

WHITEPAPER

# Trends in 3D Printing at Scale

A Survey of 3D Printing in Production Manufacturing  
December 2021

## Introduction

Modern 3D printing employs additive manufacturing (AM) to create parts and tools used in the manufacturing process. In recent years, 3D printing has migrated well beyond prototyping in the R&D lab and is now an essential component in the large-scale production of functional parts used on factory floors. With its expanded capabilities offering increased build volume, speed, and unmatched versatility, 3D printing is tackling the largest jobs in production manufacturing while disrupting traditional manufacturing processes.

This study highlights the current state of 3D printing in production for manufacturing companies to capture data on current experiences, challenges, and trends, as well as understand any changes from prior years. Participants were asked a wide range of topics related to the present and future use of industrial 3D printing and their opinions on outcomes.

The following report, sponsored by Essentium, is based on an online survey of 161 managers and executives working at manufacturing companies with responsibility for 3D printing at scale. Certain questions were repeated from similar 2018, 2019, and 2020 studies to enable trend analysis.

## Key Findings

### 3D printing for production continues to accelerate

- 86% report more than doubling 3D printing of production parts in the past year
- 57% have completed a 3D printing production run of more than 10,000 parts
- Improved part performance and design freedom are ranked as the leading business drivers for growth in 3D printing at scale

### There are tremendous future possibilities for 3D printing at scale

- 96% agree the industry could save billions of dollars in production costs — the highest level of agreement in the four years this question has been asked
- 97% believe that 3D printing enables designers to be more creative
- 77% say 3D printing will be “very” important to sustainability initiatives

### Persistent innovation is needed to realize the full potential of 3D printing at scale

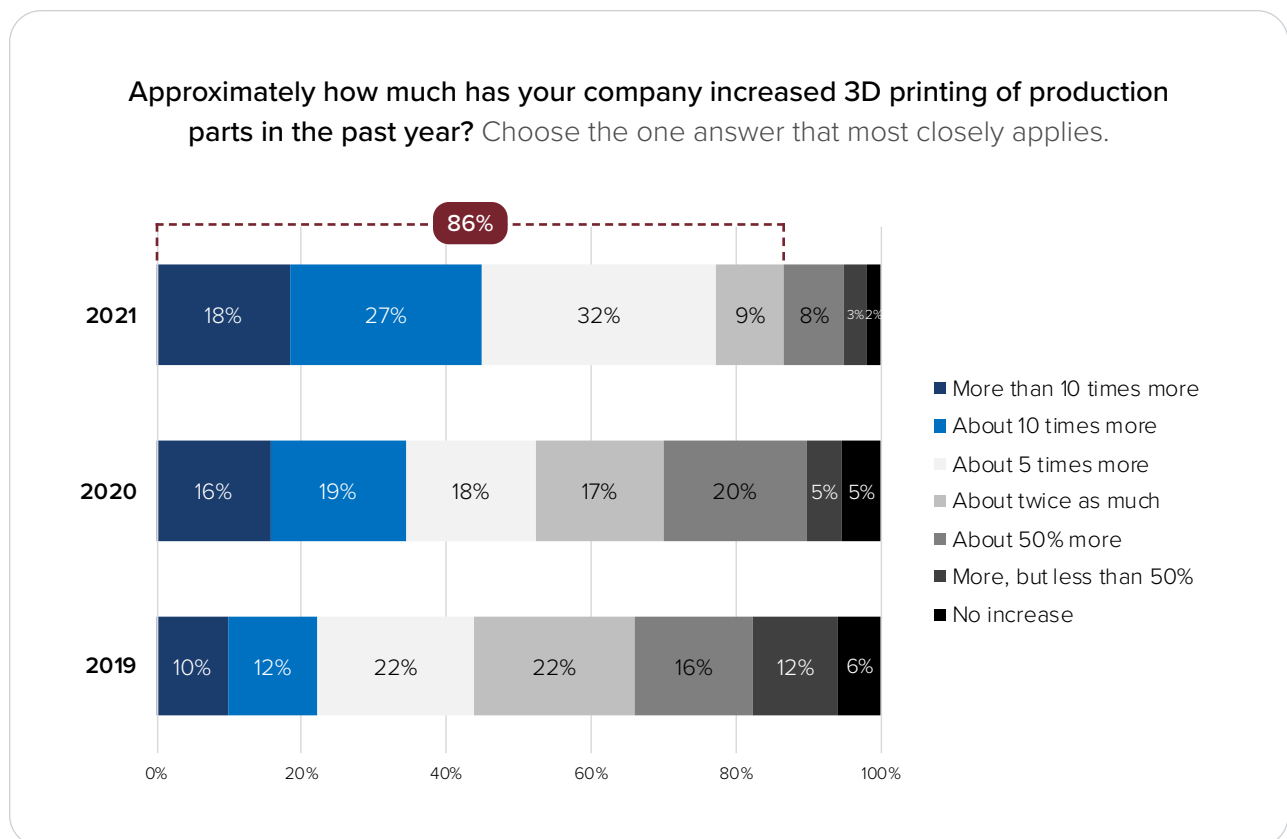
- 86% report they still face obstacles with 3D printing for large-scale production
- Platforms and software are the primary desired areas of innovation
- 74% say it is “very” important that their 3D printing vendors are part of an open ecosystem

## Detailed Findings: 3D printing for production continues to accelerate

### 3D printing of production parts continues to grow, with many companies more than doubling their output in the past year

