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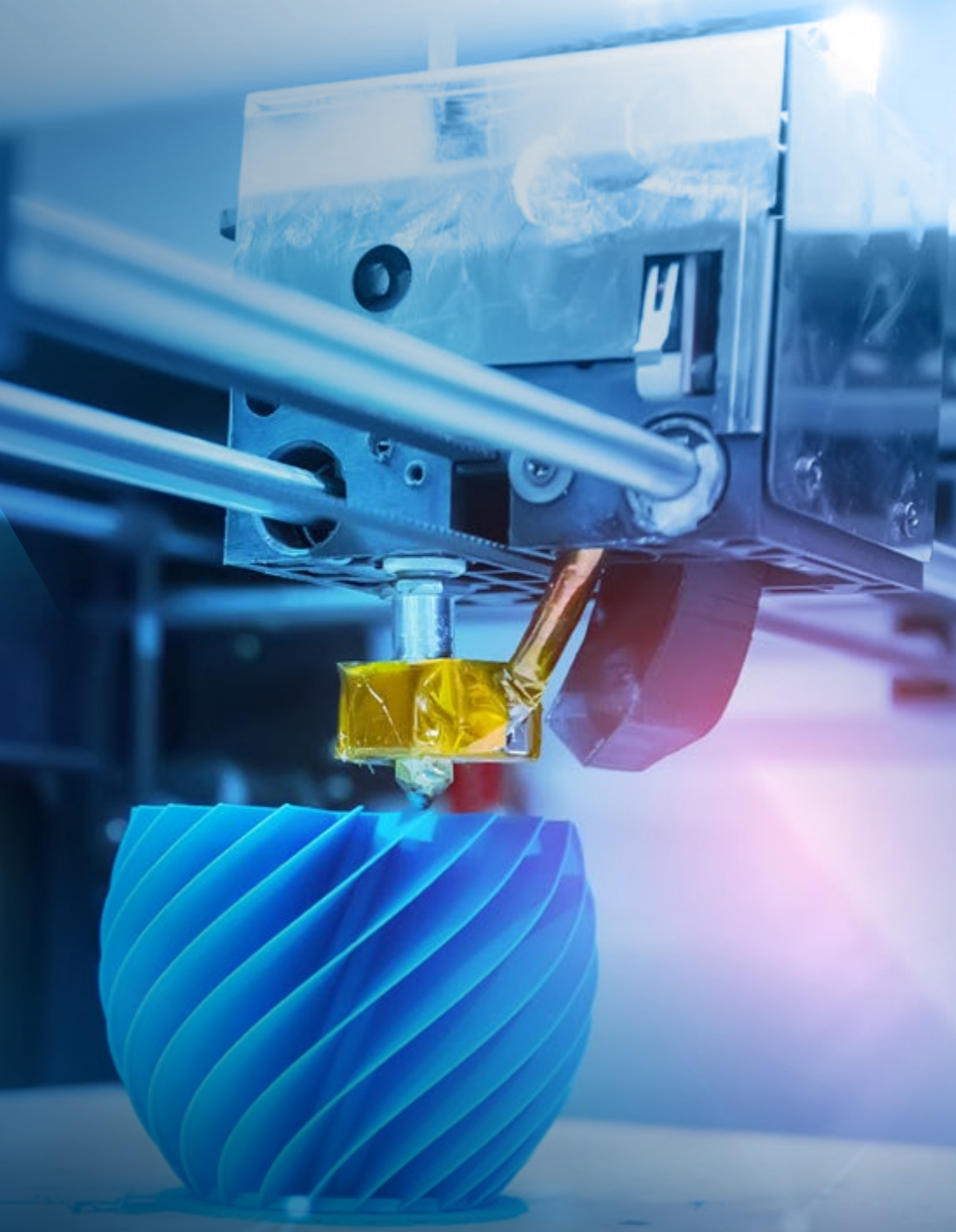
JABIL

3D PRINTING TECHNOLOGY TRENDS

*A Survey of Additive Manufacturing
Decision-Makers*

MARCH 2021

 dimensional research



INTRODUCTION

It was 2 a.m. on a Thursday when the 11 million residents of Wuhan, China, received a text message: they were being put on absolute lockdown two days before the Lunar New Year. On January 23, 2020, no one could have imagined that in a matter of months the whole world would be under quarantine orders, people keeping a distance of six feet from other people in line at the grocery store and wearing face masks to the bank. If there's one thing we learned, it's that a lot can change in just a year.

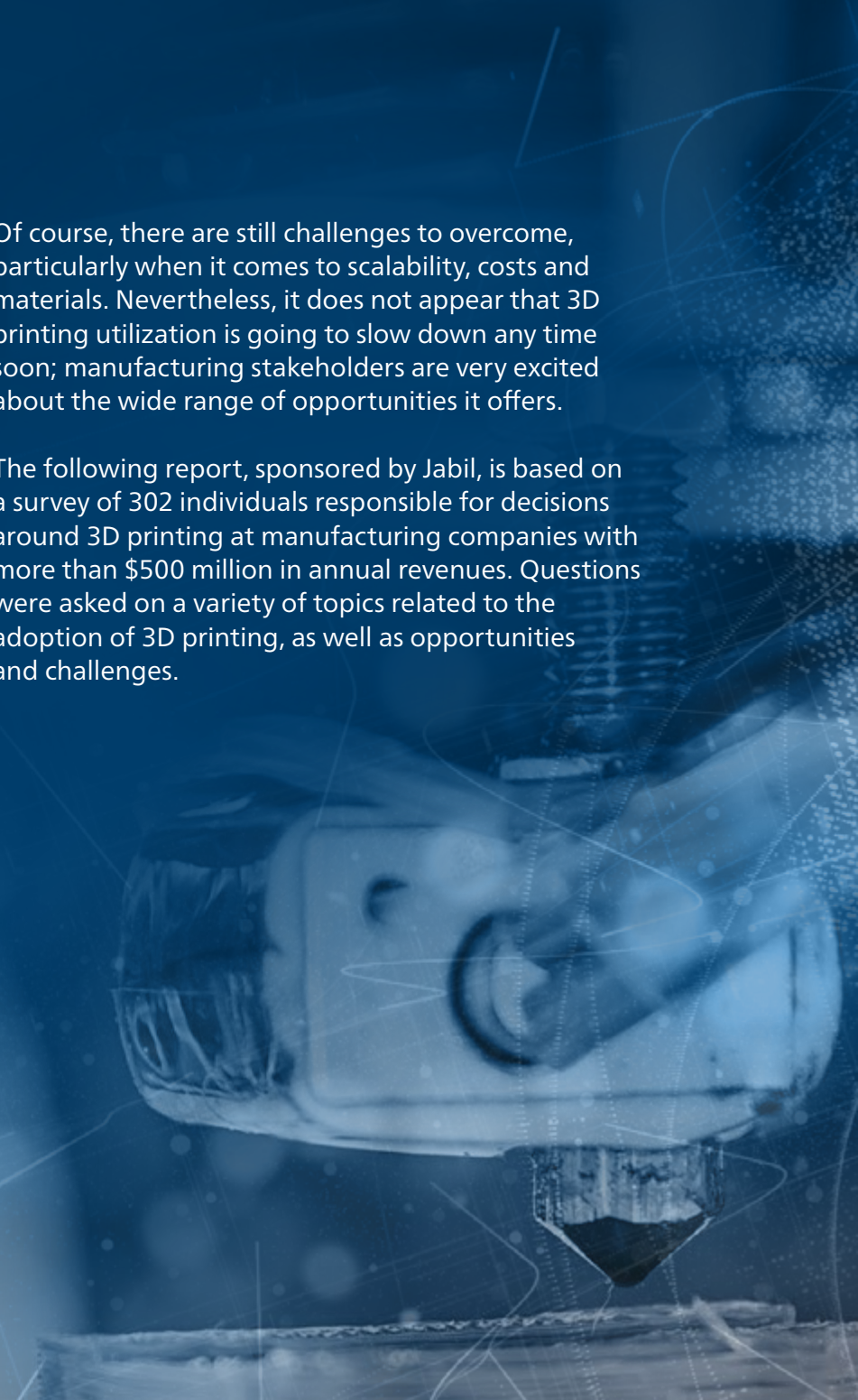
We've also seen how quickly change can happen through our series of additive manufacturing surveys. Every two years, we send out surveys to gauge the whirlwind of changes in the 3D printing market. By conducting original research since 2017 and again in 2019, we've gained unique insight into how attitudes toward 3D printing have evolved over the years.

The change isn't always dramatic—in some areas, we see huge leaps forward and in some we see steady growth. But one thing is certain: additive manufacturing is flourishing.

Manufacturers are realizing the numerous and varied benefits of 3D printing as it becomes a reliable and strategic technology in the arsenal of manufacturing processes. More and more manufacturers are leveraging additive for applications beyond research and prototyping.

Of course, there are still challenges to overcome, particularly when it comes to scalability, costs and materials. Nevertheless, it does not appear that 3D printing utilization is going to slow down any time soon; manufacturing stakeholders are very excited about the wide range of opportunities it offers.

The following report, sponsored by Jabil, is based on a survey of 302 individuals responsible for decisions around 3D printing at manufacturing companies with more than \$500 million in annual revenues. Questions were asked on a variety of topics related to the adoption of 3D printing, as well as opportunities and challenges.



KEY FINDINGS

TRENDS IN 3D PRINTING

- Use of 3D printing for functional or end-use parts continues to increase; almost **55%** say they use at least a quarter of their 3D printing capability to produce functional or end-use parts
- Prototyping has stayed flat, but all other uses of 3D printing increased notably in the last two years
- Companies that manufacture production parts are more likely to have 100+ 3D printers
- Expectations for extreme growth of 3D printing continue in 2021, with **87%** predicting that their use will at least double in the next five years
- 3D printing has the most impact early in the product lifecycle (i.e., design and prototyping)
- Expectations for growth of 3D printing for production remain high
- Issues with 3D printing in production continue; compared to 2019, platform issues rose **8%** and ecosystem issues increased by **13%**

KEY FINDINGS

TRENDS IN 3D PRINTING

- Organizations have not solved problems with 3D printing; scalability challenges rose **5%** from 2019
- Respondents anticipate a wide range of benefits, especially ability to deliver parts quickly, lower production costs, speedy responses to production line issues and production of personalized and customized goods
- Higher level of potential benefits reported among executives
- More than half of top leadership views 3D printing as strategic
- **95%** face financial barriers to the adoption of 3D printing

KEY FINDINGS

ADDITIVE MATERIALS TRENDS

- Notable growth seen in all types of materials, the most popular being plastics/polymers, composites and metals
- Plastics are used more widely than metals, but many companies use both
- Desire to use all types of materials is increasing
- There is a significant rise in all types of post-processing, with machining and polishing leading the charge
- Challenges with materials continue, including **26%** jump in frustration on time to develop

KEY FINDINGS

OUTSOURCING ADDITIVE MANUFACTURING

- **45%** printed a minimum of 50,000 parts last year
- **73%** use in-house 3D printing, but service bureaus, contract manufacturers and additive networks are commonly used
- Just **over half** report they do the majority of 3D printing in-house
- Designers far more likely to report in-house 3D printing than operations or production/manufacturing
- About **half** report outsourcing is a significant part of their future 3D printing plans
- There are a wide range of criterion for selecting an outsourcing partner, including design capabilities, ability to scale and experience in additive manufacturing

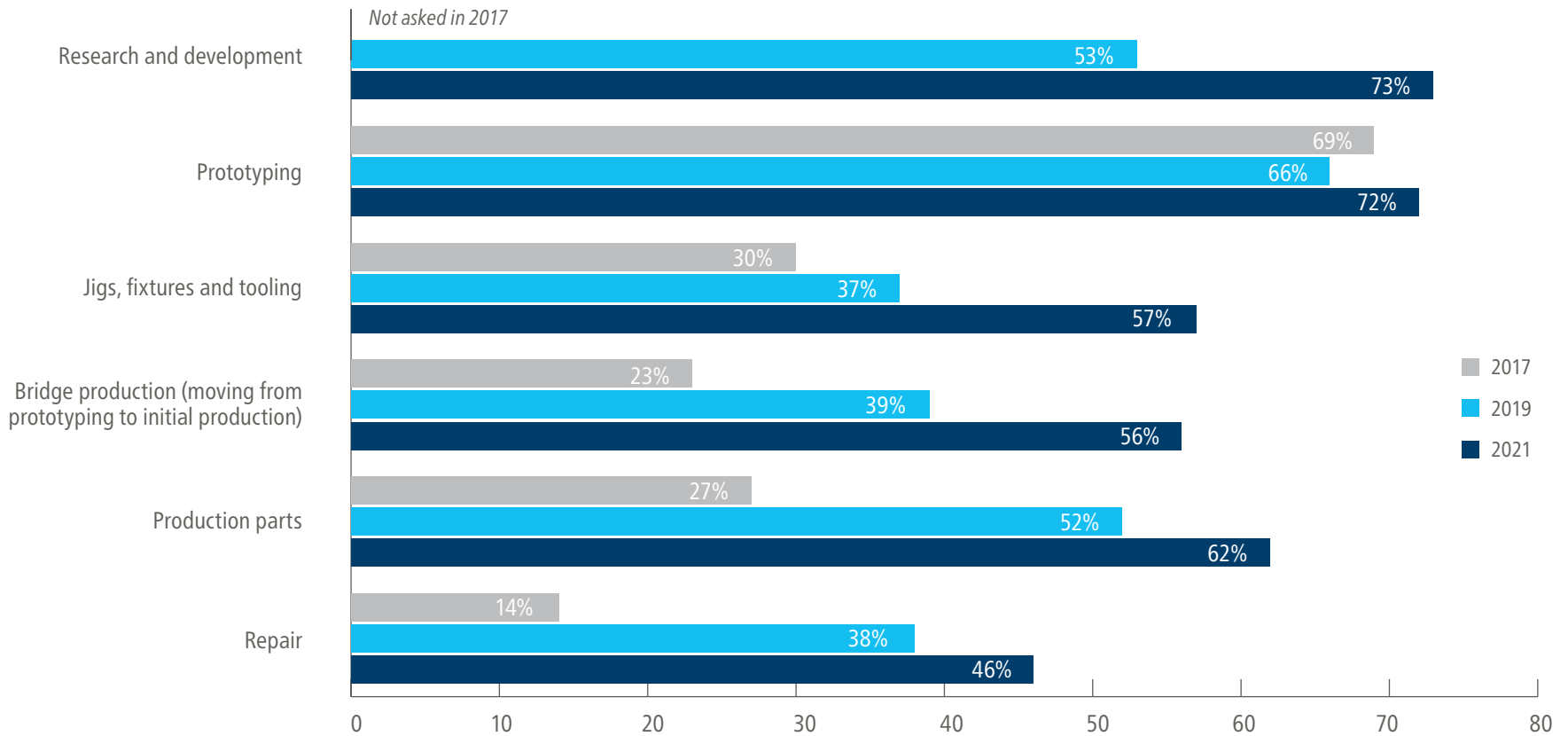


TRENDS IN 3D PRINTING

PROTOTYPING HAS STAYED FLAT, BUT ALL OTHER USES OF 3D PRINTING INCREASED NOTABLY

For years, prototyping has stayed firm as the top application for 3D printing. Although that hasn't changed, other applications are starting to catch up. This year, all other uses for additive manufacturing took a huge leap forward; particularly research and development and jigs, fixtures and tooling, which both increased by 20% compared to 2019.

