
3D PRINTING AT SCALE

A SURVEY OF 3D PRODUCTION MANUFACTURING STAKEHOLDERS

January 2019

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Introduction

It's been almost three decades since 3D printing was introduced as an innovative alternative to existing manufacturing processes. The potential of 3D printing to increase design flexibility and reduce time-to-market has inspired (and continues to inspire) forward-thinking manufacturing stakeholders. However, the industry has been understandably slow in adopting 3D printing as there are issues that must be addressed before wide-spread adoption of mass-produced 3D goods can be expected.

This research takes a practical look at current experiences using 3D printing for manufacturing tasks among stakeholders that have invested in uses beyond simple prototyping. This study gathers data on current uses and scale of 3D printing and examines progress on the challenges that slow mass adoption. In addition, it captures current opinions among decision makers on the future of 3D printing and evaluates the potential business impact if (or when) the vision of large-scale production 3D printing becomes a reality.

The following report, sponsored by Essentium, is based on an online survey of 114 stakeholders responsible for decisions regarding 3D printing for production parts. All have direct responsibility for evaluating or purchasing solutions for 3D printing in a production environment at large companies that used 3D printers for use cases beyond simple prototyping.



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Key Findings

- **3D printing has a wide range of uses, but scale remains limited**
 - 3D printers are used for production parts, manufacturing aides, tooling, service parts, MRO, end of life parts, and much more
 - 83% report that their largest production run is only in the hundreds of parts or less
- **3D printing for production parts is expected to grow dramatically**
 - 99% say use of 3D printing will increase over the next 3-5 years
 - 100% see benefits in using 3D printing for large-scale production manufacturing
 - Uses including full scale production parts, complex prototyping, MRO, service parts, mold tooling, and end of life parts will all increase substantially beyond current uses
- **3D printing has the potential to dramatically change the manufacturing industry**
 - 88% believe the industry will save billions of dollars in production costs with 3D printing
 - 91% believe 3D printing will deliver benefits at a compelling cost within 5-10 years
 - Business benefits include reduced costs and new market opportunities once 3D printing has matured
 - 57% expect future production runs to be in the thousands of parts
- **Key obstacles must be addressed to achieve the potential of 3D printing**
 - 100% report that they face obstacles in using 3D printing for large scale production
 - Cost of current printing technology most frequently cited obstacle (42%), followed by cost of materials (35%), lack of scalability of current technology (34%), printed parts being unreliable (31%), and many more

NOTE: This study focuses exclusively on companies using 3D printing for use cases beyond simple prototyping. The data in this report is not representative of all manufacturing companies.



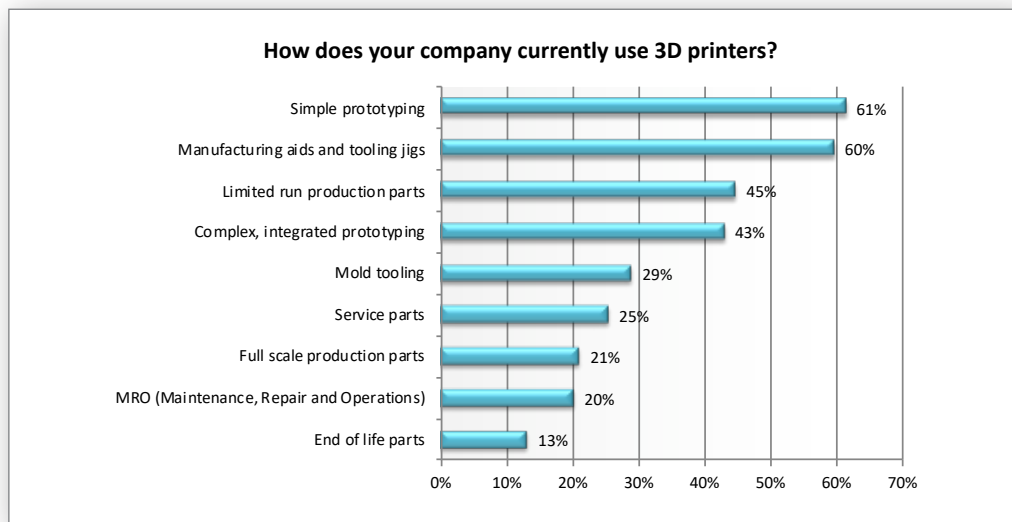
Detailed Findings: 3D printing has a wide range of uses, but scale remains limited

3D printing is deployed across a wide range of use cases

3D printing has had broad success as a solution for simple prototyping. The time and cost to move from initial concept to physical item has decreased dramatically, and the advantages for simple production tasks is clear. This study focuses on uses of 3D printing beyond simple prototyping to examine where other areas stakeholders are finding additional value.