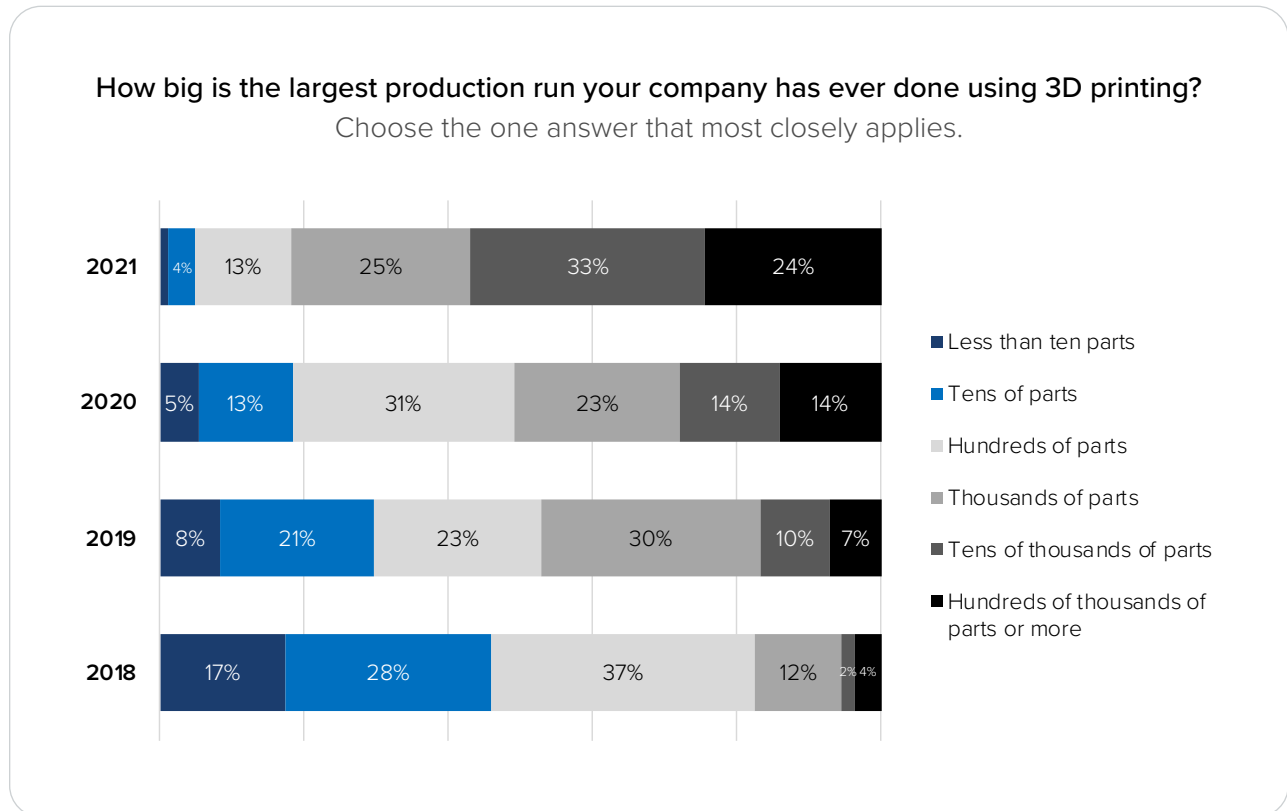
3D printing is an enabling technology that empowers manufacturers to make lighter, cheaper, and stronger parts with virtually no printing minimums. Once the design is complete, you can create one or a hundred thousand parts for only the cost of filament. Using 3D printing in production makes it possible for companies to respond faster when events like sudden changes in customer demand or massive problems, such as COVID-19, turn the global supply chain on its head and require even more part output.

One of the best ways for a manufacturer to appraise its level of maturity for 3D printing is by comparing the output of production parts in the past year to previous years. According to manufacturing stakeholders, 86% more doubled their 3D printing of production parts during the past year. And a whopping 45% increased their 3D printing by 10 times or more.



## Many companies reported completed production runs of 10,000 parts or more

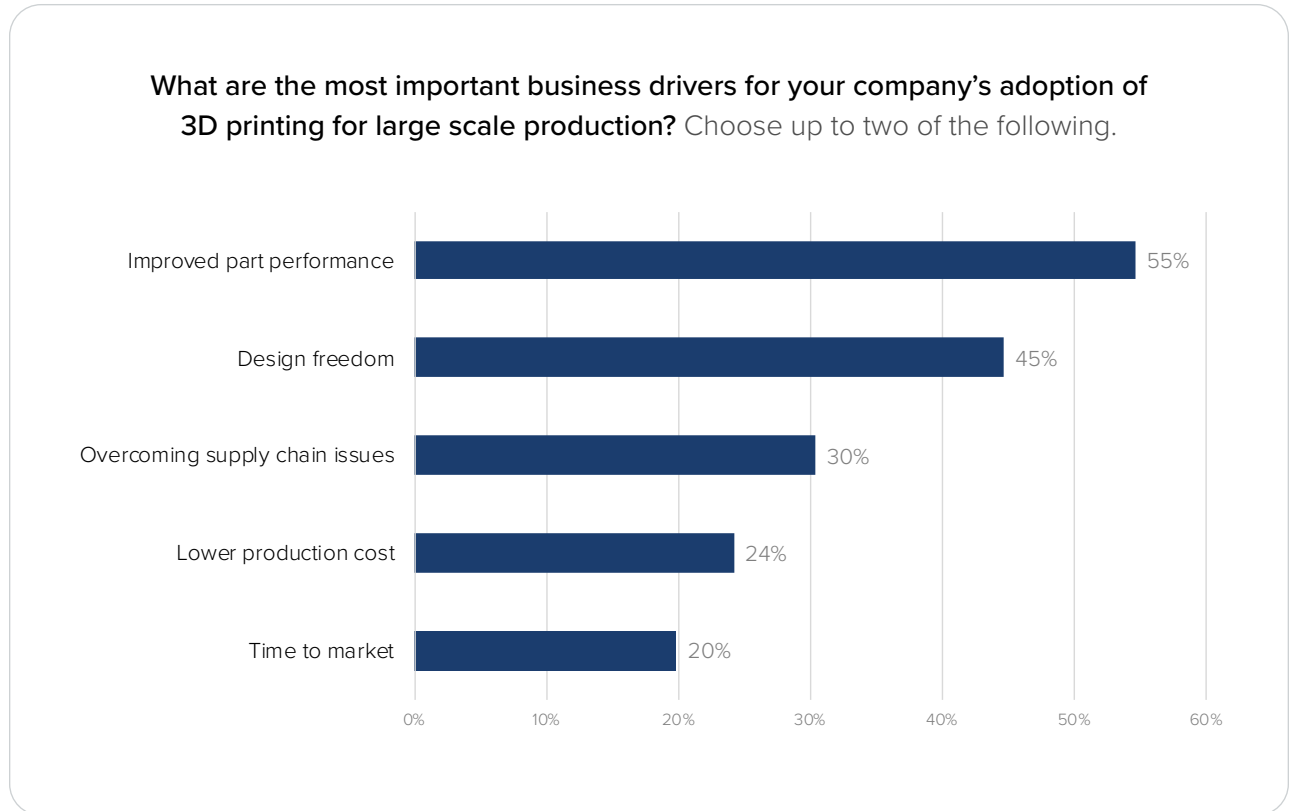
When we calculate this year’s production run growth trajectory, 57% of manufacturers have achieved a 3D printing production run of more than 10,000 parts, up substantially from 28% in 2020, 17% in 2019, and only 6% in 2018.