In what ways is your company currently using 3D printing? Choose all that apply.

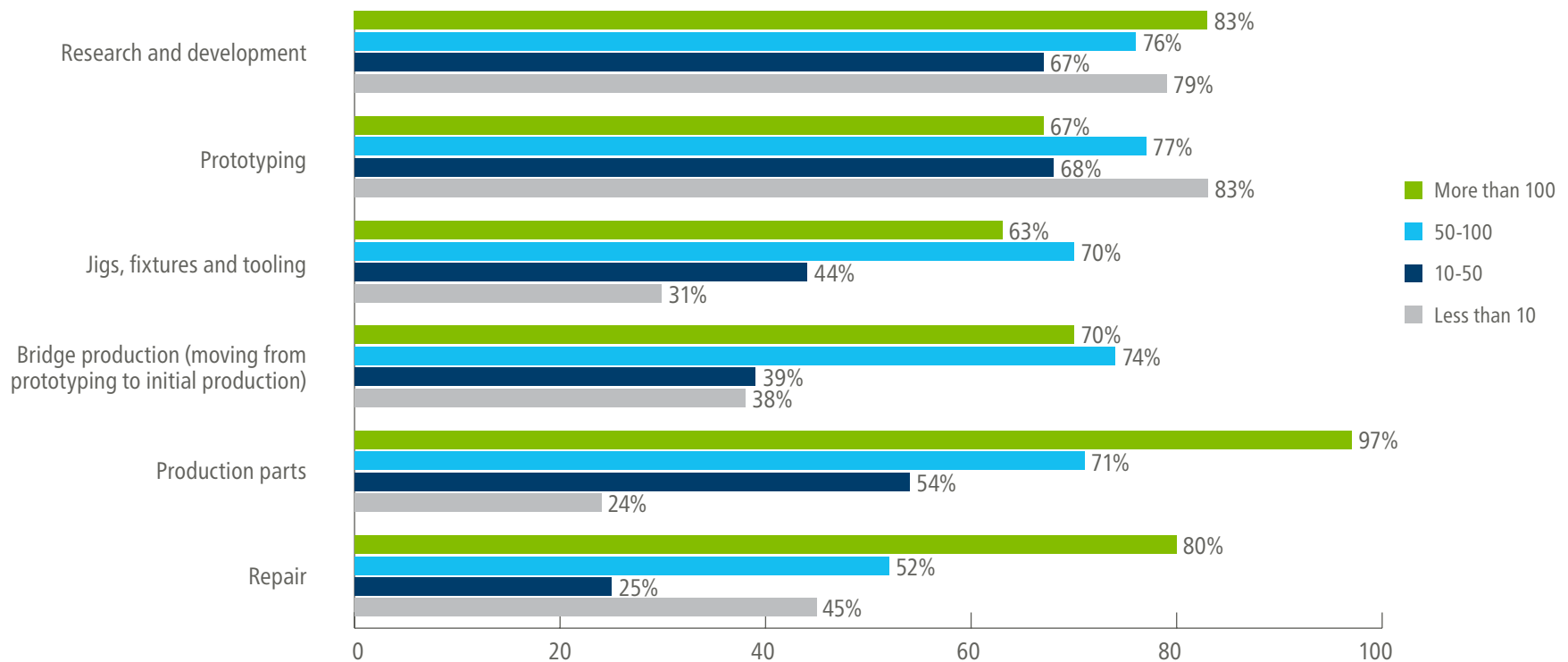


COMPANIES THAT MANUFACTURE PRODUCTION PARTS ARE MORE LIKELY TO HAVE 100+ 3D PRINTERS

Overall, there seems to be little or no correlation between the number of 3D printers a company has and the ways it uses additive manufacturing. The one outlier is production parts. The more a company prints production parts, the more likely it is to have more 3D printers; just under a quarter of companies with less than 10 3D printers use them for production parts but almost 100% of companies with more than 100 printers do.

In what ways is your company currently using 3D printing? *Choose all that apply.*

By number of 3D printers

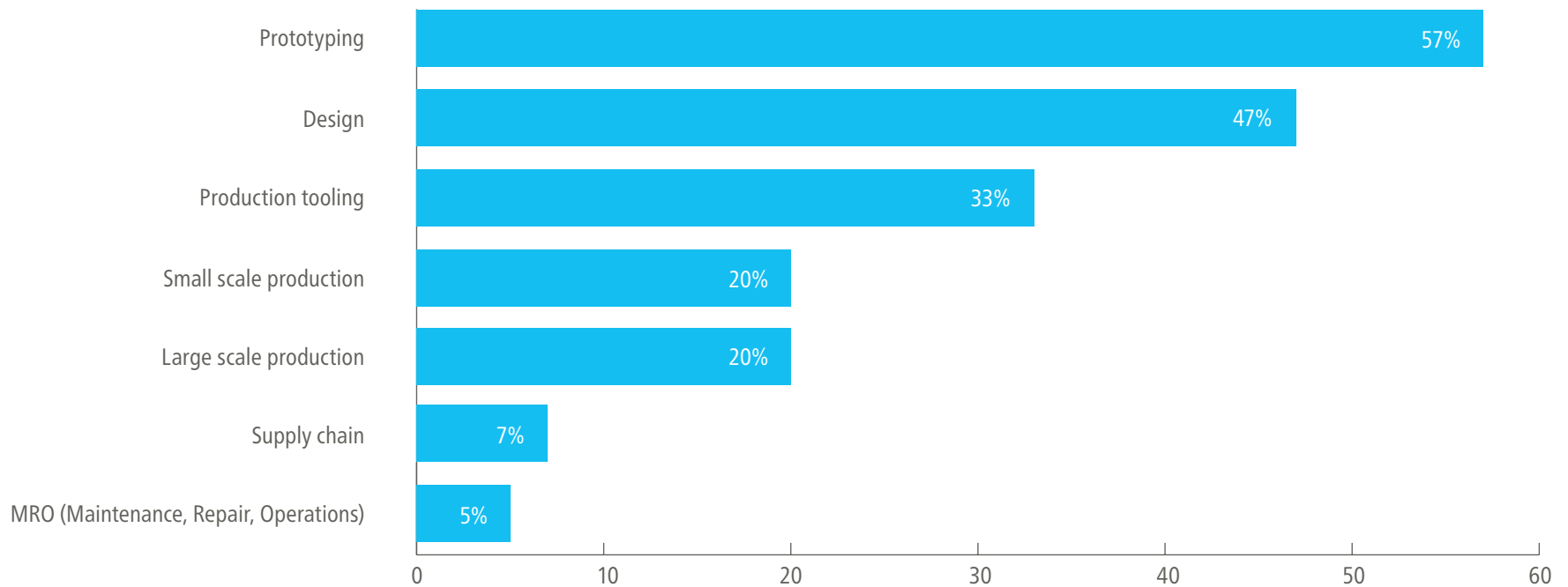


3D PRINTING HAS THE MOST IMPACT EARLY IN THE PRODUCT LIFECYCLE

Although companies are expanding their use of 3D printing, when it comes to parts of the product lifecycle that are most positively impacted by additive manufacturing, it remains most valuable early in the process. Almost half of respondents see benefits in using 3D printing in design, and a little under 60% use it for prototyping.

The advantages of additive manufacturing in the design and prototyping process are well-documented. Whereas producing a functional prototype with traditional manufacturing methods can take weeks – even months – with 3D printing, designers and engineers can often create a working prototype in 24 hours or less. This helps to significantly speed up the design process.

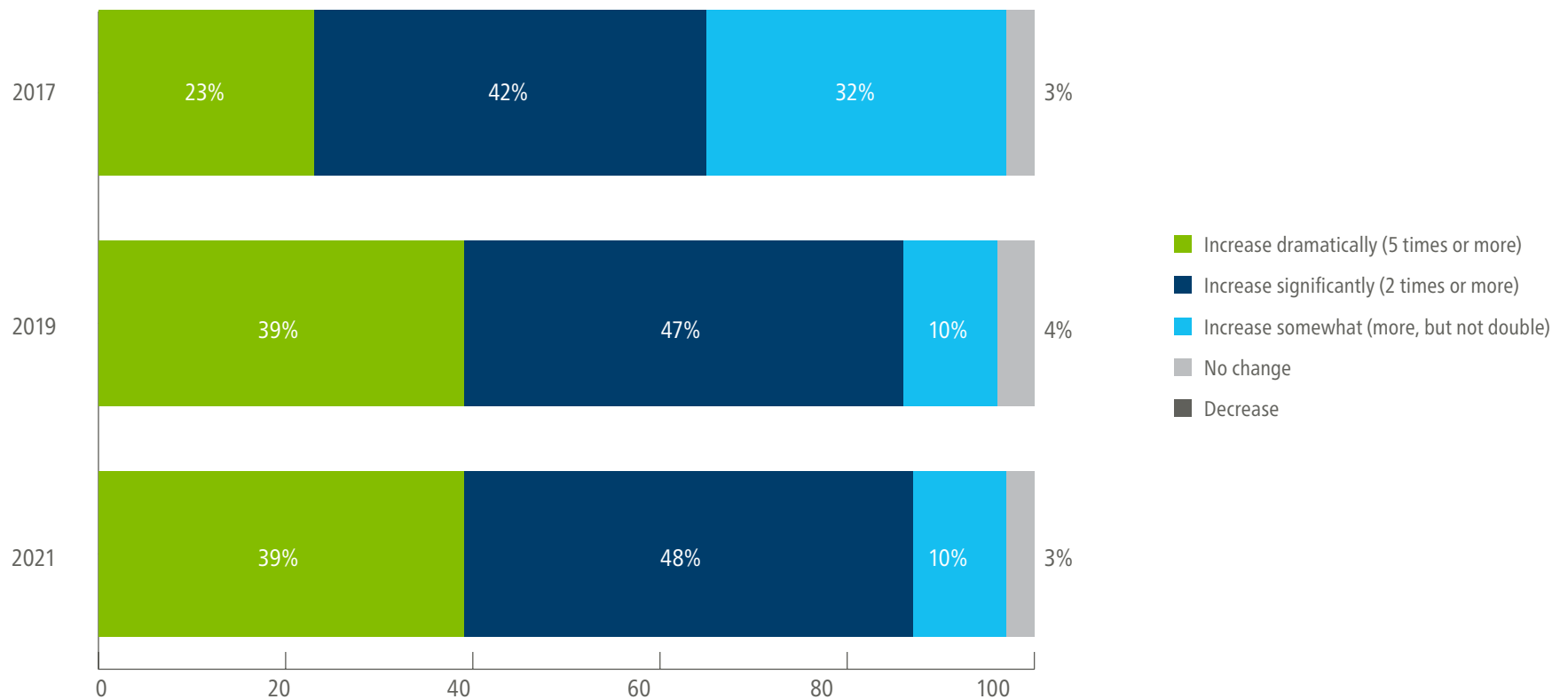
What part of the product lifecycle is the most positively impacted by 3D printing? *Choose up to two of the following.*



EXPECTATIONS FOR SIGNIFICANT GROWTH OF 3D PRINTING CONTINUE IN 2021

Although the growth projections from 2021 and 2019 are essentially identical, they still show a positive trajectory for 3D printing in the next two to five years. In 2021, 97% of decision-makers indicated that their company's growth will increase; 87% of those believe it will at least double.