The research shows that there are a wide range of complex use cases for 3D printing that are being used today. While the traditional simple prototyping is unsurprisingly the most reported use (61%), that is followed very closely by the use of 3D printing for manufacturing aids and tooling jigs (60%). 3D printing is also used for more complex, integrated prototyping (43%), mold tooling (29%), service parts (25%), MRO (20%), and end of life parts (13%).

Most importantly, 3D printing is currently being widely used to manufacture production parts. Close to half (45%) are using 3D printing for limited run production parts, while 21% are using 3D printing for full scale production part runs.



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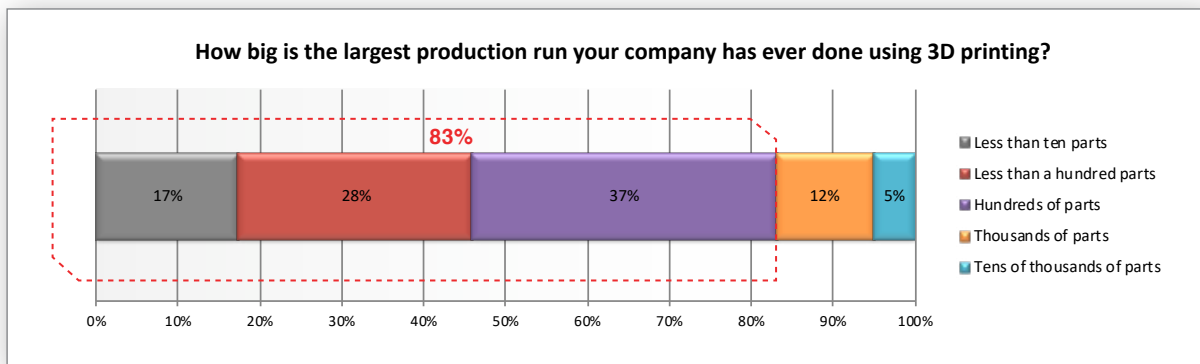
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Today's 3D printing is rarely used at scale

In spite of the broad adoption of 3D printing across a variety of uses, the use of 3D printing for mass production remains limited and focused primarily on small runs. The vast majority (83%) of the companies using 3D printing for production parts have produced less than 1,000 parts, even for their very largest run. This includes almost half of companies (45%) whose largest production run with 3D printing was less than 100 parts.



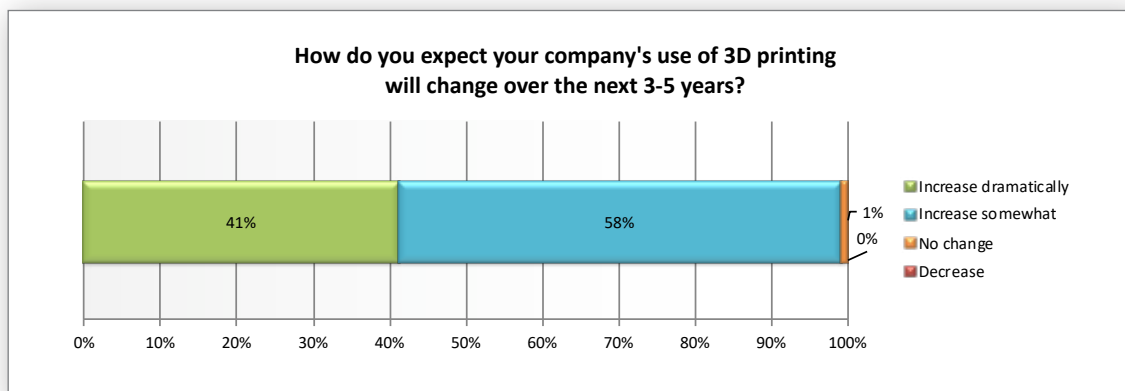
It is important to note that while the number of organizations doing large production runs is small, they do exist. There are more than a few companies (5%) that have used 3D printing for production runs including tens of thousands of parts or more.