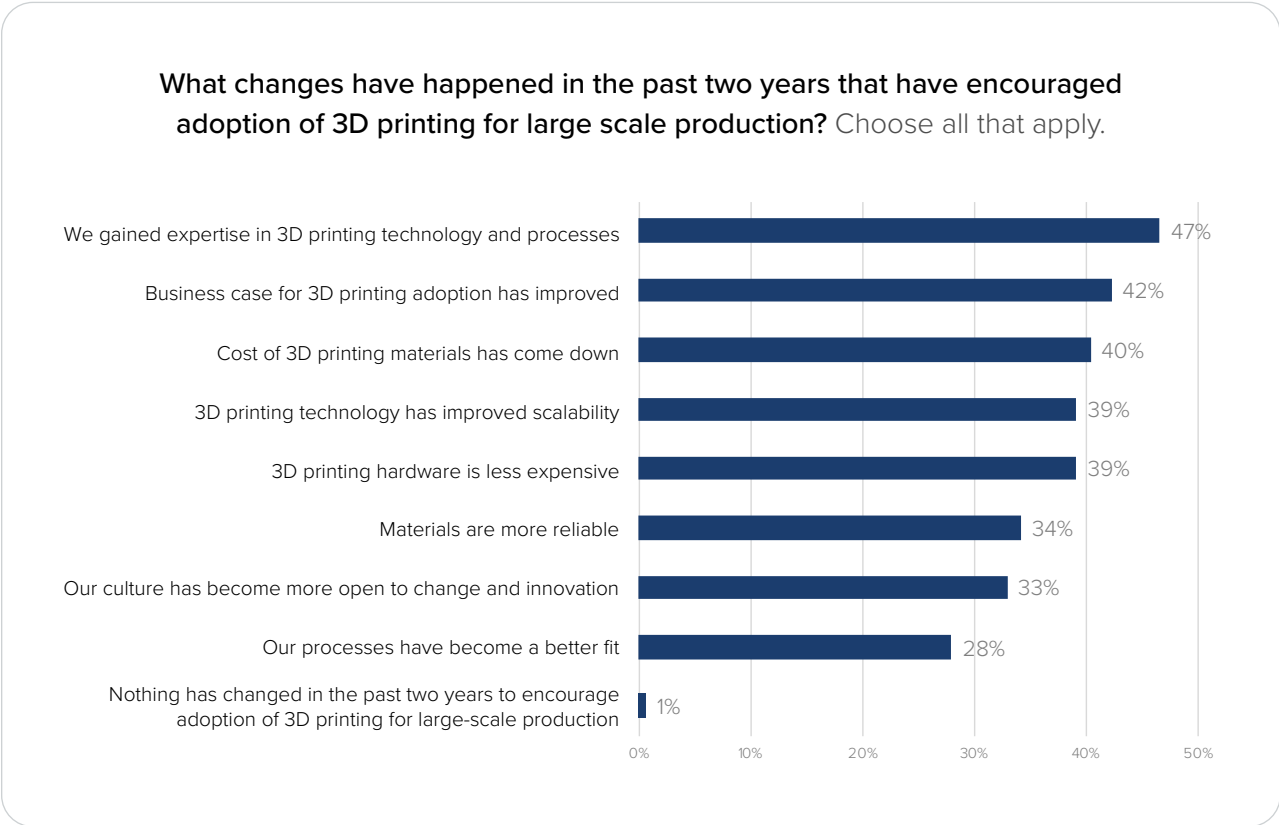
Not surprisingly, larger companies (5,000 employees or more) are doing bigger production runs this year, with 68% reporting print runs of 10,000 or more compared to only 49% of those companies with 1,000 to 5,000 employees.

## Improved part performance and design freedom ranked as the leading business drivers for growth in 3D printing at scale

One of the most important aspects of this research is uncovering what is driving this impressive adoption of 3D printing at scale. Is there one business driver influencing this growth of 3D printed production parts, or are there multiple factors contributing to the rapid acceleration this year? The research shows two primary business drivers are affecting the dramatic increases in 3D printing at scale this year — improved part performance (55%) and design freedom (45%).



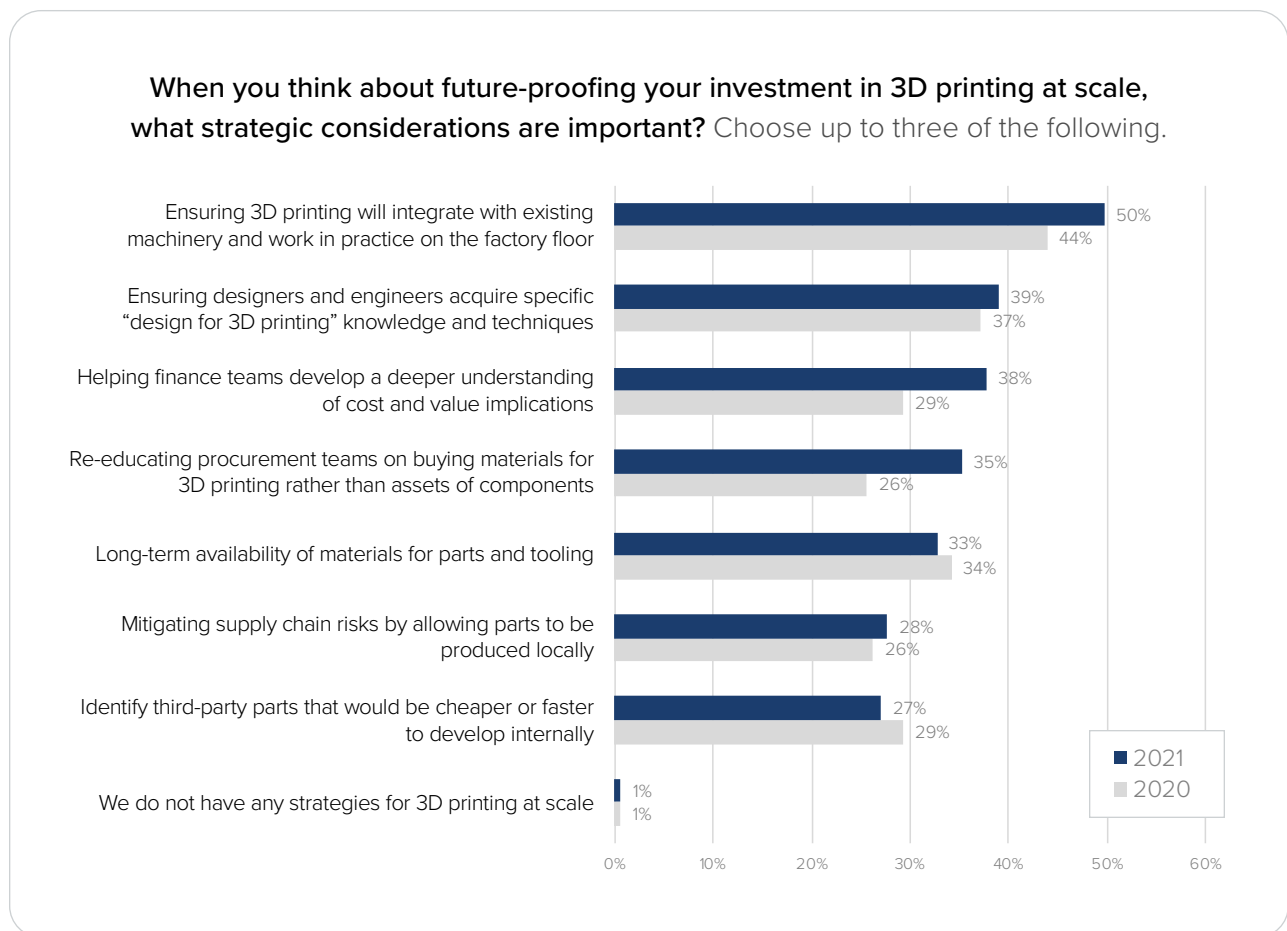
There have also been some fundamental changes in the past two years influencing the adoption of 3D printing for large-scale production. The top five changes include more expertise in 3D printing technology and processes (47%), a better business case for 3D printing adoption (42%), a decrease in the cost of 3D printing materials (40%), improved scalability from 3D printing technology (39%), and less expensive 3D printing hardware (39%).



Interestingly, when we drilled down by participants' roles to examine which changes were perceived most likely to drive improvements, procurement stakeholders were far more likely to report business cases (51%) and culture (49%) than their peers in other roles.