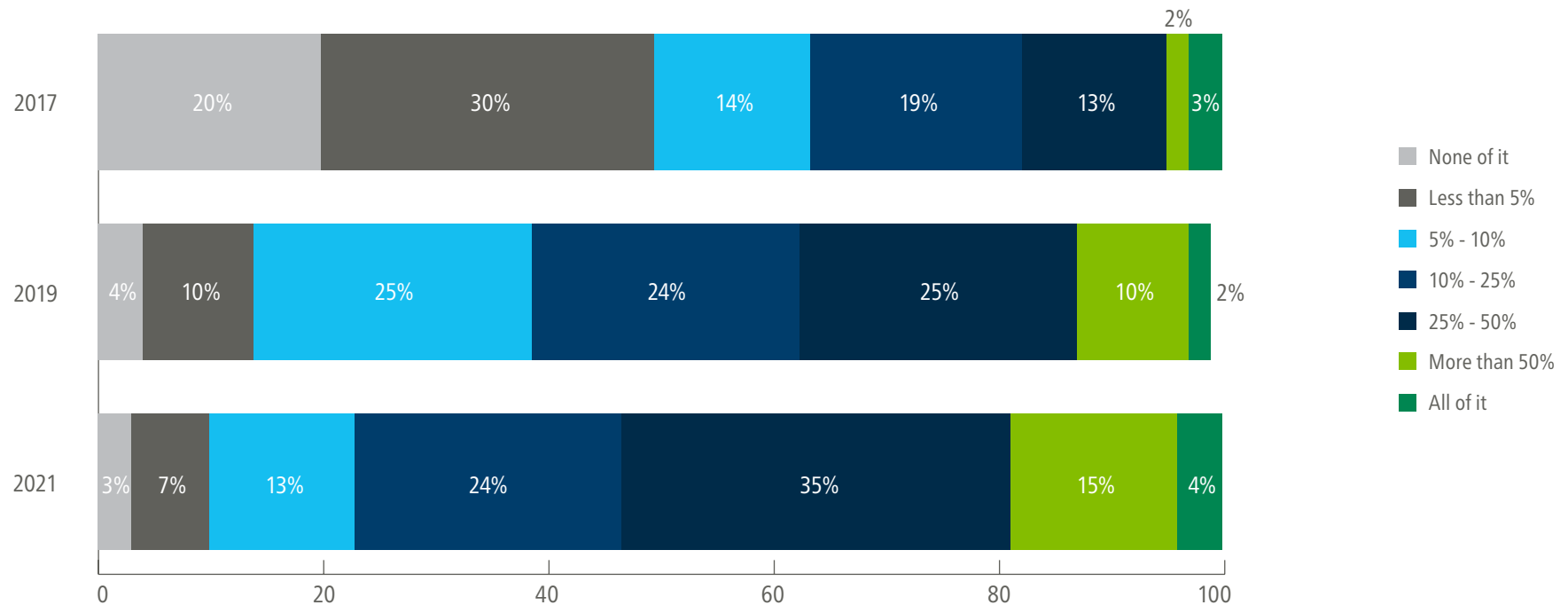
How do you expect your company's use of 3D printing to change in the coming 2-5 years? Choose the answer that most closely applies.



USE OF 3D PRINTING FOR FUNCTIONAL OR END-USE PARTS CONTINUES TO INCREASE

At first glance, the percentage of companies using 3D printing for functional or end-use parts in 2019 and 2021 doesn't look that different. In 2019, 96% of respondents used 3D printing for this purpose to some degree; in 2021, 97% affirmed their usage of 3D printing. But when we look at the degree to which companies are now using additive manufacturing for their functional and end-use parts, there is a notable growth in 2021 compared to 2019. Although only 13% of participants said that they're using additive manufacturing for 5-10% of functional and end-use parts; there is a 10% increase in the number of manufacturers using 3D printing for 25-50% of end-use parts and 5% increase of manufacturers in the more-than-50% category. It may not be a dramatic leap forward, but it is steady upward growth.

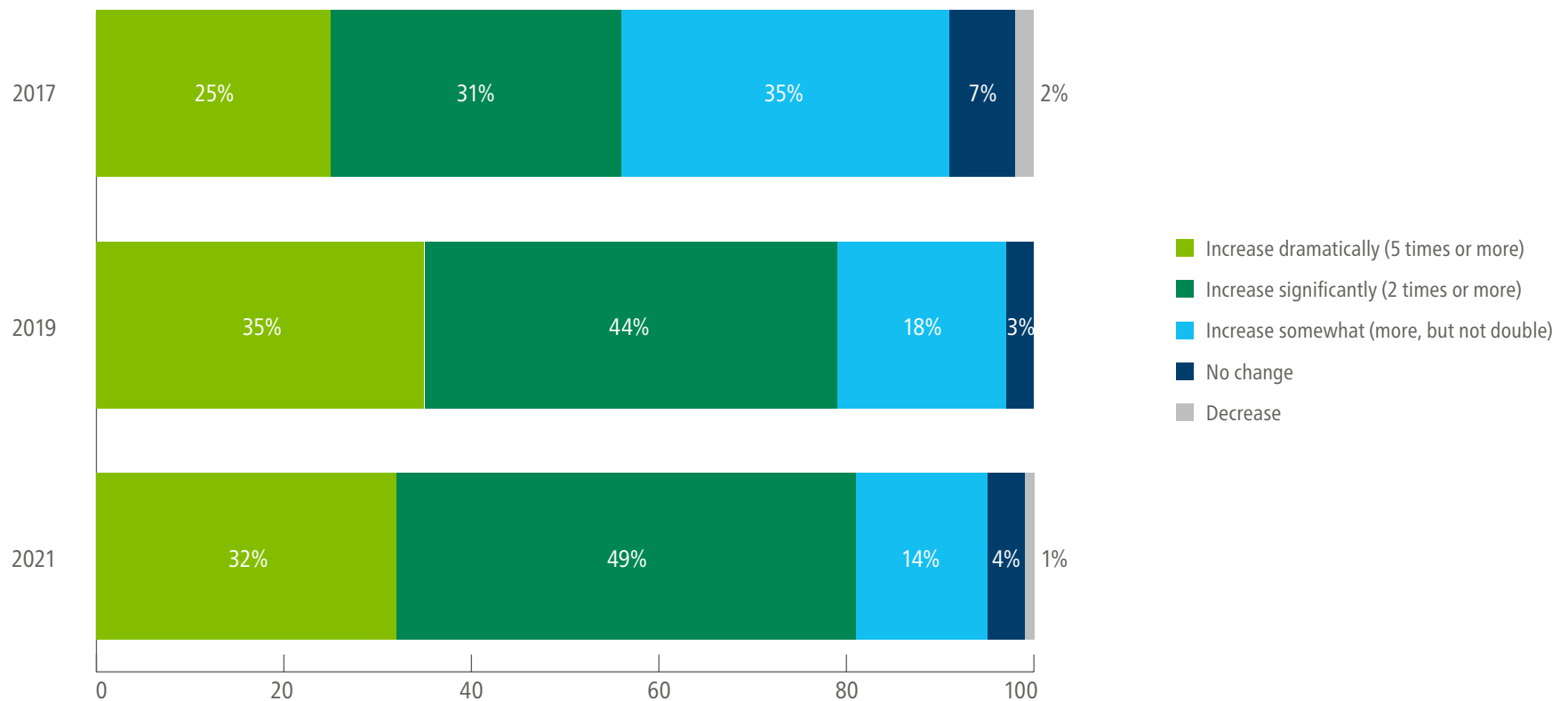
Approximately what percentage of your 3D printing is currently producing functional or end-use parts?



EXPECTATIONS FOR GROWTH OF 3D PRINTING FOR PRODUCTION REMAIN HIGH

Like 3D printing for functional and end-use parts, there is no dramatic increase in the use of additive manufacturing for production parts or goods. In 2021, 81% of participants responded that they expect use of 3D printing to at least double in the next three to five years while 79% said the same in 2019.

How do you expect your use of 3D printing for production parts or goods to change in the coming 3-5 years? Choose the answer that most closely applies.

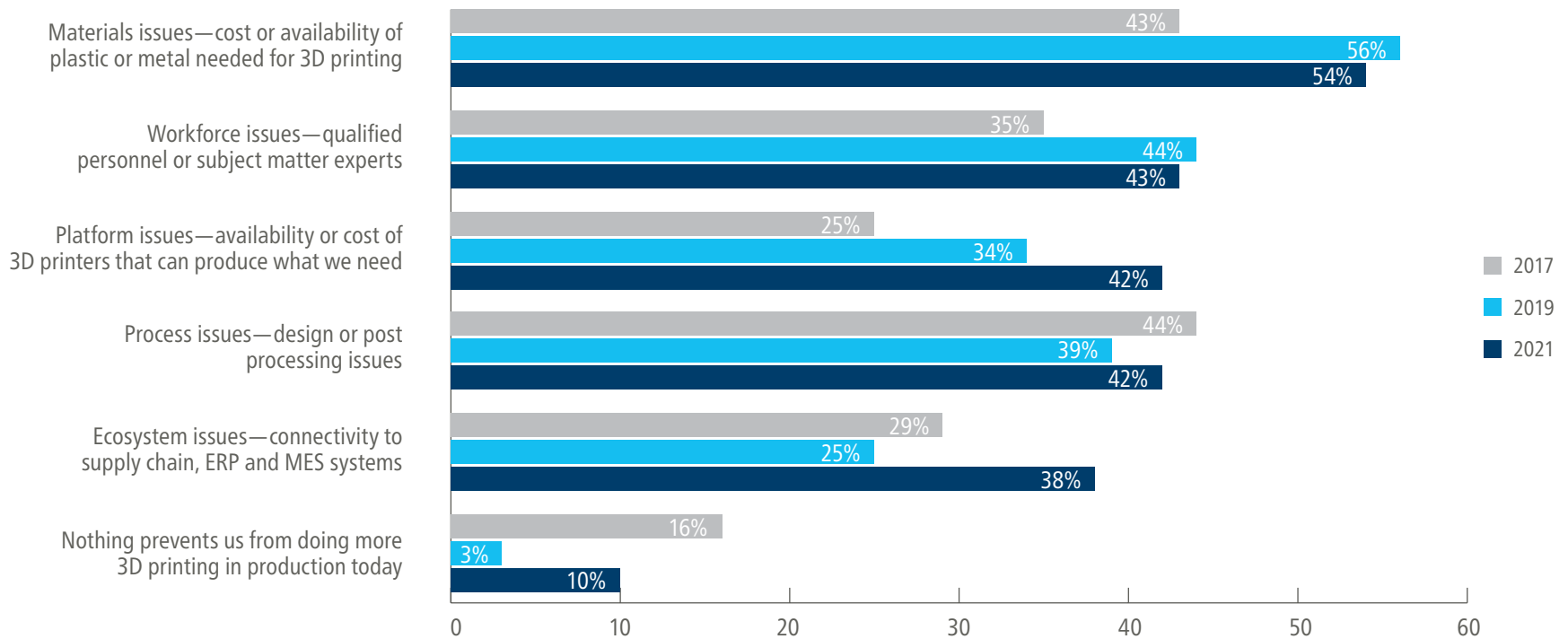


ISSUES WITH 3D PRINTING IN PRODUCTION CONTINUE

Companies continue to run into issues with 3D printing in production. Overall, the numbers from 2021 are similar to those in 2019, the notable exception being a 13% rise in ecosystem issues.

This could be due—at least in some part—to the fact that COVID-19 revealed vulnerabilities in many supply chains and created substantial obstacles for manufacturing. Companies across all industries were forced to evaluate the speed and agility of their operational processes as well as how smoothly everything works together.

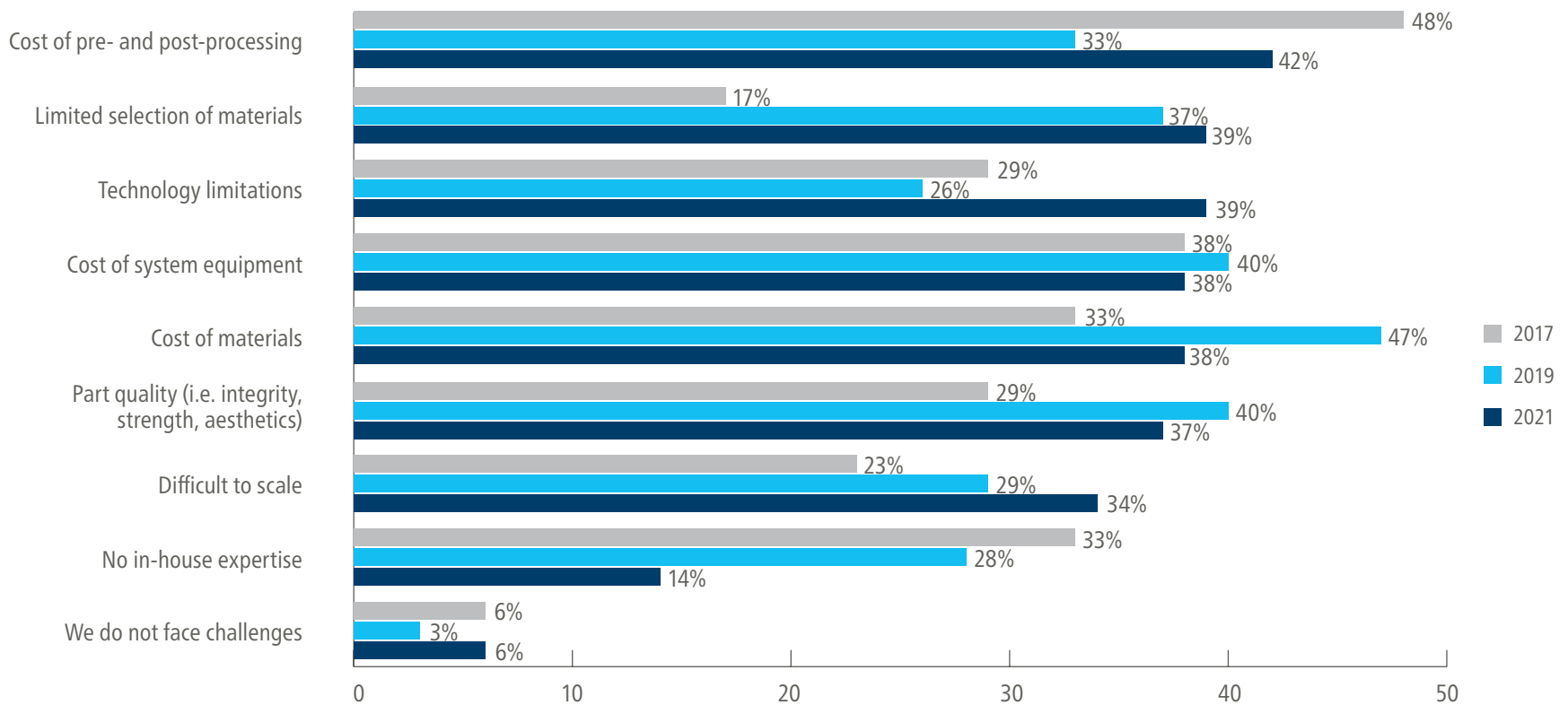
What prevents your company from doing more 3D printing in production today? *Choose the answer that most closely applies.*



ORGANIZATIONS HAVE NOT SOLVED PROBLEMS WITH 3D PRINTING

When we look at how companies are coping with 3D printing challenges, one thing is clear: there are still problems to solve. Many issues—such as the cost of system equipment, limited selection of materials and part quality—have stayed fairly stagnant. Others have gotten worse; most noticeably, technology limitations rose 13%. Still, some areas have gotten better; lack of in-house expertise is half of what it was in 2019.

