in fact, lie in post-processing technologies.

"I think going forward, post-processing automation will become one of the major things to watch out for," he says. "This is because the real step change will be in the ability to automate post-production. People are focusing a lot on the 3D printing technologies, but that's not necessarily the reason why improvements in quality or consistency are achieved.

"You have to consider the whole process, and this idea is often neglected. Many people are trying to start a 3D printing business without understanding that it's not just 3D printing by itself. The whole process needs to be considered in order to achieve something of value."

For Neil, it's important for service bureaus to fully understand the market they're operating in. "If you look at the Netherlands, there are a lot of machine manufacturers and companies implementing automation, either in food or agriculture or packaging," says Neil. "The Netherlands is really a market where a lot of production lines are being created. So a lot of what we do as a service bureau is tied to these sectors.

In contrast, if you look at Germany, there are several large service bureaus there, mostly tailored to industries like automotive and industrial goods. So for us, it's really important to understand our target markets in order to better serve our clients."

INDUSTRY SPOTLIGHT: MAKELAB

Christina Perla, Co-Founder and CEO

Makelab is a New York-based service bureau that provides 3D printing services for industries including consumer goods, architecture and industrial goods. The company offers an even split of FDM and SLA technologies, using a fleet of in-house desktop machines.

With a background in industrial design, Christina seen the 3D printing industry evolve first hand. “The industry started out mainly with prototyping and iterative design applications,” she says.

“Now the range of applications has broadened, and the industry is constantly growing. For example, a lot of our customers come to us wanting to prototype their newest IoT innovations and product and hardware designs.

“It seems like there are new technologies coming out every month. I also see a lot of advancements in the medical industry, especially dental. What I find particularly impressive are the developments being made in printing biocompatible tissues for

surgeries. The industry really has come a long way.”

In an industry that is constantly evolving, what does it take for a service bureau to succeed?

According to Christina: innovation. “There are a lot of 3D printing service bureaus that are trying to innovate, whether it’s tinkering with their machines to make them more like workhorses or continually trying to improve the workflow and their internal systems.

“It's interesting because the market is still operating in kind of an unknown. Yes, it's manufacturing — but the workflows and software for additive manufacturing are so different from traditional manufacturing, partly because there are just so many steps. I feel like we are all still adapting and finding what the standards of the industry are.”

Makelab's early days were focused on fully understanding the industries its customers operate in. This understanding — placing the customer at the heart of its strategy — remains a key point of differentiation for the company.

“We put a big emphasis on understanding our clients from the very beginning,” Christina explains. “We’re a team of designers and engineers, so we all understand the motivations behind creating and are able to really understand our customers. We’re heavily focused on the quality and reliability of our service, and how we can best deliver. We are always questioning how we can do and be better.

“Sometimes, in the beginning, you bend over backwards for customers, and that approach doesn't always fit with your business. It becomes a stressful situation because oftentimes you're not actually able to deliver what you sold.

“But a lot of what we've done is trying to standardise everything so that there's a nice balance between providing an amazing service while being able to work efficiently.”

Christina notes the increasingly competitive landscape for service bureaus, particularly as the cost of desktop machines continues to fall, lowering the barrier for entry for new businesses.

"There are a lot of companies who entered the industry as makers who love the technology and the process, which is how my business partner and I came into it,” she says. “But I think that after some time, you’ll need to evolve into more of a business mindset, where you're looking at how to make your business sustainable and scalable.”

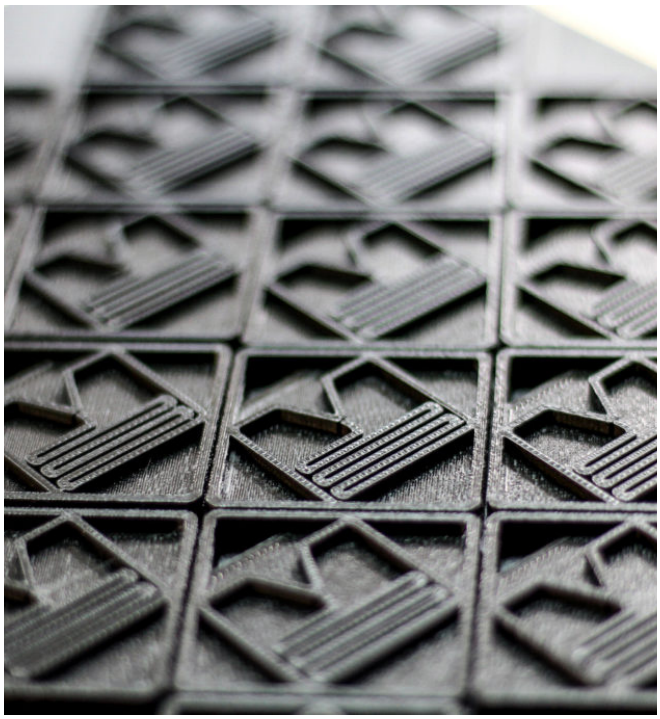
In spite of the competition, Christina says, collaboration is crucial for success. “Having a collaborative relationship is not only empowering and validating as a business owner, but it's also really effective and productive.