Detailed Findings: 3D printing for production parts is expected to grow dramatically

Use of 3D printing expected to grow in near future

The data suggests that manufacturers who have used 3D printing for production parts appear to have been quite successful, as they have plans to do more. There are no companies (0%) that have any plans to decrease their current level of 3D printing, and only a tiny percentage (1%) that believe their current level of use is adequate.

There is almost complete agreement (99%) that use of 3D printing will increase over the next 3-5 years. This includes 41% who characterize their company's expected increase in their use of 3D printing as "dramatic."



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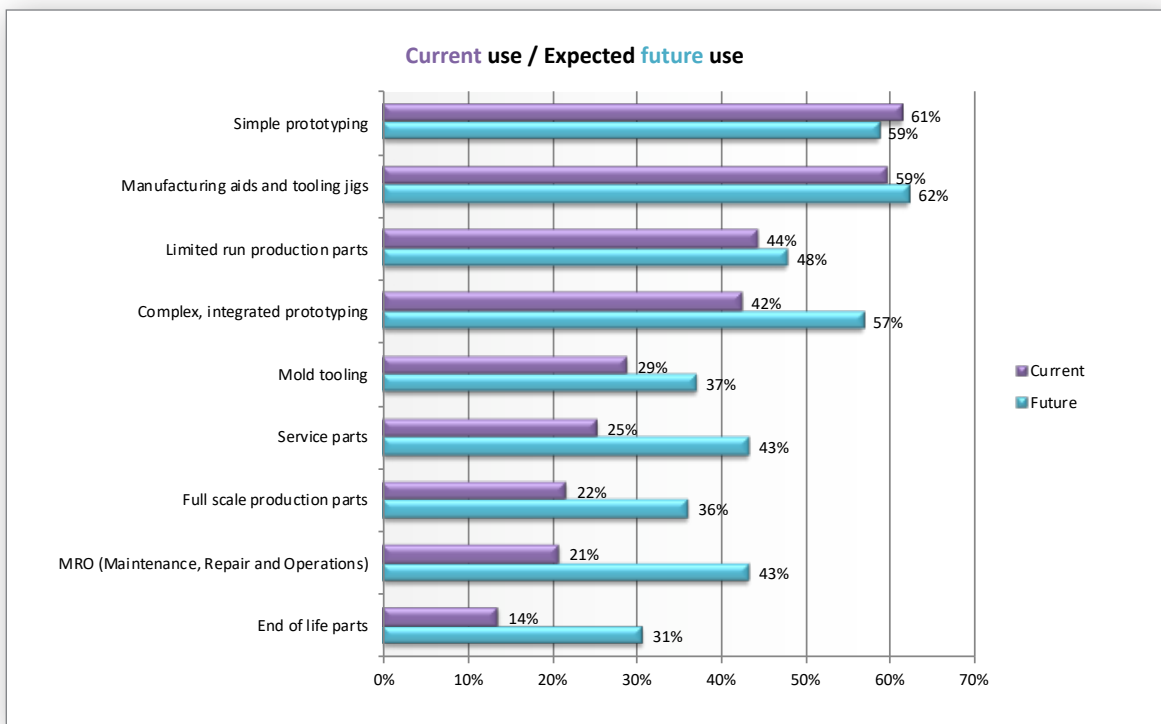
Companies will have a broader range of 3D printing uses in the future

To gain a better understanding of how 3D printing is expected to change, we compared current uses of 3D printing to expected future uses.

3D printing decision makers report very little change in the frequency of the most common use cases in the foreseeable future. The number of companies using 3D printing for simple prototyping, manufacturing aids, and tooling jigs today changes very little when you ask about future use.

However, all other types of uses are expected to expand in the future. Survey participants predicted that the number of companies using 3D printing for end of life parts (currently 14% expected to increase to 31%) and MRO (21% to 43%) will both double in the coming years. Similarly, production of service parts (25% to 43%), mold tooling (29% to 37%), and complex prototypes (42% to 57%) will all see dramatic growth.

Limited run production parts are anticipated to grow at a lower rate (currently 44% expected to increase to 48%) but use of 3D printing for full scale production parts will see fairly dramatic growth. Today less than a quarter (22%) use 3D printing for full scale production parts, but that is expected to grow to over a third (36%) in the near future.