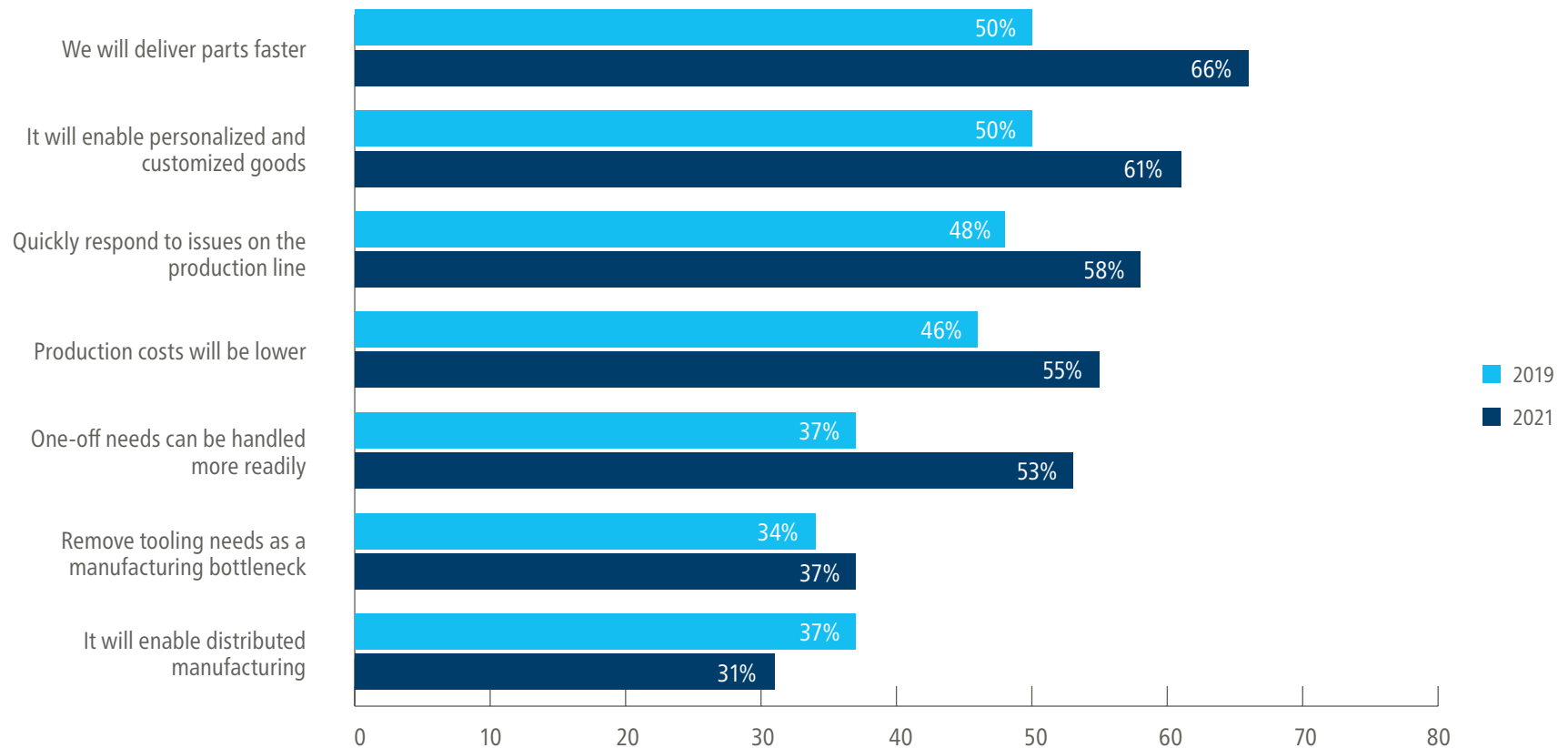
What challenges does your organization face with 3D printing? Choose all that apply.



RESPONDENTS ANTICIPATE A WIDE RANGE OF BENEFITS

Respondents were unanimous in asserting that 3D printing will bring a wide range of benefits. They were especially optimistic about additive manufacturing's ability to enable faster delivery of parts as well as the creation of personalized and customized goods.

What benefits do you expect to gain from mass adoption of 3D printing for manufacturing? Choose all that apply.

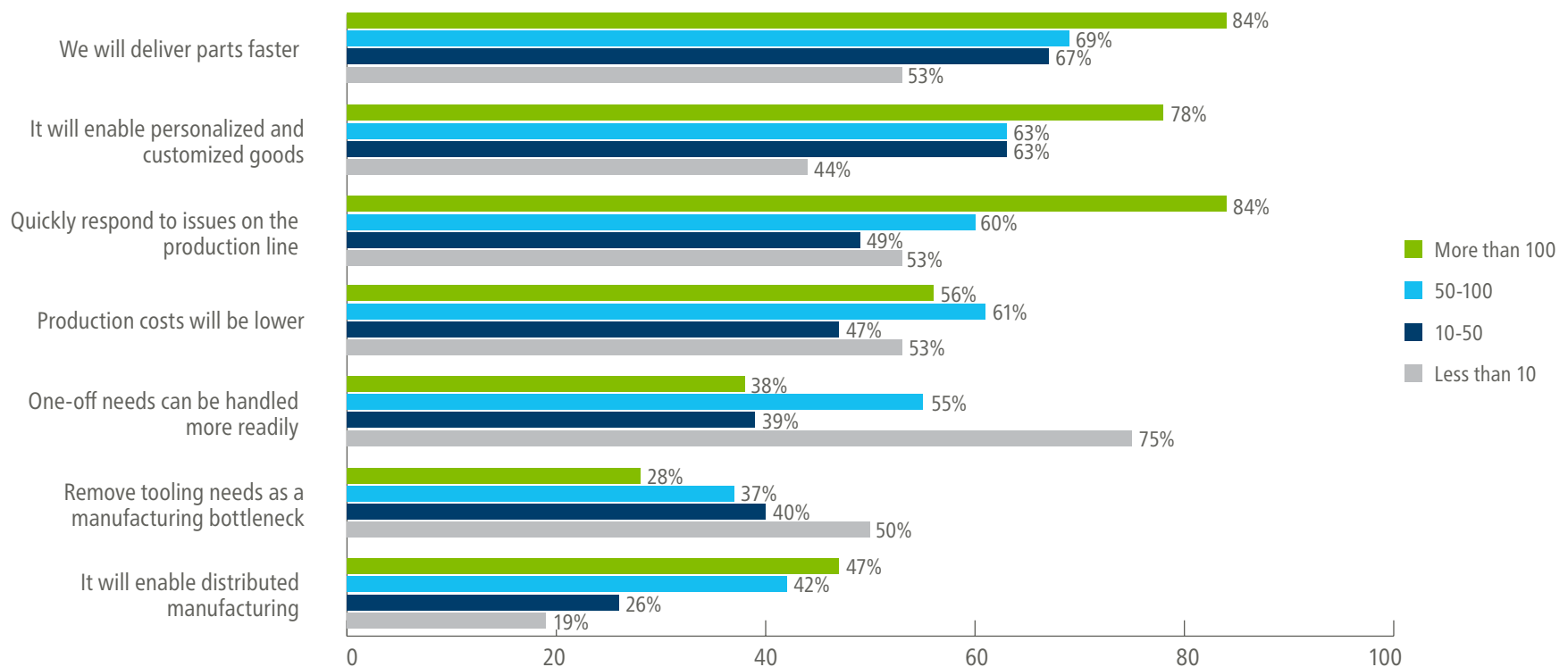


THOSE WITH HIGHER NUMBERS OF PRINTERS EXPECT MORE BENEFITS FROM MASS ADOPTION

Overall, companies that have invested in a higher number of 3D printers expect more benefits from mass adoption of additive manufacturing. It's hard to definitively say whether these companies invested in more 3D printers because they're more optimistic about the benefits or whether they're more optimistic because they have more 3D printers. It's likely a combination of both; because they had high hopes for the benefits of additive manufacturing, they bought more 3D printers, which bore out their expectations.

What benefits do you expect to gain from mass adoption of 3D printing for manufacturing? Choose all that apply.

By number of 3D printers

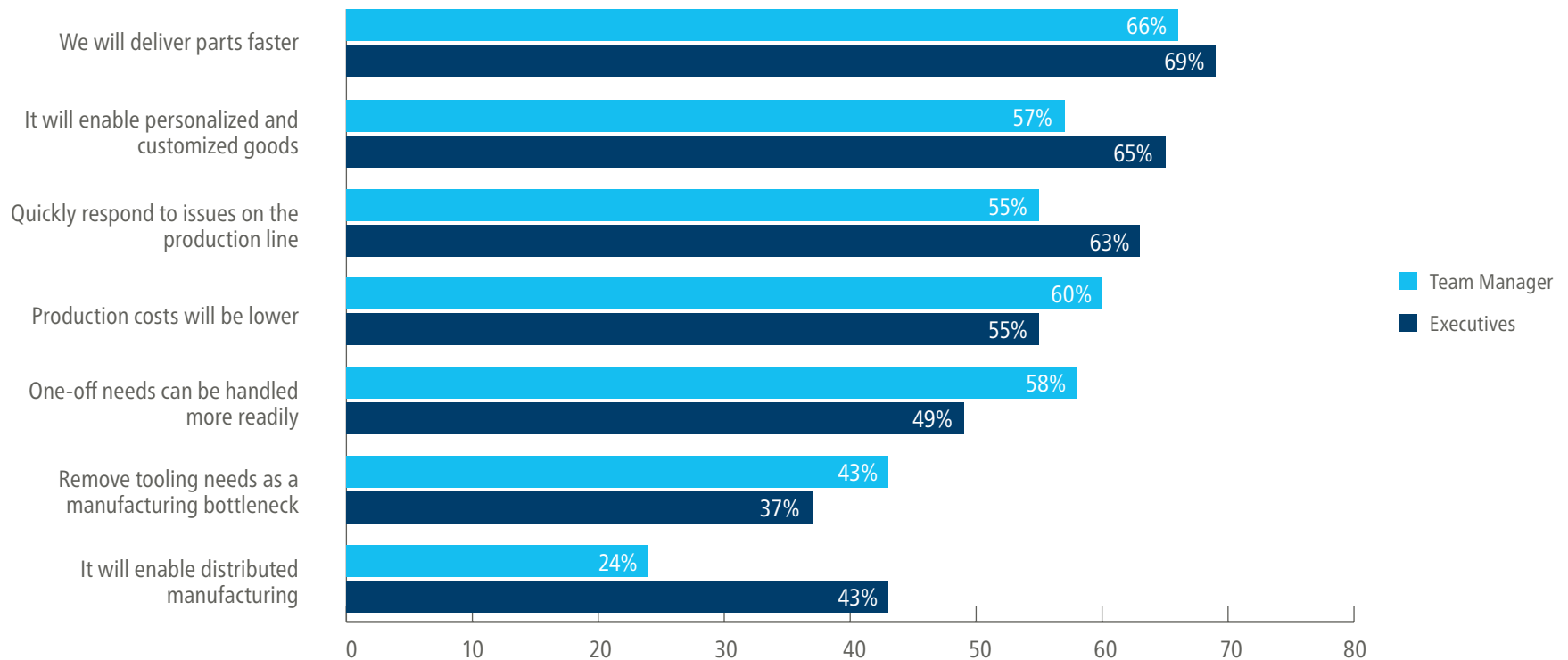


HIGHER LEVEL OF POTENTIAL BENEFITS REPORTED AMONG EXECUTIVES

When we broke down the data by job level, we saw that executives are more optimistic about the ability of 3D printing to help with faster delivery of parts, the production of personalized and customized goods and quick response to issues on the production line.

What benefits do you expect to gain from mass adoption of 3D printing for manufacturing?