“When you're running a bureau, you’re really at the hands of your

customers and what they want and need from your service. If you're targeting a new customer group, that's a whole new service sector — at least, that's how we think of it. When we do target a new customer group, we define a whole new set of needs. But if you can find someone to collaborate with and work with it, it makes perfect sense. So for us, it's really interesting to talk to others in the space, share ideas and be more collaborative rather than see others as competitors."

Whether it's considering the competition or managing internal operations, running a service bureau, like any business, is not without risk. "There's always a risk factor," says Christina. "For example, a big problem for us is factoring in print failures or machine downtime, and assessing how that affects the whole workflow. Another challenge is being able to predict how much you can do at once or how much you can manufacture in a day, for example."

One solution lies in digitising much of the company's processes and workflows to streamline operations and gain efficiency. This has included implementing workflow software."We're working on digitising more and getting our software more aligned so that we can have more control over our operations and bring certain processes down to just a few steps," says Christina.



"With desktop printers, you often have to use an SD card and various different slicers just to get the files to the printer. But we're working on merging a few of those steps to make it a little bit more seamless and ensure there's less room for human error."

Embracing digitalisation has also helped Makelab better serve the needs of its clients. "For our customers that are more experienced with 3D printing, we use workflow software to provide an online portal through which they can submit their orders. We also have repeat clients who need a custom order or a bulk order. Others may require a print in a few different materials or need things to be assembled. Creating a digital workflow helps us manage these different demands much more easily."

Investing in new technologies is another common concern for service bureaus. "We look at it from a perspective of scalability, " says Christina. "The more machines and technologies you have in-house, the more inventory, software, and workflows you need to maintain. To continually invest in new technologies requires quite a bit of change, so we're trying to shift the focus and be a little bit niche."

Christina acknowledges the challenge of predicting what is still, in many ways, an unpredictable market. "The market is still like the wild west," she says. "People are still finding out what works and what's needed to succeed as a service bureau in 3D printing.

"I'm not sure what the future holds. You see service bureaus in the space constantly pivoting,changing their target market to or from B2B, changing their service offerings, everything. It's a super exciting time and I'm excited to see where we all end up."

As for Makelab itself, expansion is a key focus for the months ahead. "We definitely want to scale. In the first few years of our business, we were very much establishing the foundation for a great service, figuring out what works for us, what our clients want and what makes them come back.

"Now that we have that settled and we all feel confident about it, the next step for us is to see how much we can do and how far we can push it."

CONCLUSION

Differentiation will be key to success

With the additive manufacturing industry poised for continued growth in the year ahead, service bureaus will continue to play a pivotal role. However, to succeed in this dynamic and ever-evolving market will ultimately require differentiation.

In a market that is becoming increasingly crowded, service bureaus will need to identify the areas that set them apart from the competition. For example, this could mean targeting specific areas of expertise, industries or technologies.

In parallel, the other key takeaway is the need for more education on the capabilities of 3D printing. While this is an industry-wide issue, service bureaus will have a key part to play, by providing useful case studies of examples of how 3D printing has successfully being used, not only for prototyping, but also for end-part production.

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About AMFG

AMFG provides an AI-powered workflow software platform that enables manufacturers and service bureaus to streamline and manage their entire additive manufacturing workflows.

AMFG offers customisable workflow solutions to ensure a seamless production workflow, from request management to production scheduling and post-processing management.

For more information, or to request a demonstration, contact: **info@amfg.ai** or visit: **www.amfg.ai**.