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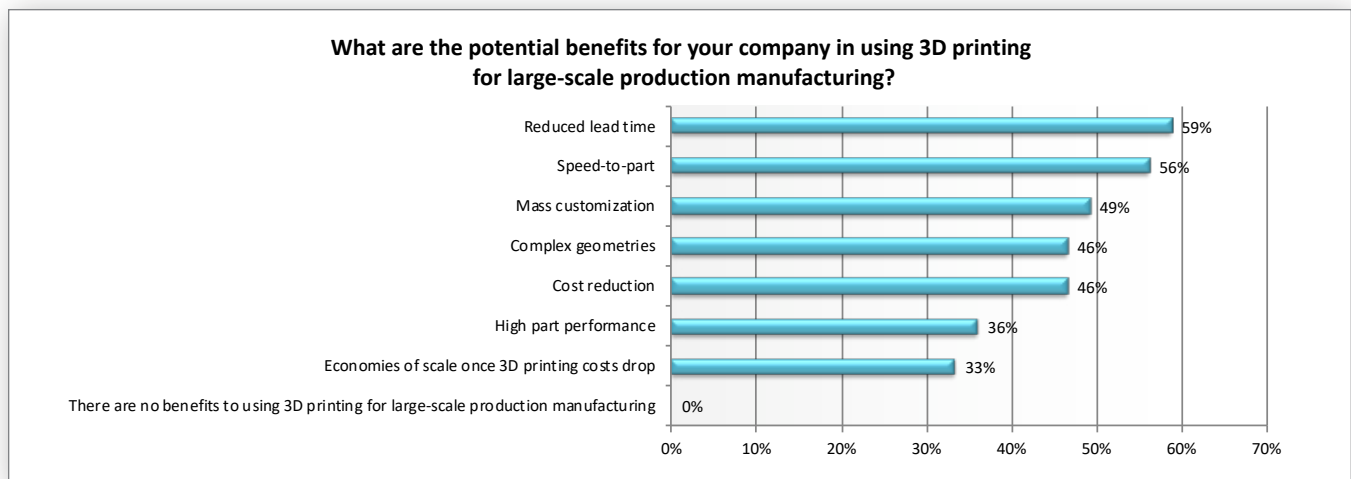
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Using 3D printing for large-scale production manufacturing has a wide range of benefits

The strong growth of 3D printing and the expansion of use cases is unsurprising given that these decision makers report strong motivations to find a way to scale quickly. When asked about the potential benefits for using 3D printing for large-scale production manufacturing, all participants (100%) reported that there were benefits.

Specific benefits reported did vary depending on specific business needs and operations. The most common benefit reported was speed, including reduction of lead time (59%), followed closely by speed-to-part (56%). The ability for mass customization (49%), support for complex geometries (46%), and high performance of parts (36%) were also reported as common benefits for using 3D printing for large-scale manufacturing.

Cost savings were highlighted as a direct benefit of using 3D printing at scale, including cost reduction (46%) and economies of scale once 3D printing costs drop (33%).



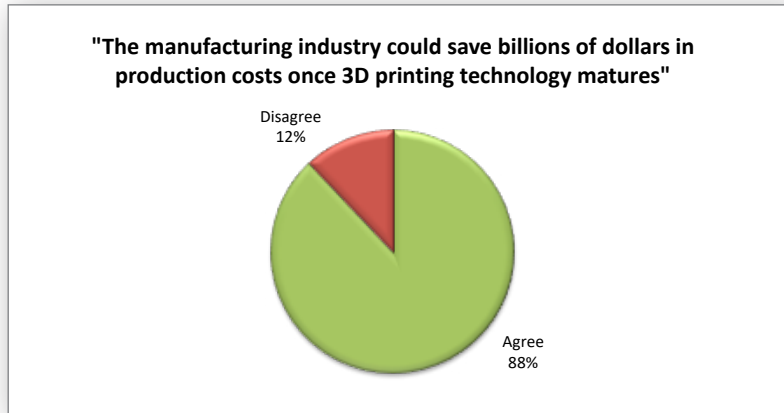


Detailed Findings: 3D printing has the potential to dramatically change the manufacturing industry

3D printing could save billions of dollars in production costs

The participants in this study all had practical, hands-on experience with 3D printing for production parts. As hope for exciting outcomes often fade in the face of the reality of new technology, we wanted to capture the expectations for the overall industry and for their companies held by these stakeholders who have all been given a strong dose of reality.