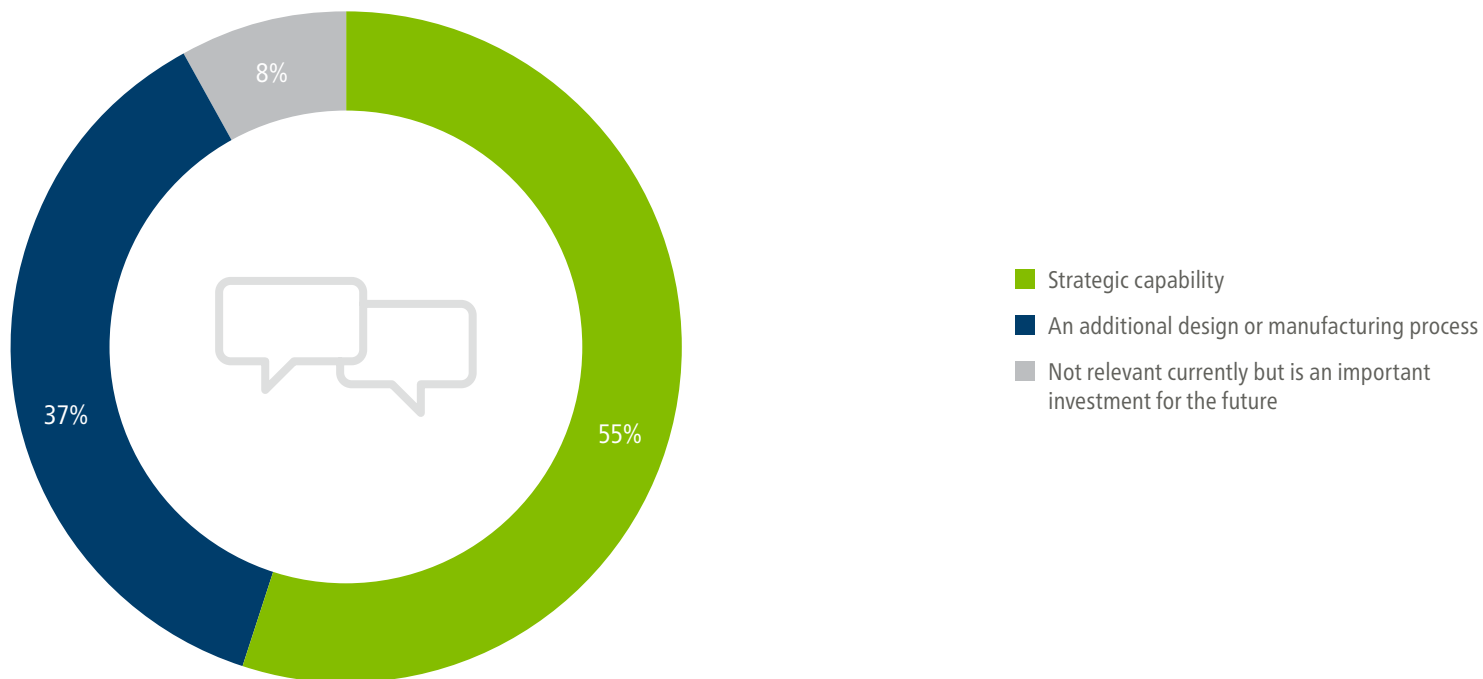
By Job Level



MORE THAN HALF OF TOP LEADERSHIP VIEWS 3D PRINTING AS STRATEGIC

More than half of top leadership views 3D printing as enhancing their strategic capabilities. This includes the ability to produce customized or personalized products at scale. Given leadership's tendency to look at the larger picture, it makes sense that they would be more excited about the benefits additive manufacturing can offer to operations and the business as a whole.

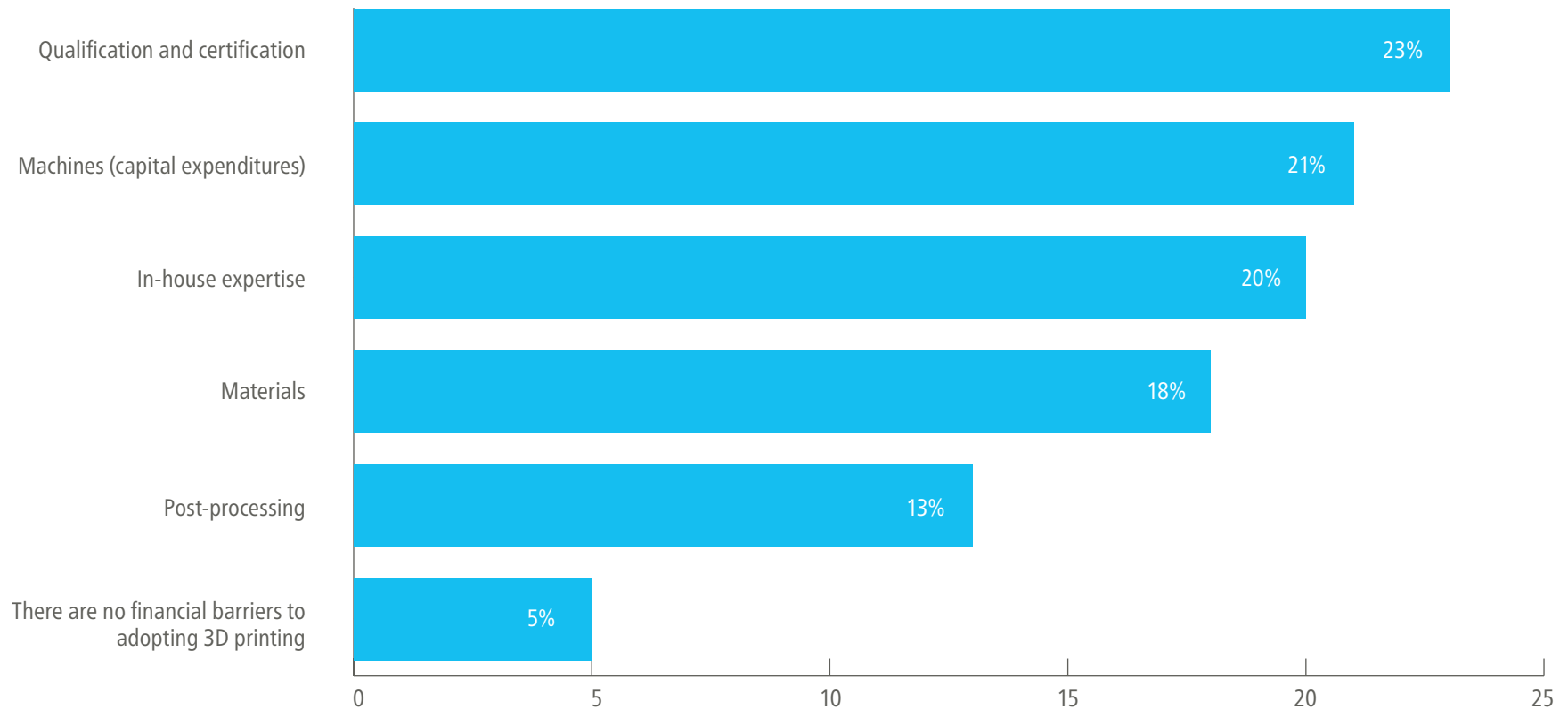
Which of the following best represents the opinion of your company's top leadership towards 3D printing?



95% FACE FINANCIAL BARRIERS TO THE ADOPTION OF 3D PRINTING

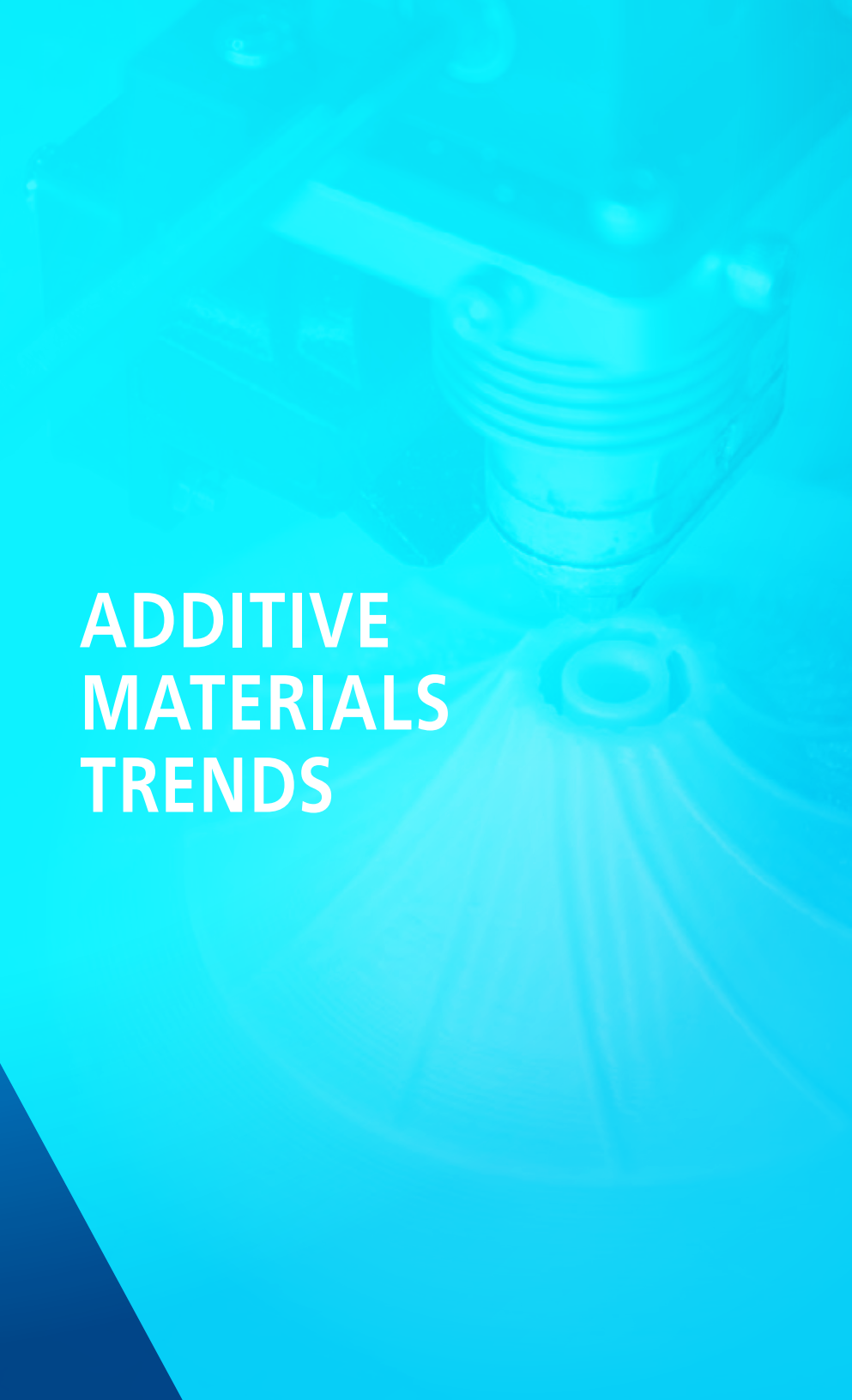
When it comes to financial barriers, there are numerous issues at play. Obtaining the appropriate qualifications and certifications ekes in at number one, but capital expenditures associated with machines and having to gain in-house expertise closely follow.

Which of the following causes the primary financial or cost barrier to adopting 3D printing at your company? Choose up to two of the following.





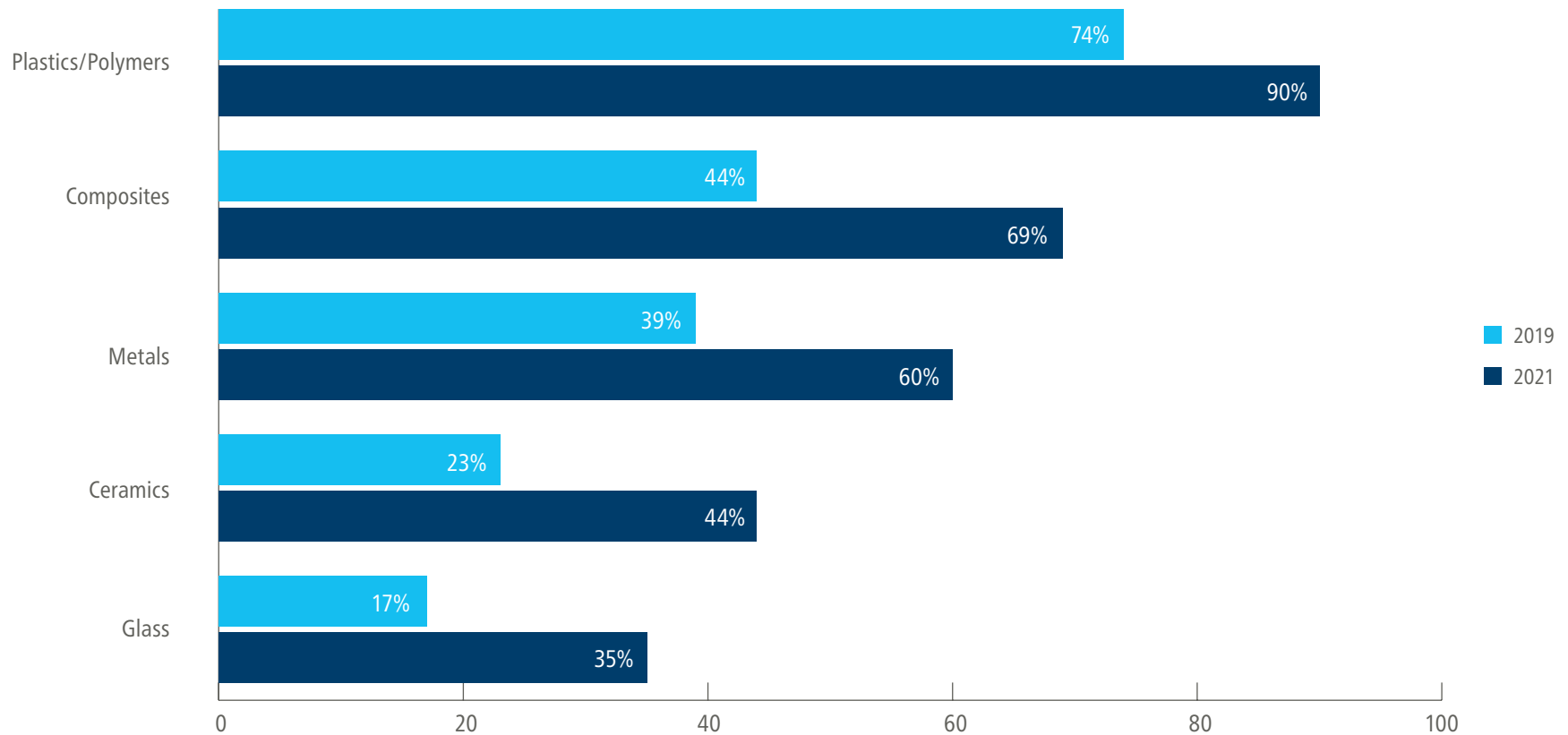
ADDITIVE MATERIALS TRENDS



NOTABLE GROWTH SEEN IN ALL TYPES OF MATERIALS

The use of all types of materials has grown by leaps and bounds in about two years. Plastics and polymers continue to sit at the top of the leaderboard, but in 2019, 74% of respondents said their companies used plastics/polymers; composites now lag only 5% behind that number. Metals made significant progress, rising by more than 20%.