## Future-proofing investments in 3D printing at scale necessitate various strategies

The current impact of 3D printing in production is enormous, and it is predicted to grow exponentially with the next generation of emerging technology. But how are manufacturers protecting their investment in this vital technology? More specifically, what are they doing today to safeguard their strategic advantage now into the future? When manufacturing stakeholders were asked to think about future-proofing their investment in 3D printing at scale, the primary strategic considerations are ensuring integration with existing machinery and work in practices on the factory floor (50%), making sure designers and engineers acquire the specific knowledge and techniques (39%), helping finance develop a deeper understanding of cost and value (38%), re-educating procurement teams on buying materials for 3D printing rather than assets of components (35%), warranting the long-term availability of materials for parts and tooling (33%), and more.

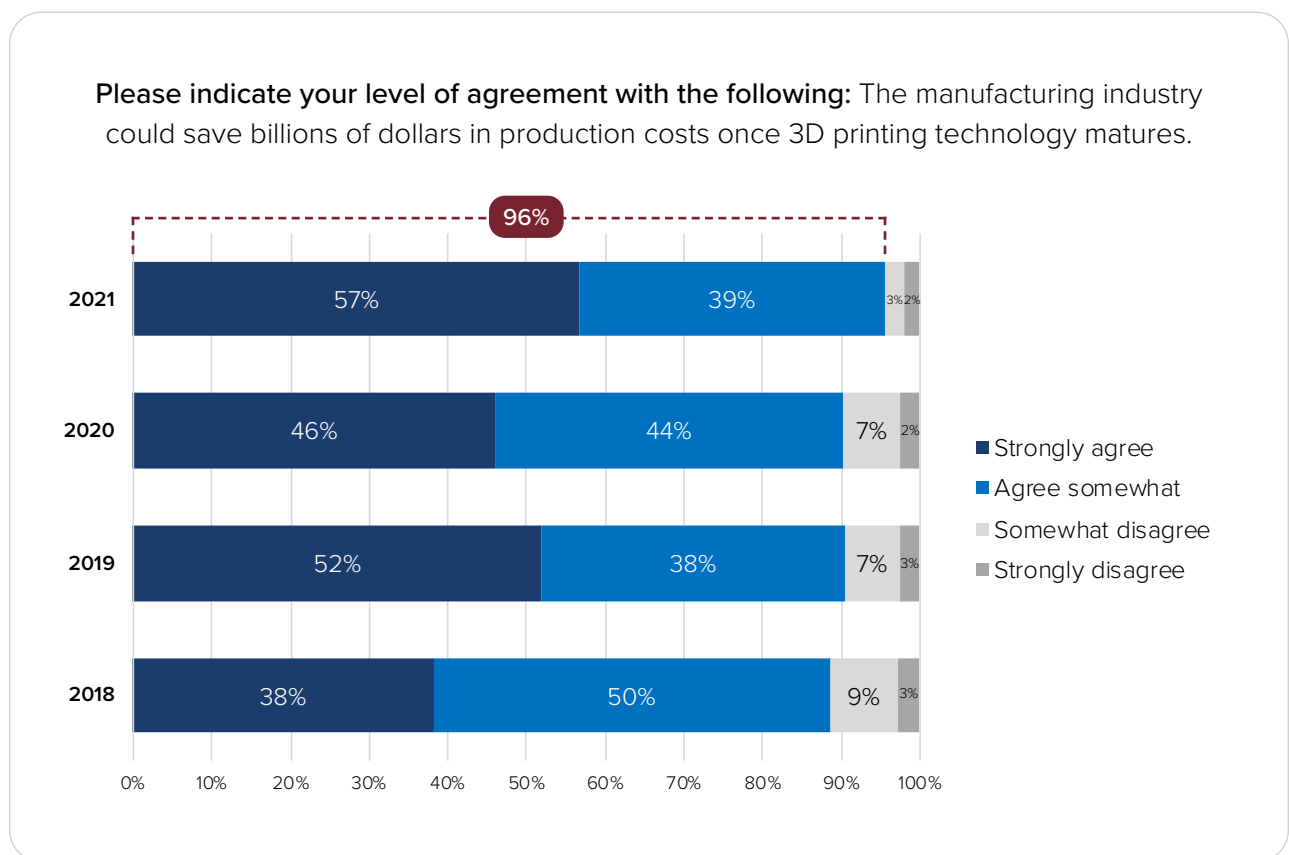


When comparing participants' future-proofing responses year over year, there was a notable increase this year in the efforts to educate finance and procurement teams. In particular, 38% of stakeholders report they are helping finance teams gain a deeper understanding of cost and value implications, up from 29% last year. Similarly, 35% say they are re-educating procurement teams on buying materials for 3D printing, which is 9% higher than in 2020.

# Detailed Findings: There are tremendous future possibilities for 3D printing at scale

## Nearly all stakeholders agree 3D printing technology could save billions

One of the bright takeaways from the study is the stakeholders' continual, strong confidence in 3D printing maturity, and it is the highest reported in the four years this study has been conducted. Almost all (96%) manufacturing managers and executives agree that the industry could save billions in production costs once the technology matures, up from 90% reported in 2020 and 2019 and 88% in 2018. This constant upward trend suggests that 3D printing at scale still has enormous financial value even as manufacturers gain more expertise with the technology.

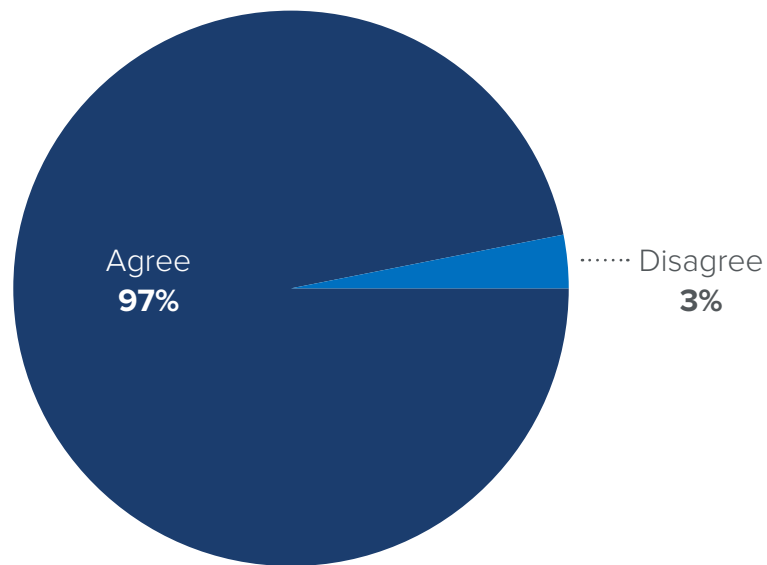




## Most manufacturers recognize that 3D printing enables designers to be more creative

One of the unique advantages of 3D printing is it takes a manufacturing process that's been performed nearly the same way for decades and turns it on its head. By enabling limitless creative possibilities, 3D printing technology is empowering designers to invent new ways to fabricate parts at multiple points in the production line, including manufacturing tools, jigs, and fixtures, fit tests, and of course, end-use parts. Manufacturing stakeholders couldn't agree more, with 97% agreeing 3D printing enables their designers to be more creative. And that's a good thing as it's often employee creativity that keeps an organization moving forward with fresh new ideas and innovation.