We found that experience has not soured the expectations of 3D printing stakeholders. This group is very bullish with the vast majority (88%) agreeing that the savings for the overall manufacturing industry will be in the billions of dollars. This statement did include a caveat that should be noted – the technology does still need to mature to have this level of impact.





3D printing stakeholders expect a great future

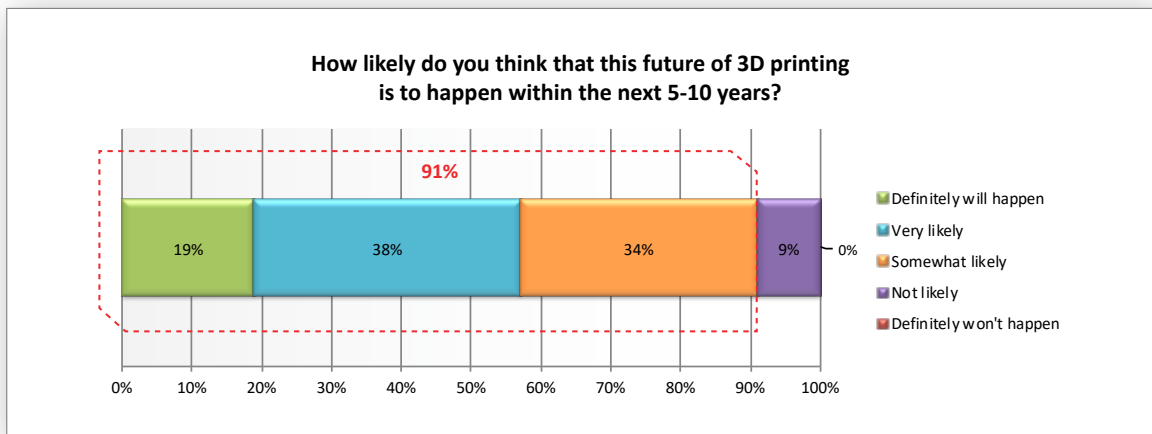
To further investigate opinions on the future impact of 3D printing among this experienced group, we posed a series of questions assuming that technology and industry had matured, and the potential of 3D printing had been delivered. Survey takers were presented with a very positive scenario for the future of 3D printing, and then asked a series of questions about potential outcomes of this scenario.

Future 3D Printing Scenario

Imagine the scenario in the future where 3D printing technology and costs have evolved to the place where a typical factory could have thousands of 3D printers on the factory floor replacing or augmenting existing CNC or injection molding machines.

At this point 3D printing is delivering all potential benefits at a compelling cost.

We wanted to know if today's experienced 3D printing stakeholders believe this is a realistic future, or if they think it is a pipe dream. What we found was strong levels of optimism for this rosy view of the future. The majority (91%) agreed that this was a likely outcome, even when asked to consider if it could happen under a time constraint of 5-10 years. Even more, we found that over half (57%) didn't think this positive version of the future was overstated. They characterized this future as "Very likely" or "Definitely will happen."