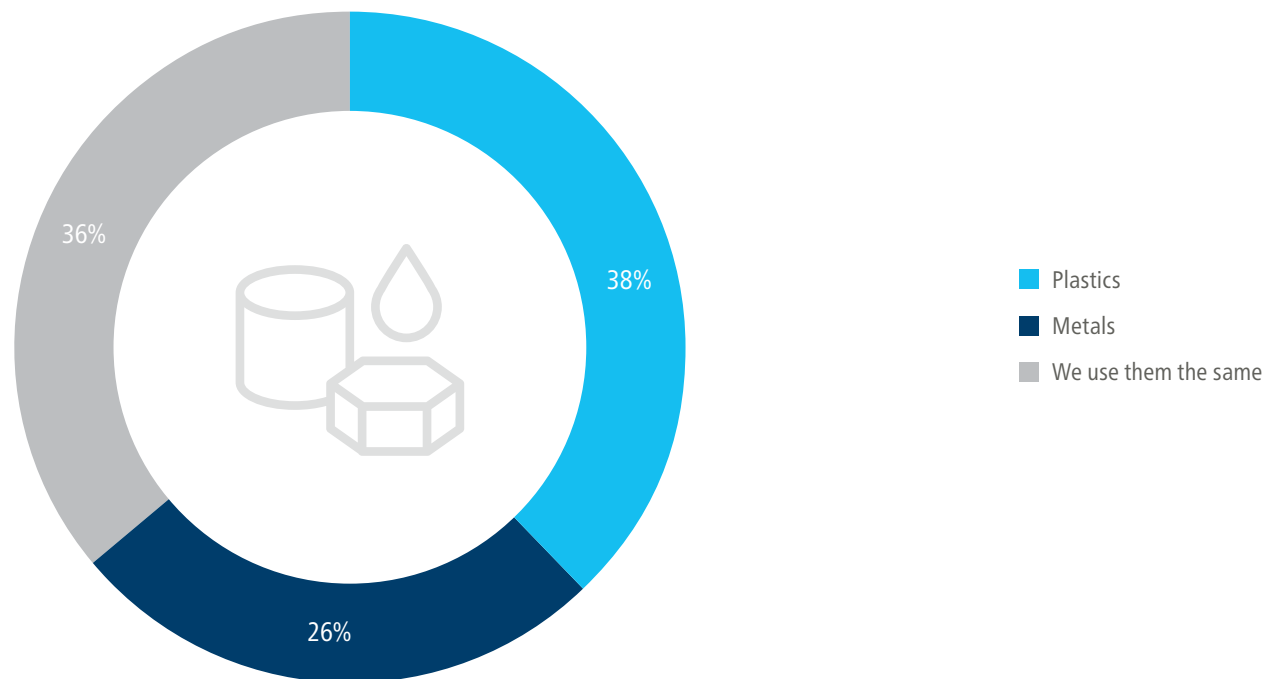
What types of additive materials is your organization currently using for 3D printing? Choose all that apply.



PLASTICS ARE USED MORE WIDELY THAN METALS, BUT MANY USE BOTH

Although plastics reign supreme as the most-used material, the discrepancy between plastic and metal usage for additive manufacturing isn't as big as you might think. More than a third of respondents answered that they use plastics and metals equally, and even between those who selected either plastics or metals, plastics only had a lead of 12%.

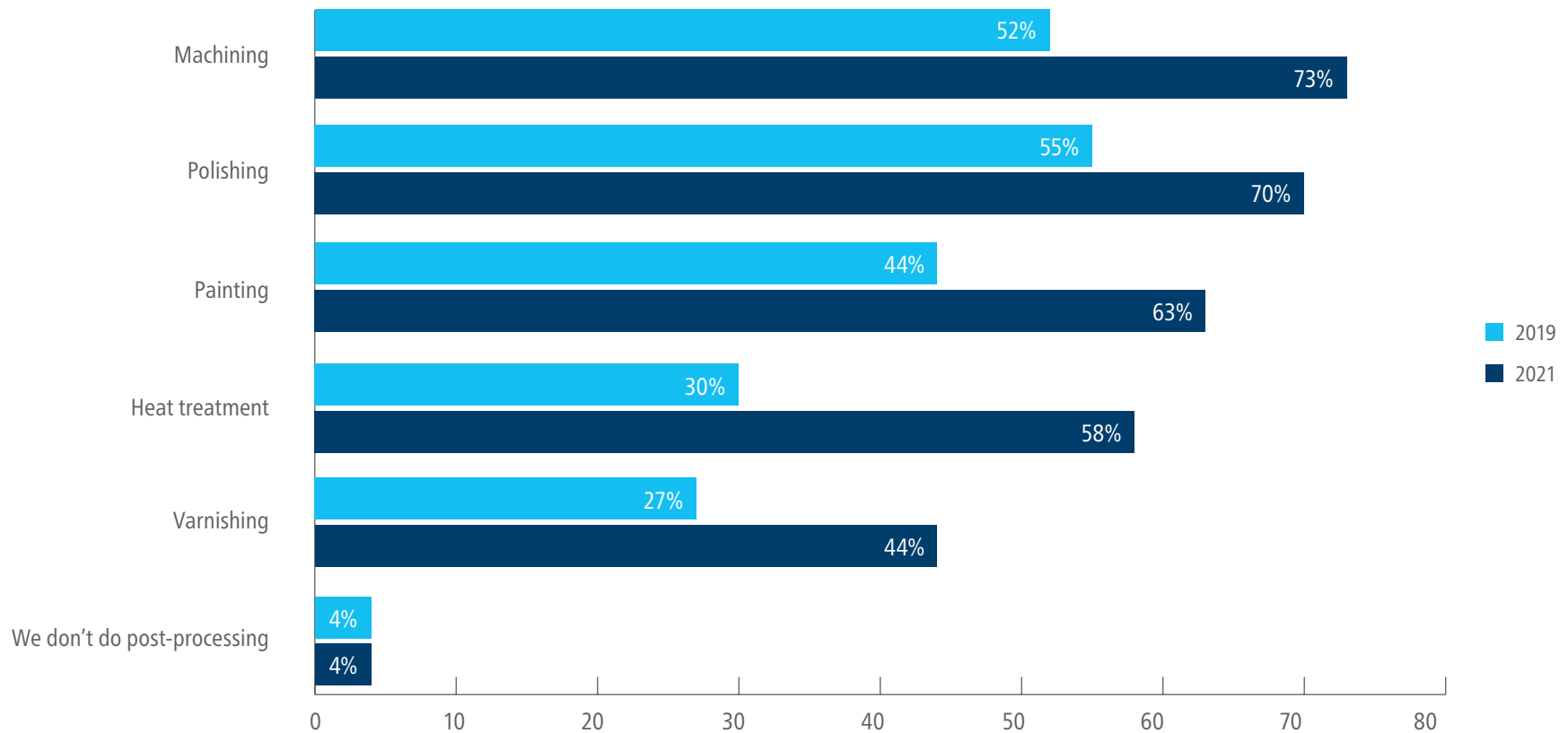
Which of these types of additive materials does your company use the most?



SIGNIFICANT INCREASE IN ALL TYPES OF POST-PROCESSING

Companies have taken huge leaps in the types of post-processing they leverage. Respondents are using each type of post-processing about 20-30% more in 2021 than 2019. In fact, by increasing more than 20%, machining surpassed polishing as the most popular post-processing option.

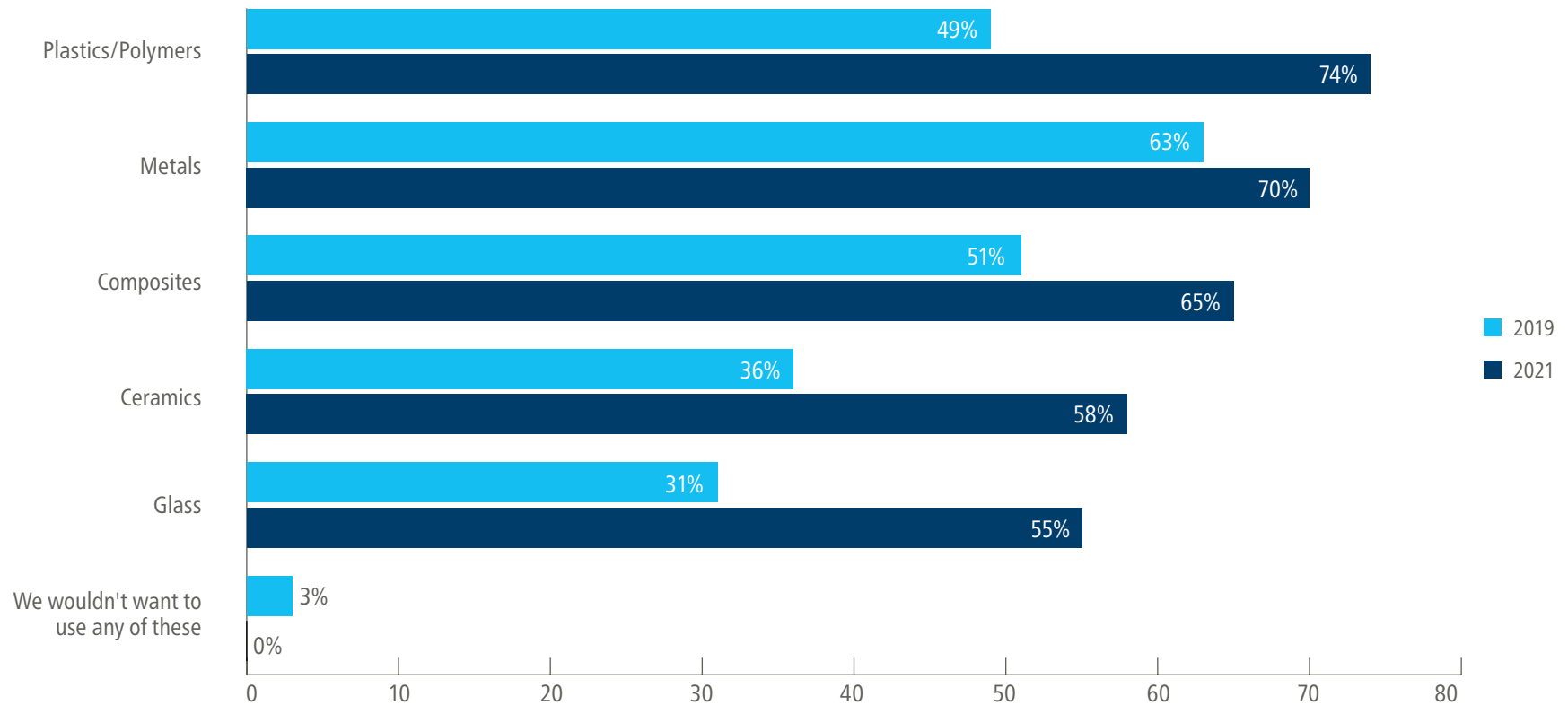
What types of post-processing are you currently using for 3D printing? Choose all that apply.



DESIRE TO USE ALL TYPES OF MATERIALS IS INCREASING

When we look at what materials are currently being used compared to desired materials, plastics remain the top choice. However, the desire to use almost all other materials surpasses the current use. Most noticeably, the desire to use glass surpasses current usage by 20%; desire to use ceramics exceeds use by 14% and interest in metals surpasses current use by 10%.

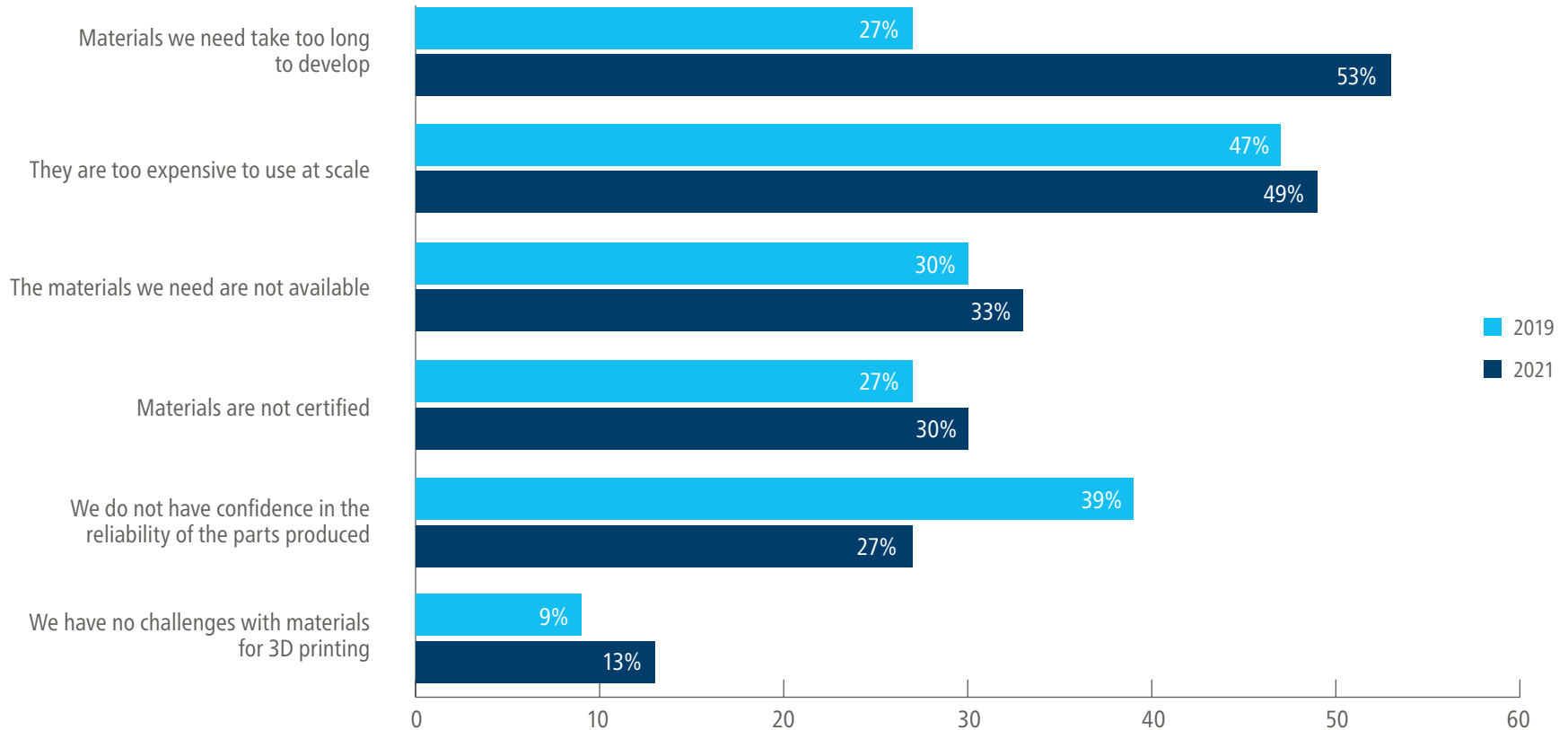
What types of additive materials would your organization want to use if there were certified versions available at a reasonable cost? Choose all that apply.