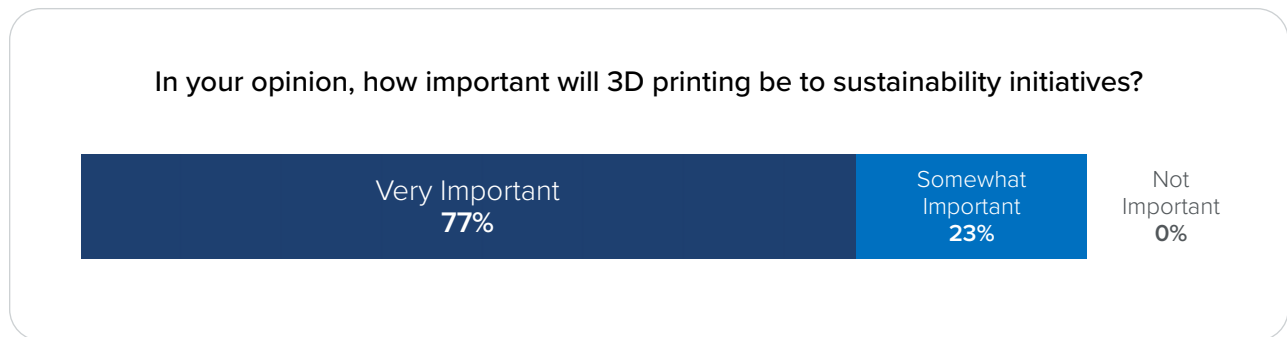
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3D printing enables our designers to be more creative



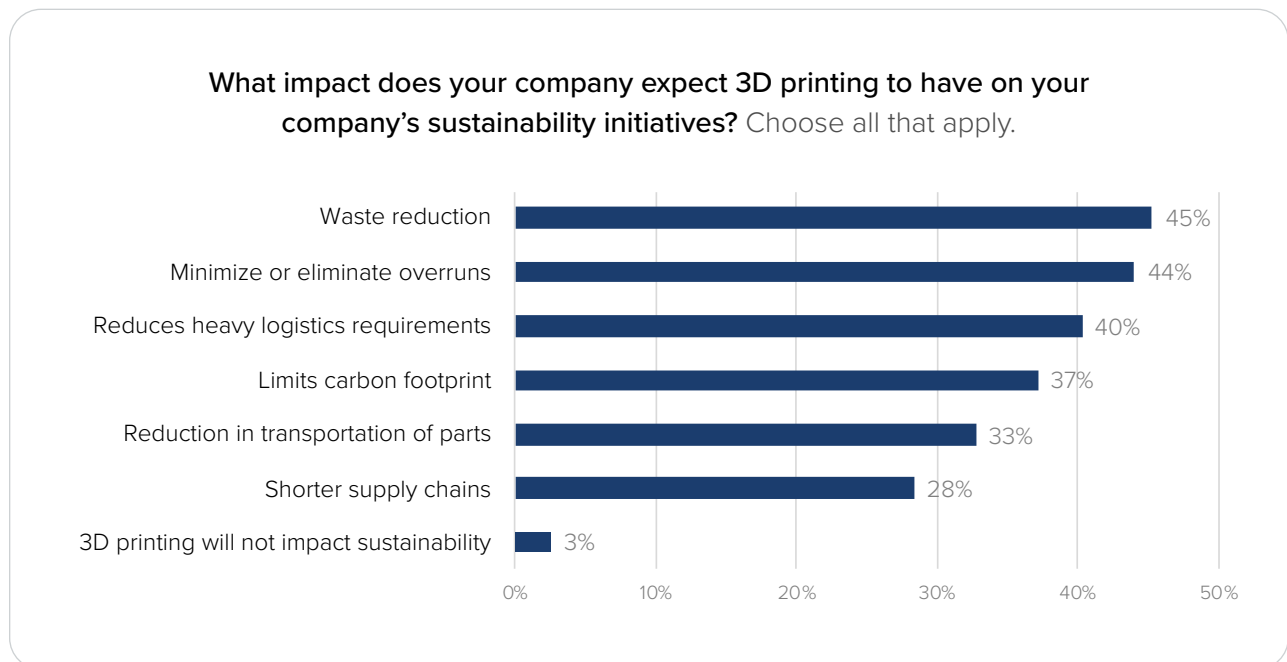
## Manufacturers believe 3D printing will be important to their sustainability initiatives

Traditional manufacturing processes often can be wasteful, resulting in unwanted and discarded items due to many prototypes and iterations. In addition, these processes may also consume more energy and raw materials with less focus on cleaner, greener techniques. 3D printing can enable a broader range of sustainability methods across manufacturing and help a company embark on a more sustainable journey.

When we asked manufacturers how vital 3D printing will be to their sustainability initiatives, 100% say it is important, with more than three in four saying it is “very” important.



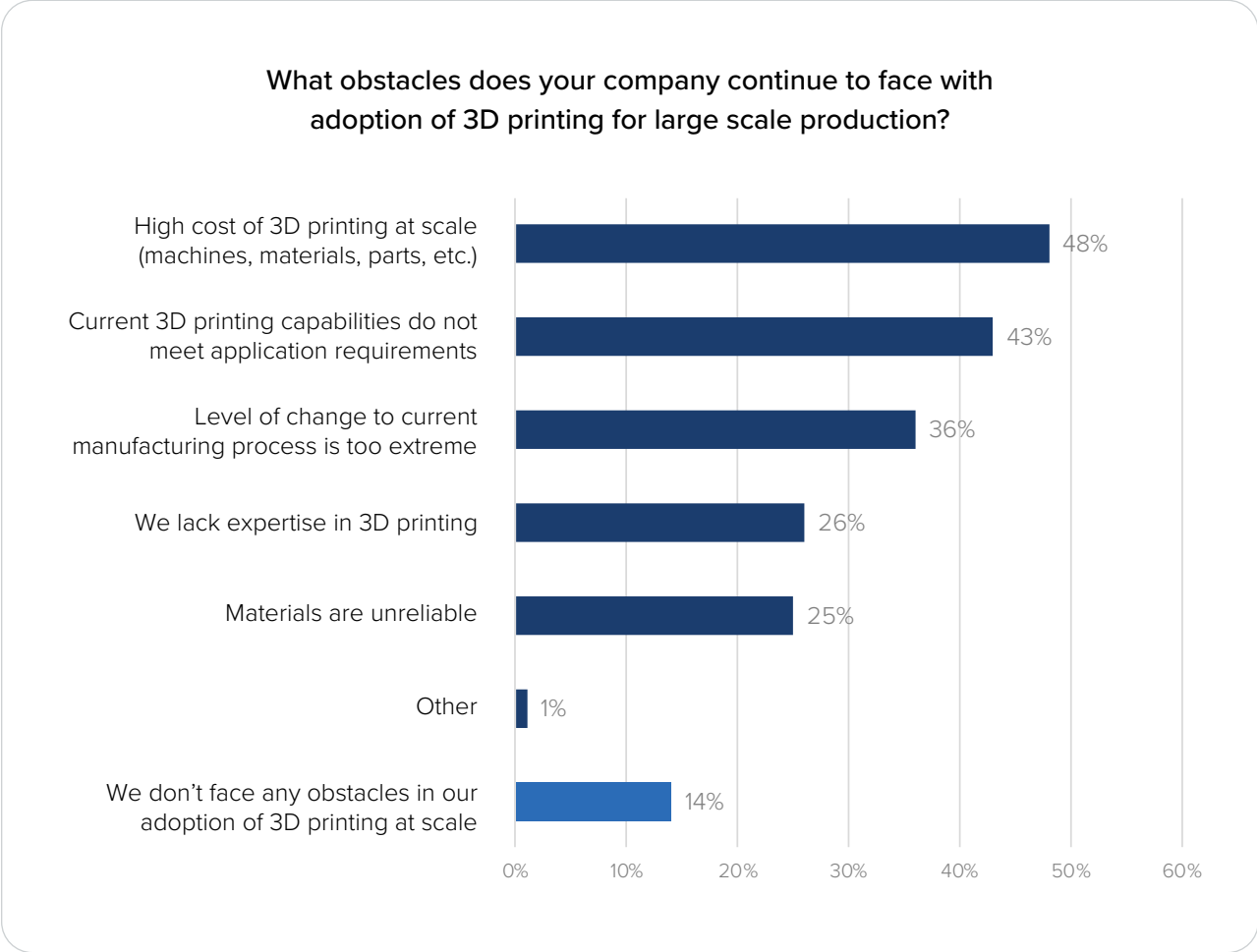
Furthermore, 97% expect 3D printing to impact their sustainability practices positively. Specifically, companies expect 3D printing to reduce waste (45%), minimize or eliminate overruns (44%), lower heavy logistics requirements (40%), limit carbon footprints (37%), cut the transportation of parts (33%), and shorten supply chains (28%).