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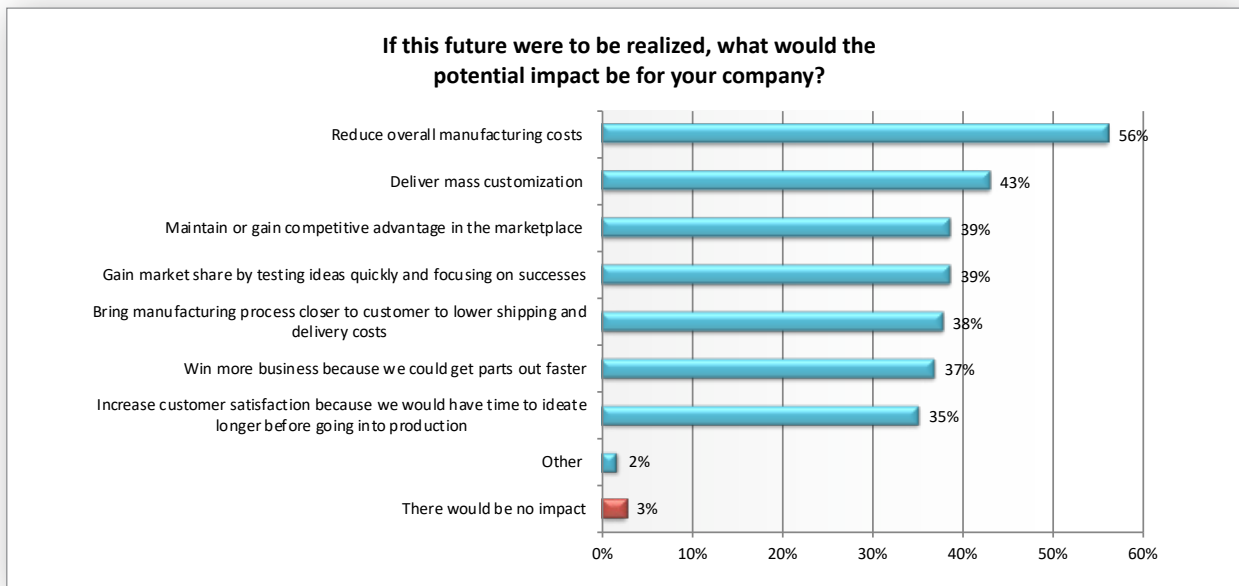
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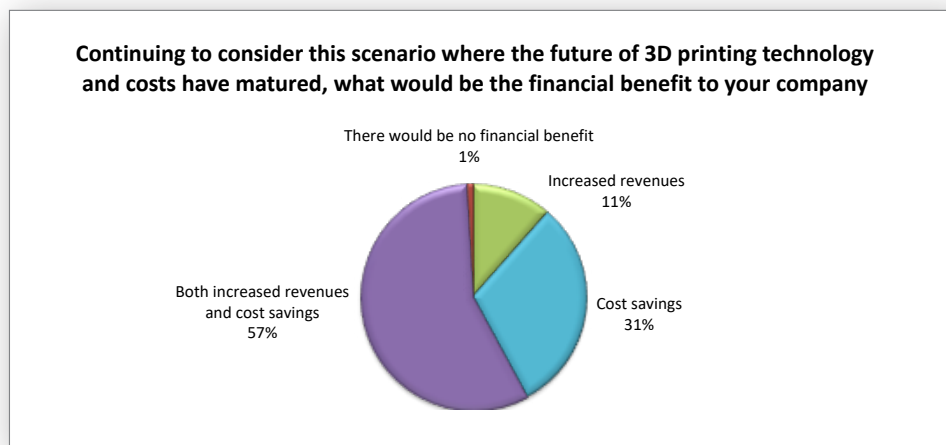
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3D printing will have direct financial benefits in the future

When the future of 3D printing is realized, the vast majority of decision makers at manufacturing companies (97%) believe their companies will see many positive business impacts. The most common benefit reported will be a reduction in overall manufacturing costs (56%). Other positive business impacts reported include the ability to deliver mass customization (43%), gain competitive advantage (39%), gain market share through quick testing and validation of new ideas (39%), reduce shipping costs by bringing manufacturing processes closer to the customer (38%), win additional business because of faster speed-to-delivery (37%), and increase customer satisfaction (35%). Several participants took the time to write in “Other” responses including reduced inventory and new part geometrics that reduce weight and part counts.



These impacts are expected to have a direct financial impact on almost all (99%) companies represented in this study. About a third expect cost savings (31%), about a tenth expect increased revenues (11%). But most (57%) expect the ideal financial impact - both cost savings and increased revenues.