CHALLENGES WITH MATERIALS CONTINUE

Despite the increases in usage of all types of materials, manufacturers still have challenges to overcome in terms of additive manufacturing materials. The biggest challenge cited in 2021 is that materials take too long to develop, followed by how expensive desired materials are to use at scale.

What challenges does your organization face with 3D printing materials? Choose all that apply.



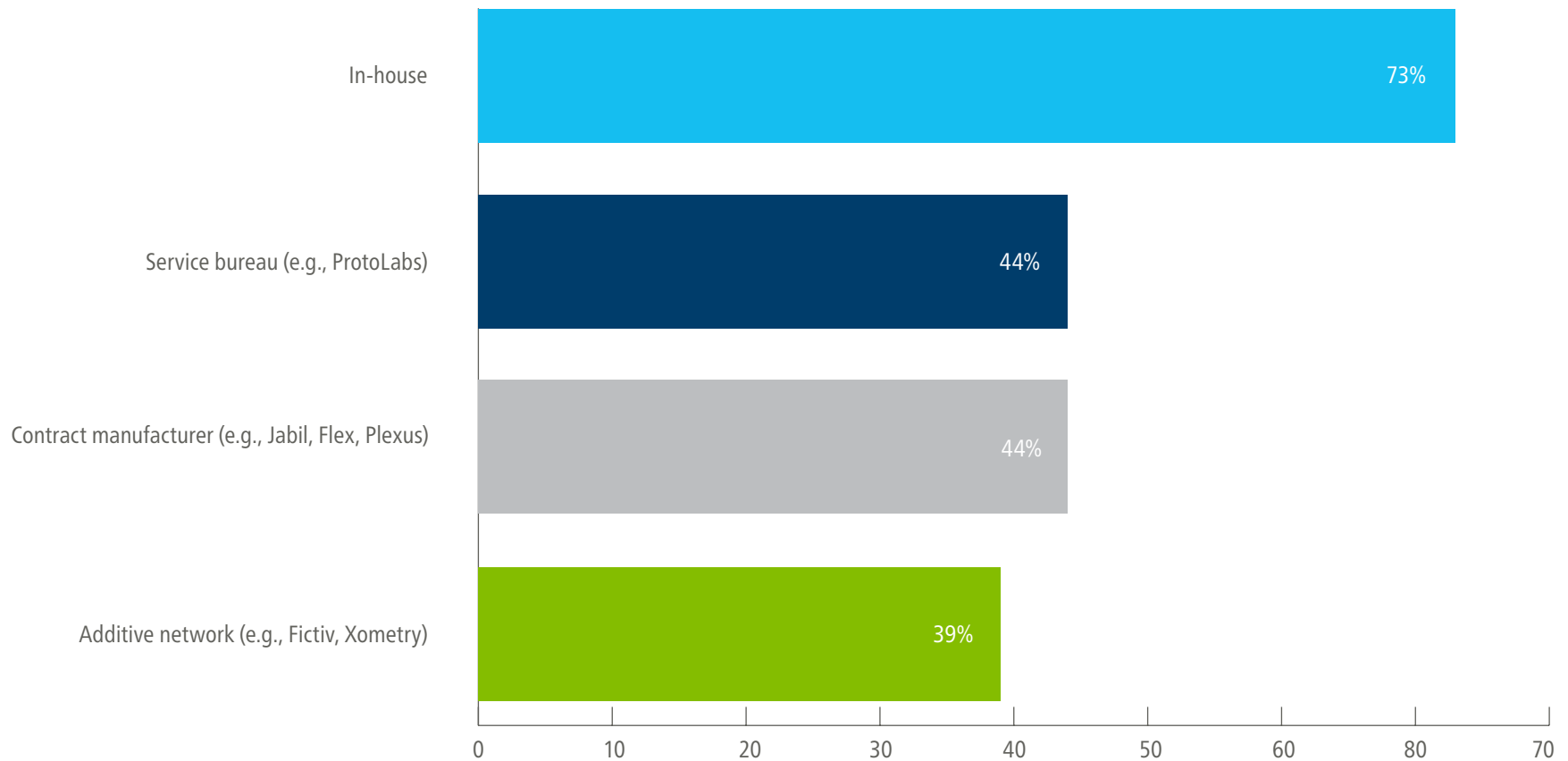


OUTSOURCING ADDITIVE MANUFACTURING

WHILE IN-HOUSE IS MOST COMMON, MANY TYPES OF OUTSOURCING ARE USED

Almost three-quarters of companies continue to do their additive manufacturing in-house. When it comes to outsourcing options, there is no clear winner, although participants did indicate that outsourcing is fairly common (around the 40-45% range).

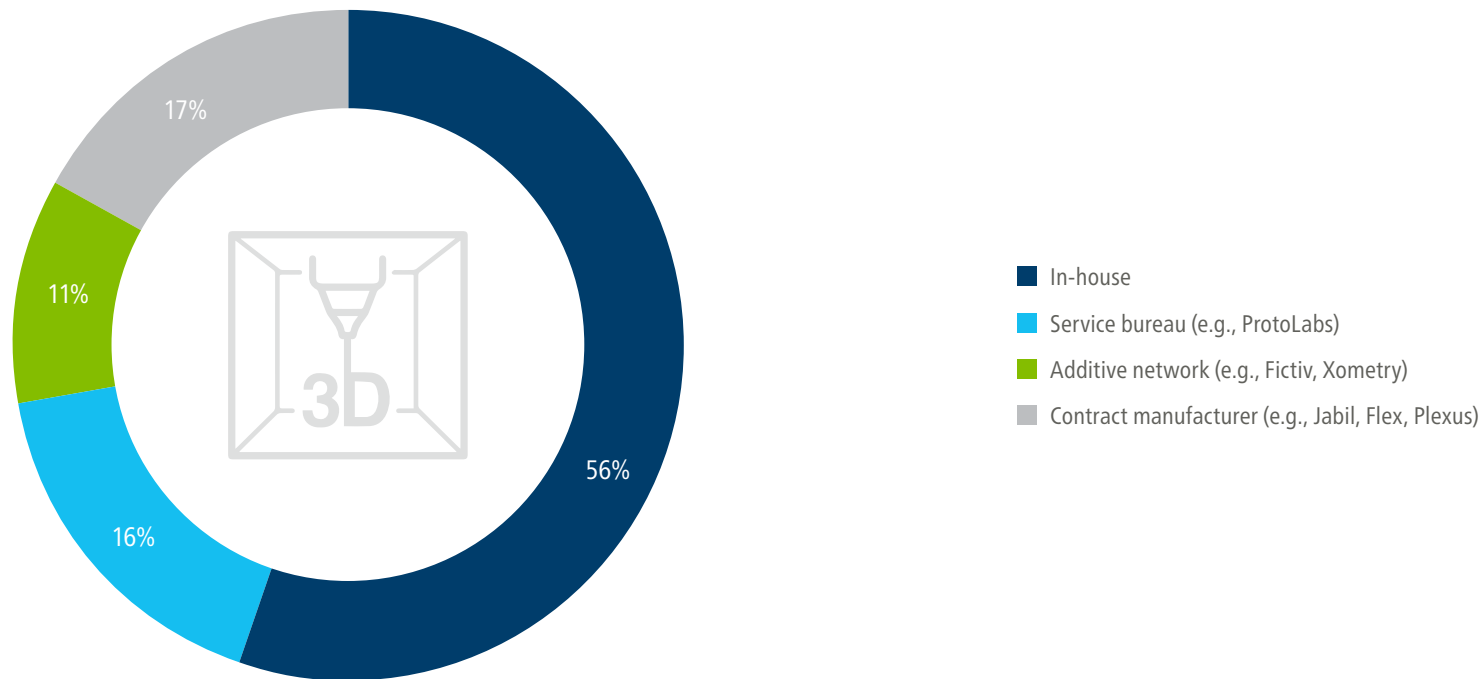
Where does your company conduct 3D printing today? *Choose all that apply.*



JUST OVER HALF REPORT THEY DO THE MAJORITY OF 3D PRINTING IN-HOUSE

When survey participants were asked where they do the majority of their additive manufacturing, in-house emerged as the clear winner. This correlates with our earlier finding that half as many companies report lack of in-house expertise as a challenge compared to 2019. This indicates that companies are prioritizing either educating their employees on 3D printing or hiring individuals who are already knowledgeable in additive manufacturing. Either way, it supports the trend toward a more 3D printing-oriented future in design, engineering and production.

Where is 3D printing primarily conducted for your company today? *Choose the one answer that most closely applies.*

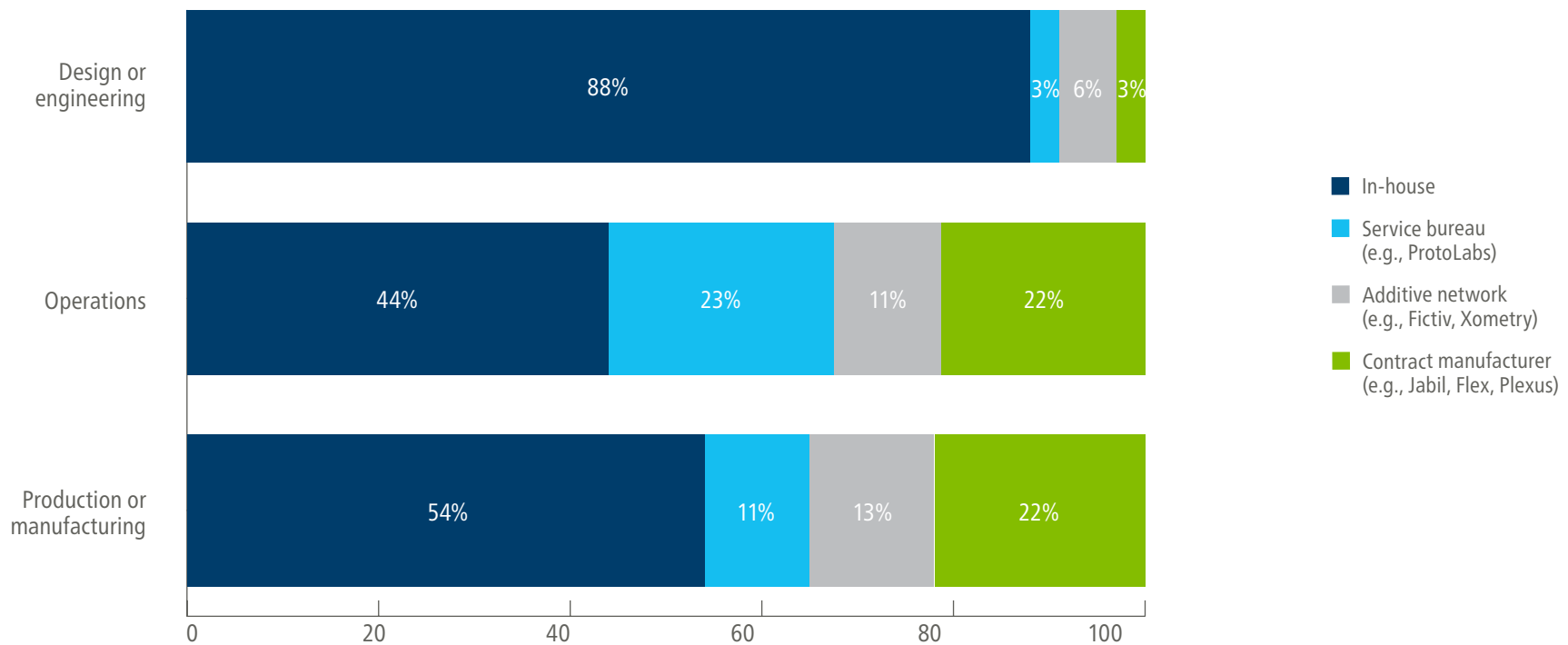


DESIGNERS FAR MORE LIKELY TO REPORT IN-HOUSE 3D PRINTING

When we break down the data by job type, designers and engineers are most likely to report in-house 3D printing. Since additive manufacturing is most commonly used in early production (i.e., design and prototyping), these roles are also the most likely to be hands-on with 3D printing, followed by production and manufacturing professionals (the second most likely group to report in-house 3D printing).

Where is 3D printing primarily conducted for your company today?