# Detailed Findings: Persistent innovation is still needed to realize the full potential of 3D printing at scale

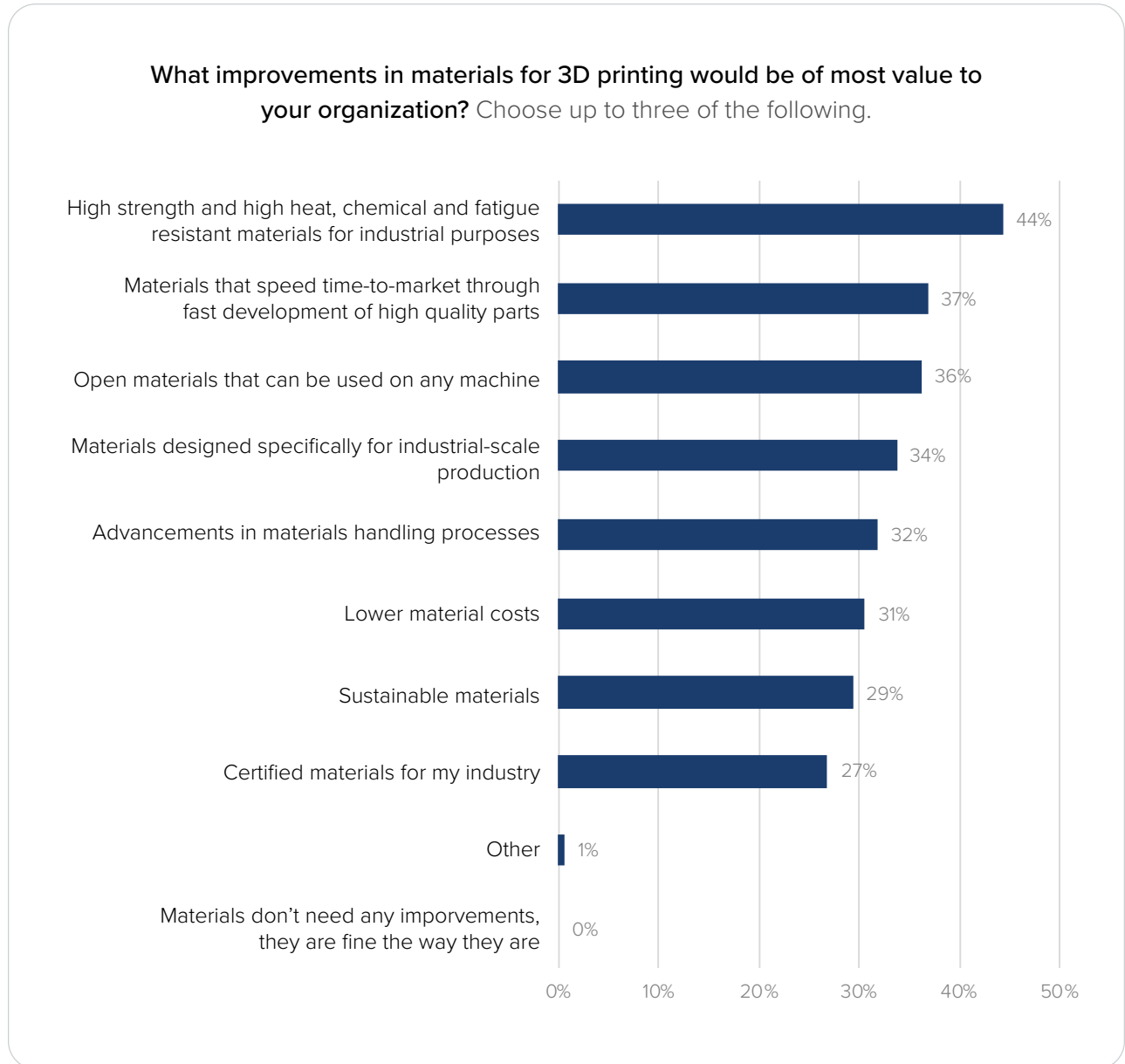
## Manufacturers still face obstacles in the adoption of 3D printing at scale

Despite its well-documented benefits, one would think 3D printing at scale would now be the norm for most manufacturers. But that’s not the case. Many manufacturing companies are still struggling to incorporate this technology into their operations. To better understand why the adoption of 3D printing for large-scale production is continually difficult, we asked manufacturing managers and executives to identify their greatest obstacles. Most stakeholders (86%) report they still face difficulties. The top challenge cited is its high cost (45%) followed by current 3D capabilities not meeting application requirements (43%), the level of change to current manufacturing processes is too extreme (36%), the lack of expertise (26%), and unreliable materials (25%). One stakeholder also wrote certification as an “other” challenge.