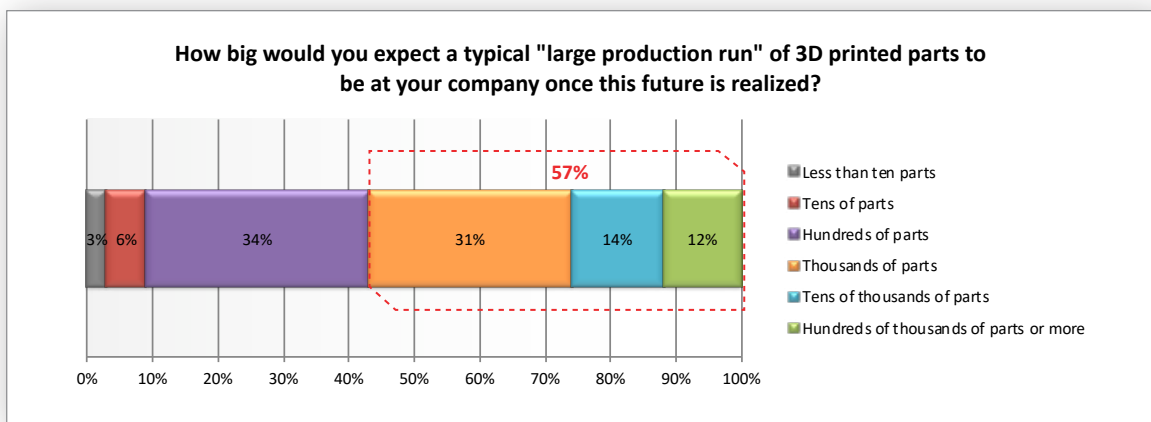




Future production runs expected to be in the thousands of parts

When 3D printing matures, production runs are expected to be very large. More than half (57%) foresee that they will regularly do production runs of thousands of parts.

It is particularly interesting to note how this level of growth compares to what is happening today. Earlier in this report we shared data on their largest 3D printing run. To date, only 18% of these companies have done even one single run with more than 1,000 parts, so the jump to 57% in the same number is an impressive leap.



Detailed Findings: Key obstacles must be addressed to achieve the potential of 3D printing

Broad range of obstacles remain in large scale adoption of 3D printing

While 3D printing stakeholders agree on the benefits and impact of large-scale 3D printing, they also agree on the challenges.

All participants (100%) in our study report that their company faces obstacles in scaling their use of 3D printing. The most frequently reported issues are related to cost, including the expense of 3D printing technology (42%) and the price of materials (35%). Clearly these will need to come down in order to enable large scale use of 3D printing.

There are many issues in addition to cost that are impacting adoption. There is a need for additional technology innovation since a third (34%) report that current technologies don't scale and 31% say their printed parts are unreliable.

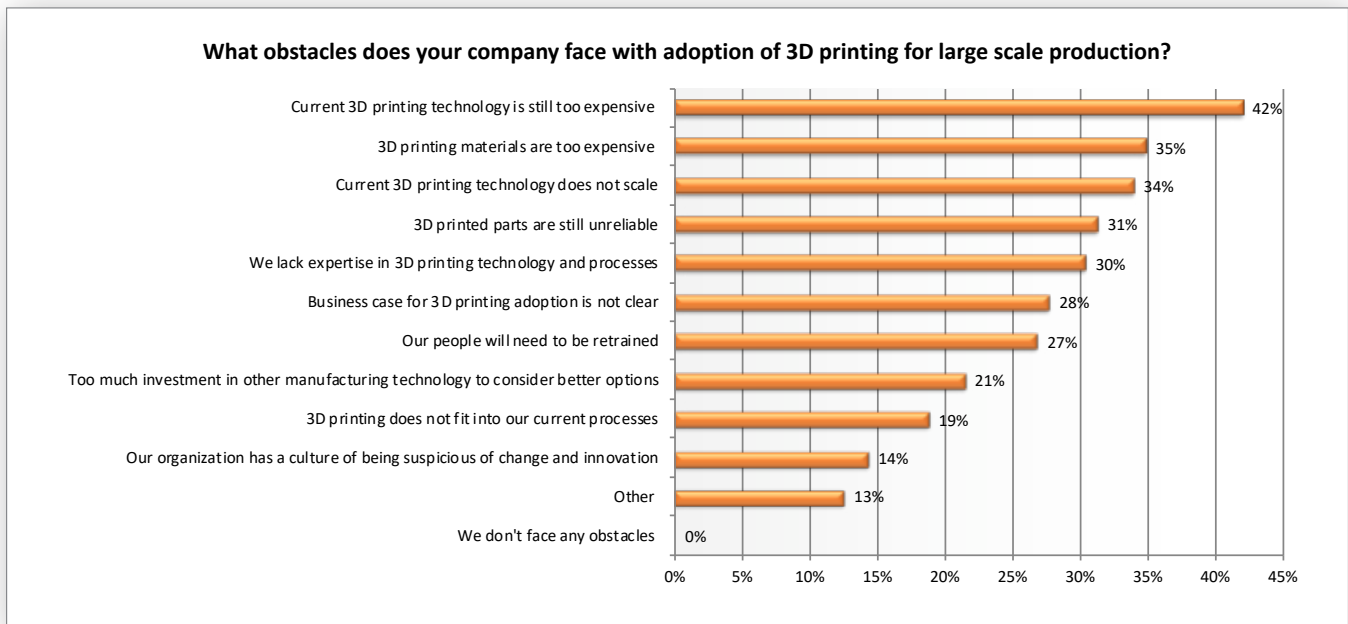
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Additionally, there are people issues. Several participants reported concerns around skills with 30% saying they lack expertise in 3D printing technology and processes, 22% saying that their existing staff will need training, and 14% reporting that their company has a culture of being suspicious of innovation and change. These people issues go hand-in-hand with organizations that feel they have too much invested in existing manufacturing to consider options even if they are better (21%) or have existing processes that don't fit into the model of 3D printing (19%).

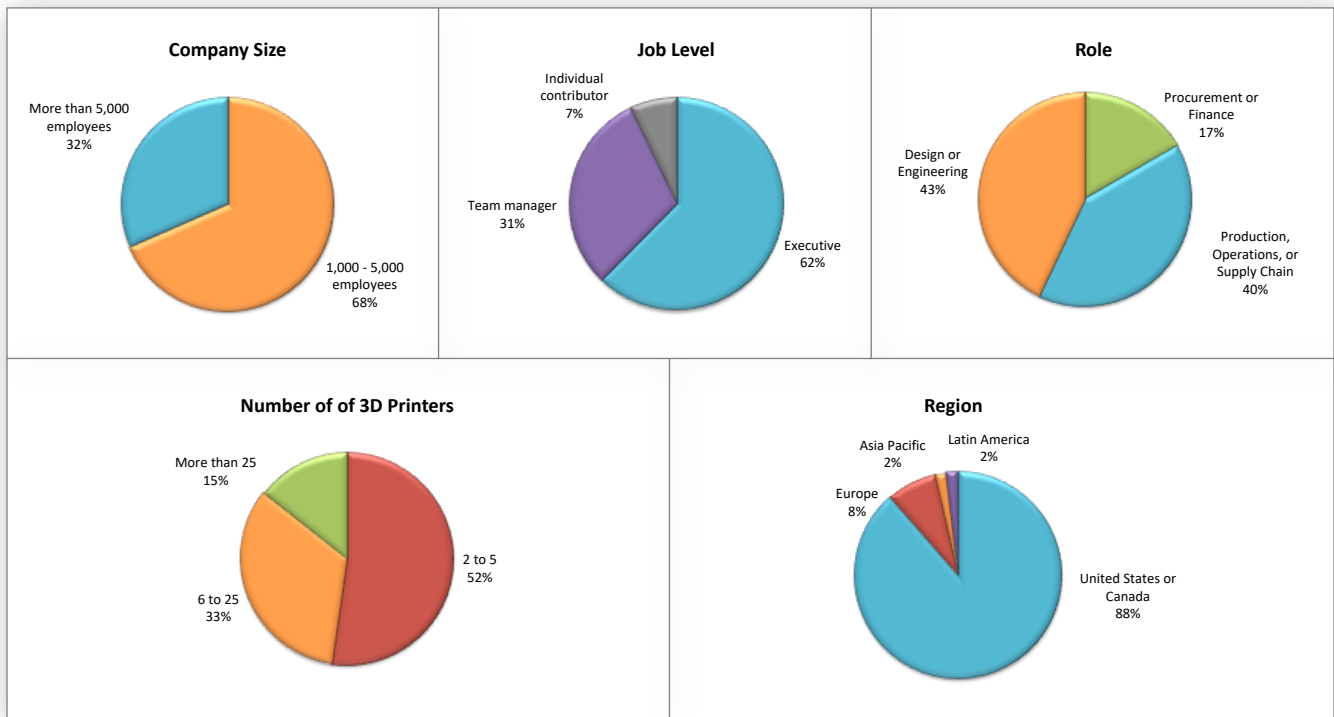


When asked about obstacles, a large number of participants took time to describe their personal challenges and unique obstacles. The most frequently mentioned of these “Other” responses referred to difficulties with qualification and certification of 3D printed parts, particularly when manufacturing parts for regulated industries. The limitation of part size due to the size of today’s 3D printers was also mentioned frequently, as was current printing speed which is still too slow for many companies.



Survey Methodology and Participant Demographics

An online survey was sent to an independent database of individuals responsible for 3D printing at manufacturing companies. A total of 114 qualified participants completed the survey. All had decision-making responsibility for 3D printing solutions at a large manufacturing company. Participants included a mix of roles and company sizes. All used 3D printers for use cases beyond simple prototyping.



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