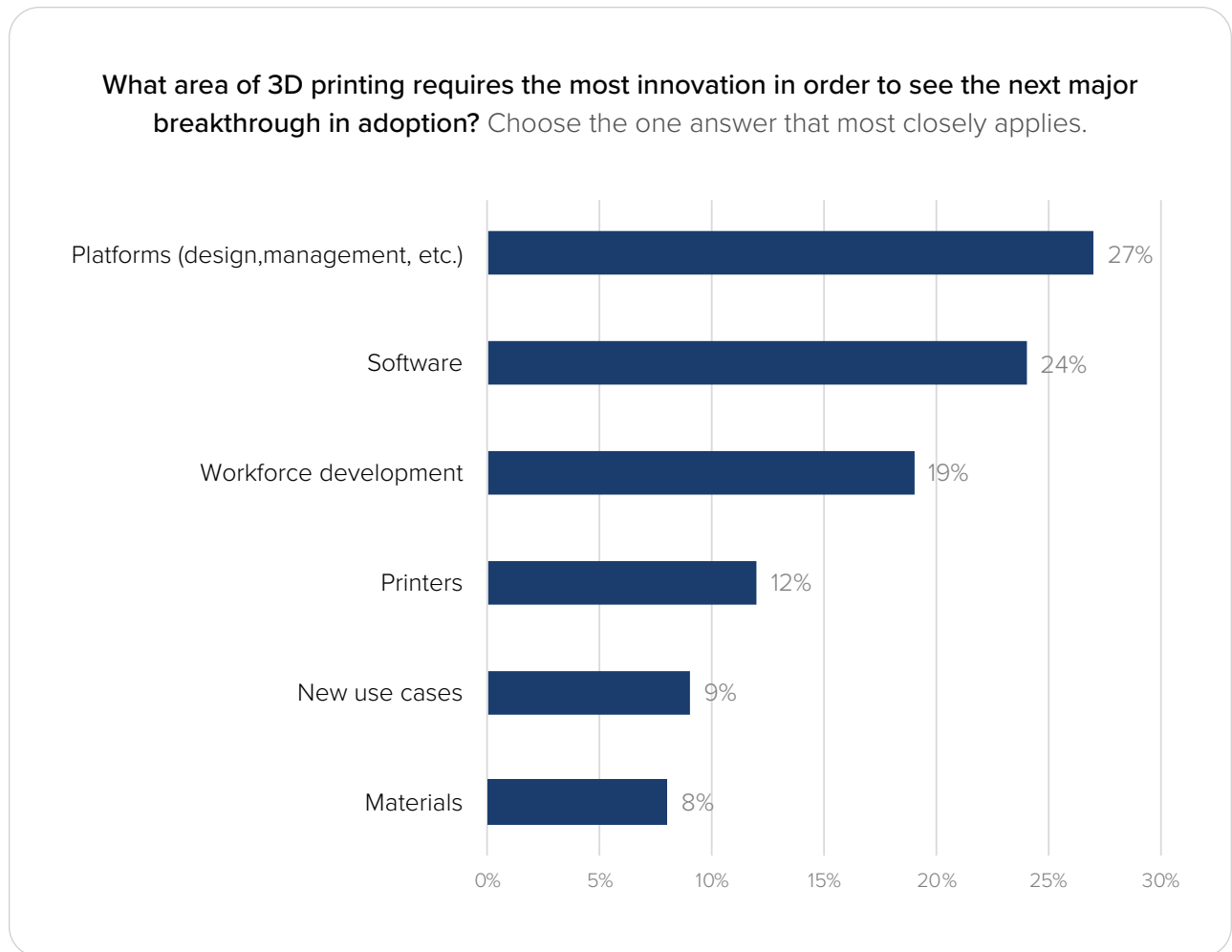
## Multiple kinds of improvements to materials are desired, with resistant materials topping the list

When asked explicitly if the materials for 3D printing could be improved, 100% of manufacturing stakeholders want changes, with resistant materials (44%) topping their lists. Other key improvements include materials that speed time to market (37%), open materials that can be used on any machine (36%), materials designed specifically for industrial-scale production (34%), advanced materials for handling processes (31%), and more.



## Platforms and software are the primary desired areas of innovation in 3D printing

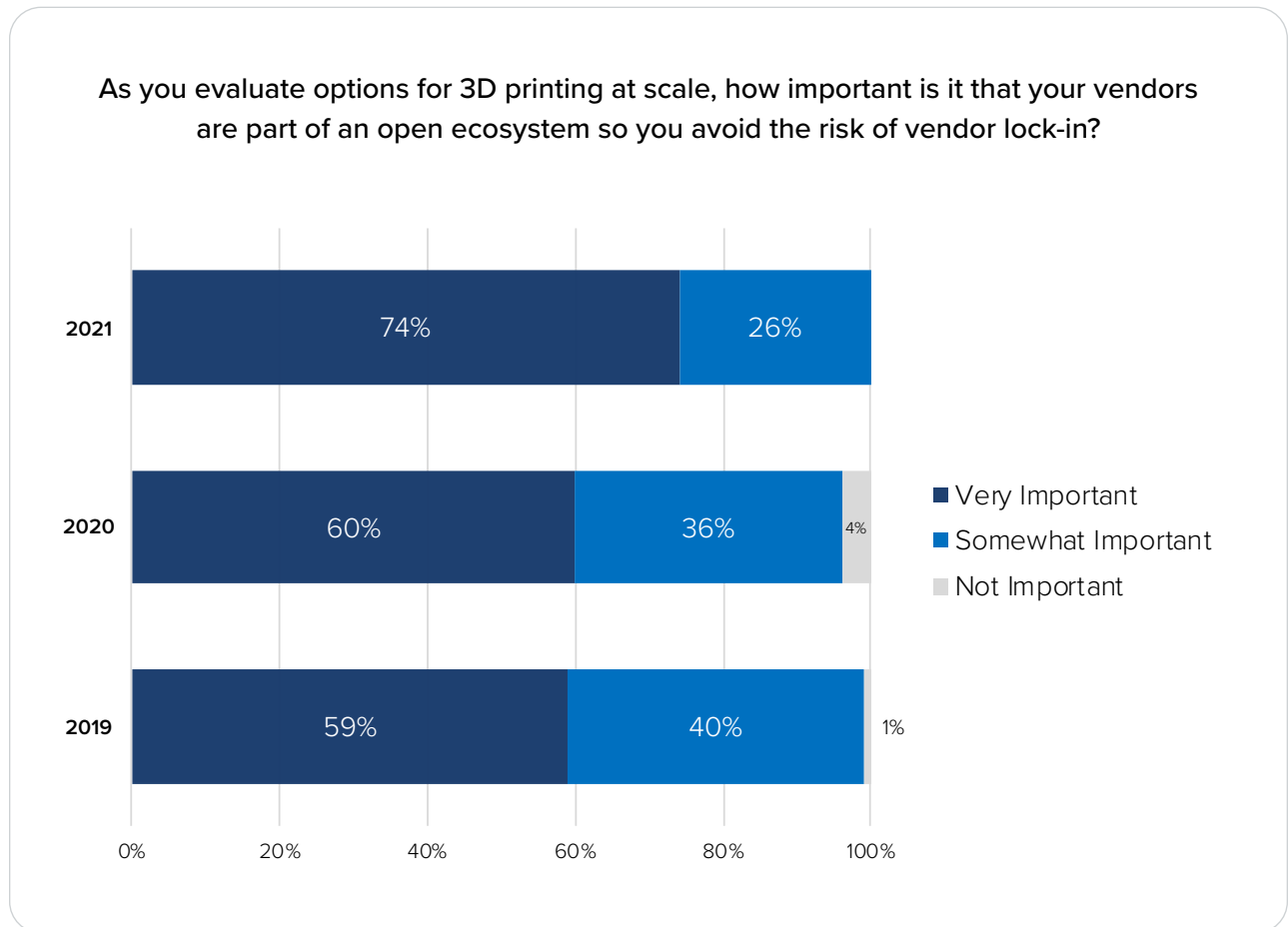
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Yet, there is some discrepancy in the most desired areas for 3D printing innovation among the various organizations involved. Designers and engineering prioritize improved platforms (40%), ops teams want better software (35%), and procurement and finance prefer enhanced workforce development (32%).

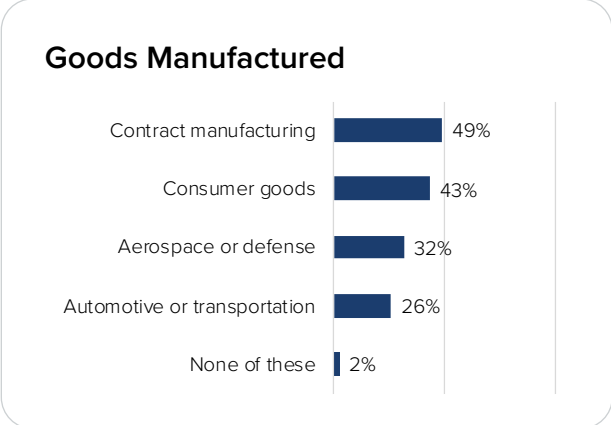
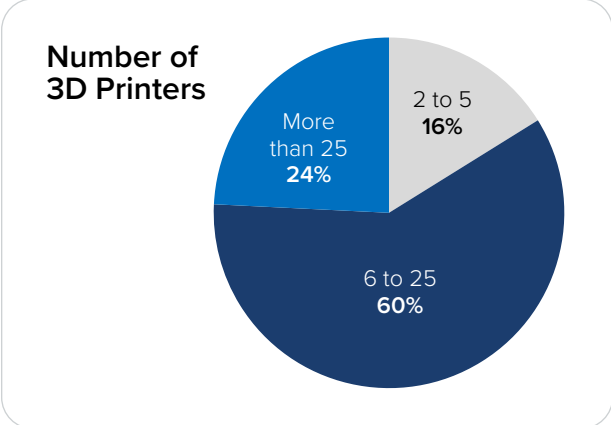
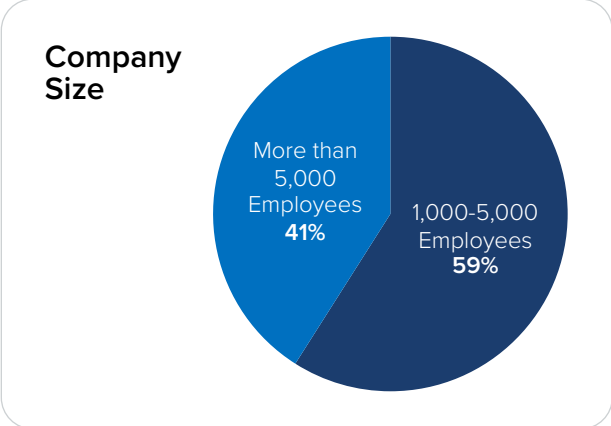
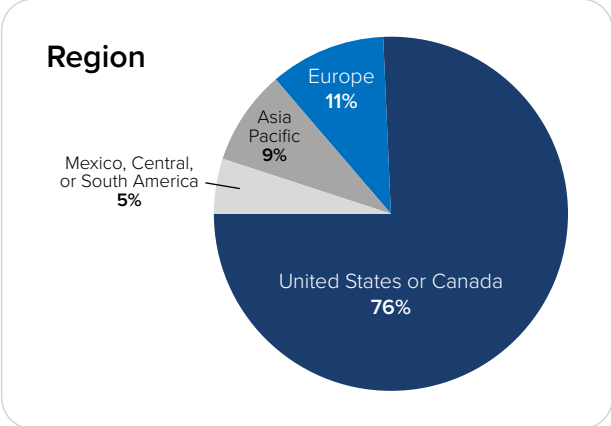
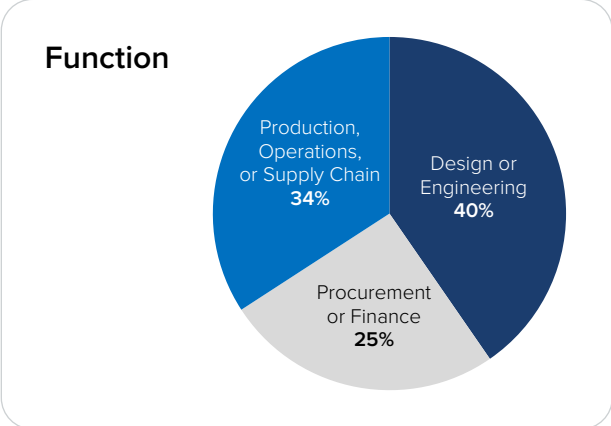
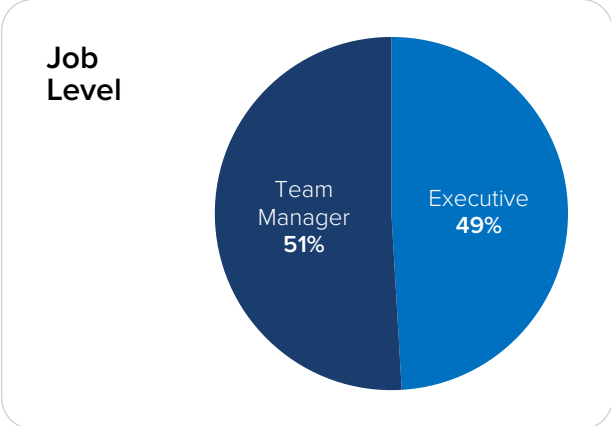
## Avoiding vendor lock-in grows increasingly important with time

In the past, the industry was dominated by closed systems where customers were locked into vendors' hardware, processes, and materials. Breaking the chains of vendor lock-in not only expands choice through competition but also unlocks endless innovation across the entire manufacturing industry and partner ecosystem. The requirement for an open ecosystem to 3D printing at scale is more critical now than ever, with all (100%) of 3D printing stakeholders reporting its importance this year.



# Survey Methodology and Participant Demographics

In the fall of 2021, an online survey was sent to independent sources of executives and managers working at manufacturing companies. A total of 161 qualified executives completed the survey. All participants were responsible for decisions regarding 3D printing for production parts. Participants included a mix of roles, functions, regions, and types of goods manufactured.



## About Dimensional Research

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## About Essentium

Essentium, Inc. provides industrial 3D printing solutions that are disrupting traditional manufacturing processes by bringing product strength and production speed together, at scale, with a no-compromise engineering material set. Essentium manufactures and delivers innovative industrial 3D printers, materials, software, and services, enabling the world's top manufacturers to bridge the gap between 3D printing and machining and embrace the future of advanced manufacturing. Essentium is AS9100D certified and ITAR registered. For more information, visit [essentium.com](http://essentium.com).