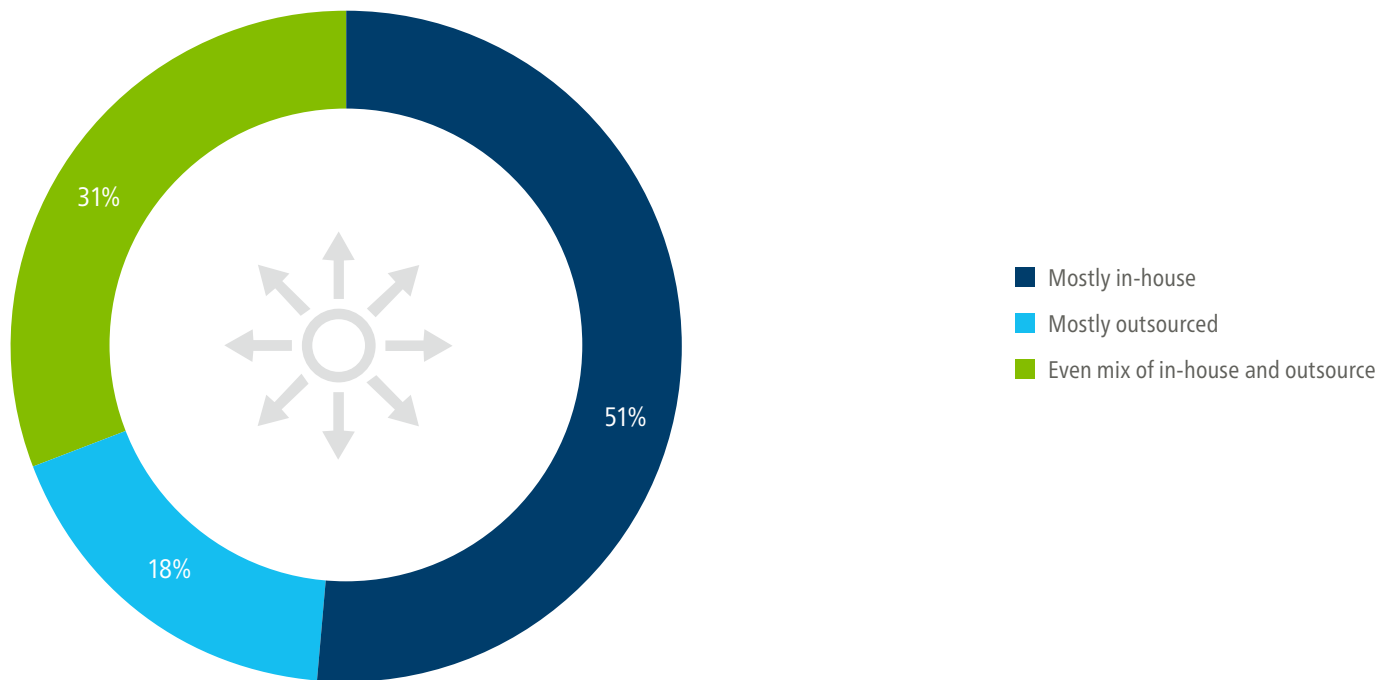
By Role



ABOUT HALF REPORT OUTSOURCING IS A SIGNIFICANT PART OF THEIR FUTURE 3D PRINTING PLANS

Although about half of respondents asserted that they plan to keep additive manufacturing mostly in-house, roughly three out of 10 predict that their companies will use an even mix of manufacturing in-house and outsourcing. Of course, this is only a prediction; teams will likely be open to seriously considering outsourcing if manufacturing partners can offer resources and knowledge that solve key pain points.

Which of the following best describes your plans for how you will conduct most 3D printing moving forward? Choose the one answer that most closely applies.

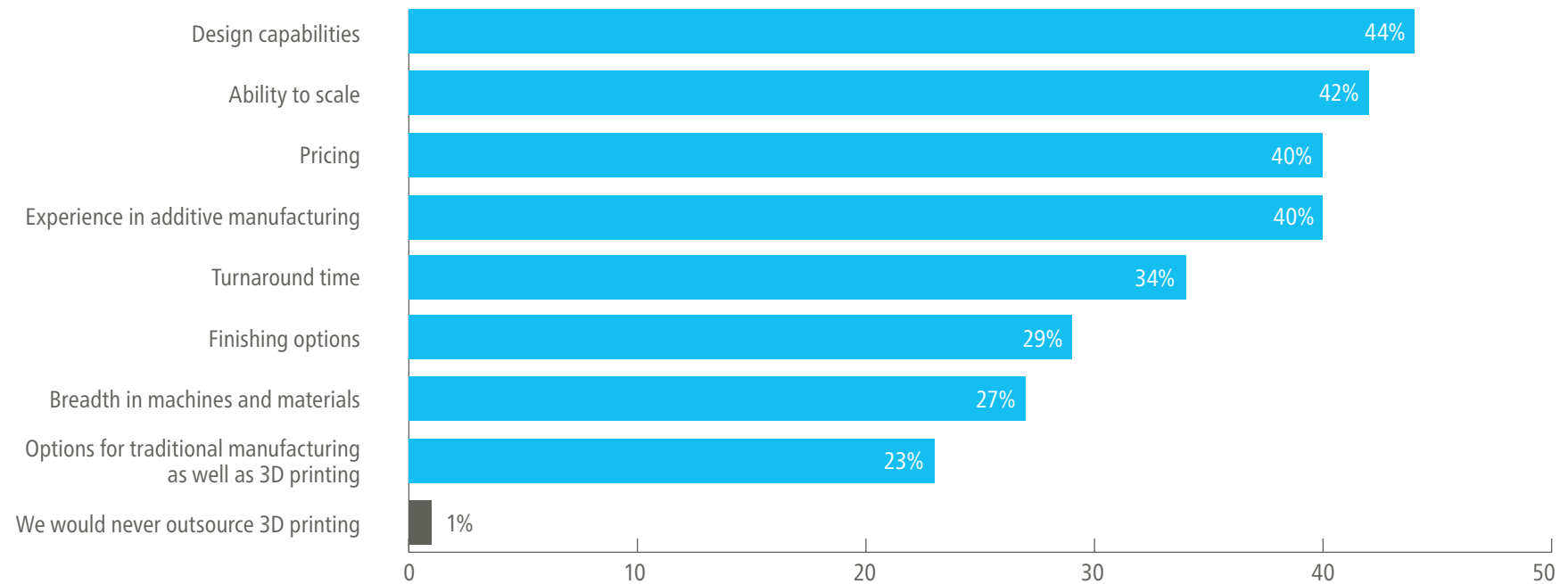


WIDE RANGE OF CRITERION FOR SELECTING AN OUTSOURCING PARTNER

Although most are currently doing the majority of their 3D printing in-house, almost 100% of survey participants are willing to outsource their additive manufacturing. When considering a 3D printing partner, there are several major factors at play, with design capabilities leading the pack. Given that design and prototyping are the most popular applications of 3D printing, the emphasis on this capability makes sense.

Ability to scale, experience in additive manufacturing and pricing rank slightly below design capabilities but are still weighty considerations for companies looking to out-source.

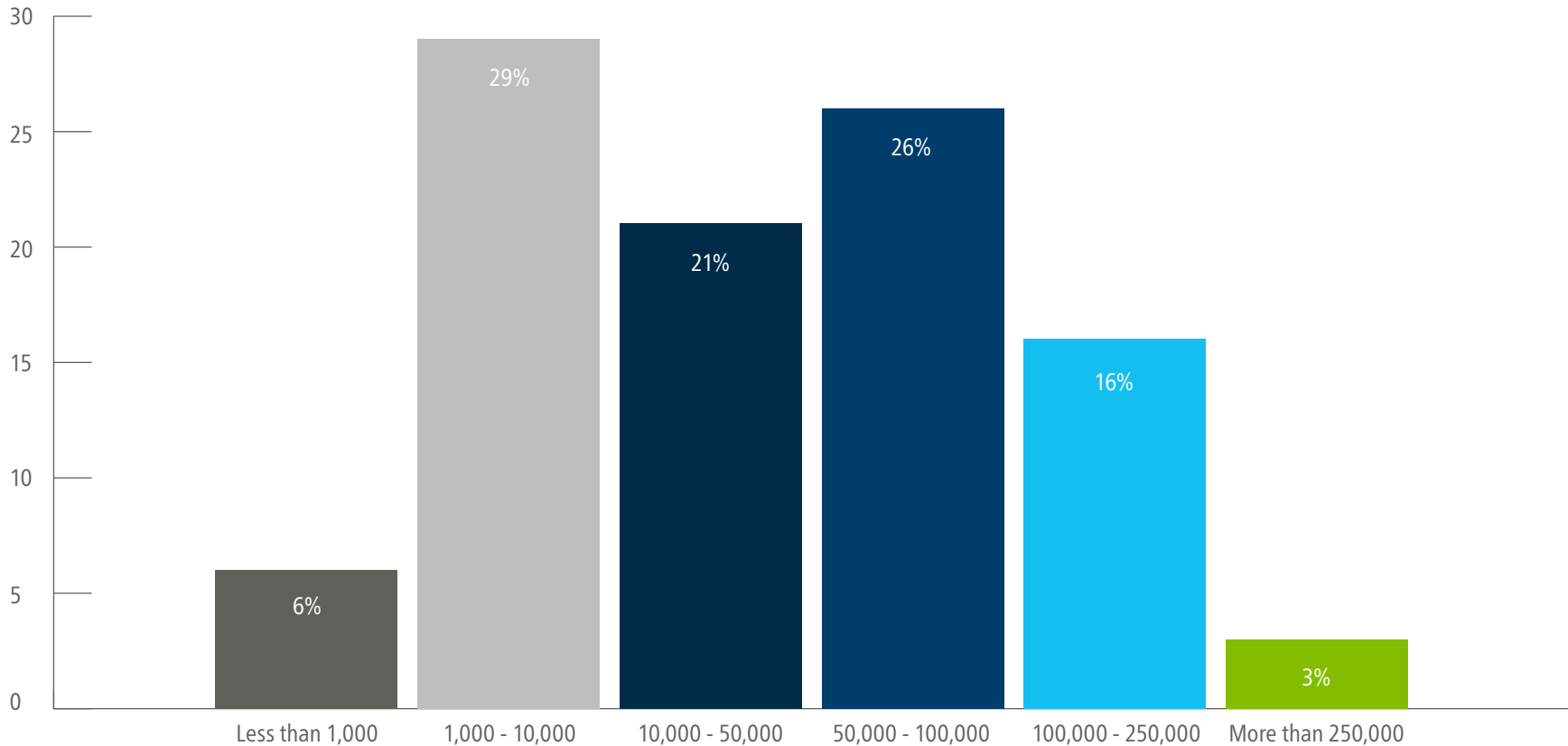
What are your most important factors when selecting an outsourcing partner for 3D printing? *Choose up to three of the following.*



COMPANIES ARE PRINTING A LARGE NUMBER OF PARTS

Almost 95% of companies are using 3D printing to produce at least 1,000 parts. Half of participants use additive manufacturing for 1,000-50,000 parts.

In the last year, approximately how many parts has your company produced using 3D printing? *Choose the one answer that most closely applies.*



SURVEY METHOD AND PARTICIPANTS



Research Goal

The primary research goal was to understand trends in 3D printing and additive materials for manufacturing.

Methodology

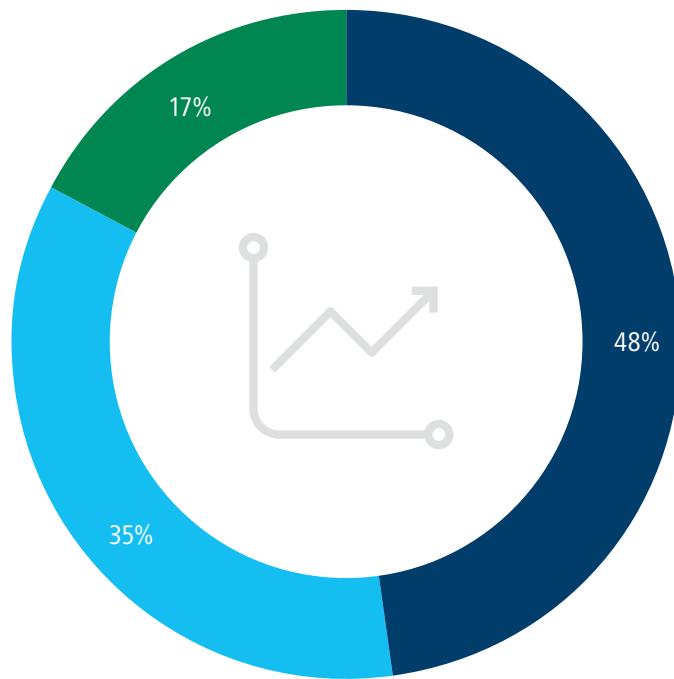
Independent sources of manufacturing decision makers were invited to participate in an online survey. A variety of questions were asked on use of 3D printing, challenges and opportunities. Certain questions were repeated from a similar 2019 and 2017 study to enable trend analysis.

Participants

A total of 302 qualified individuals completed the survey. All were decision-makers for 3D printing at a manufacturing company with more than \$500M in revenue in a target role and industry.

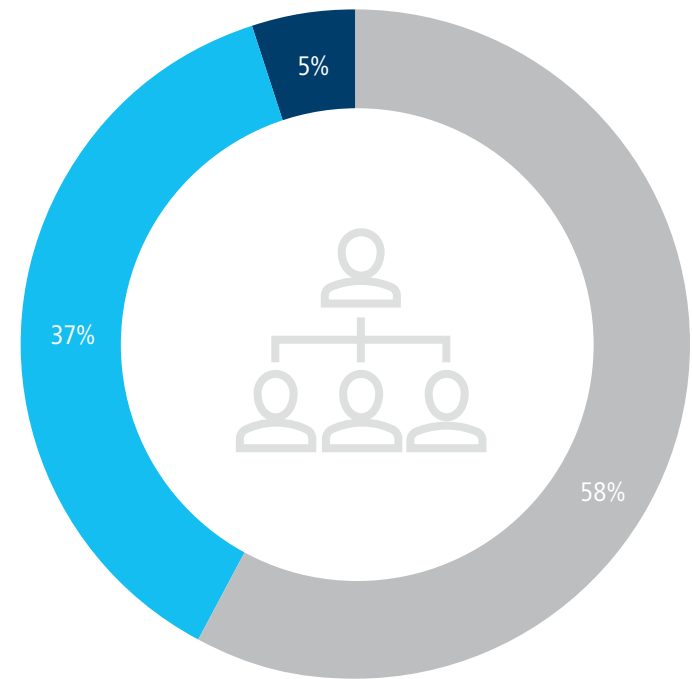
SURVEY PARTICIPANTS

Company Size
(Annual Revenue)



■ \$500M to \$1B ■ \$1B to \$5B ■ More than \$5B

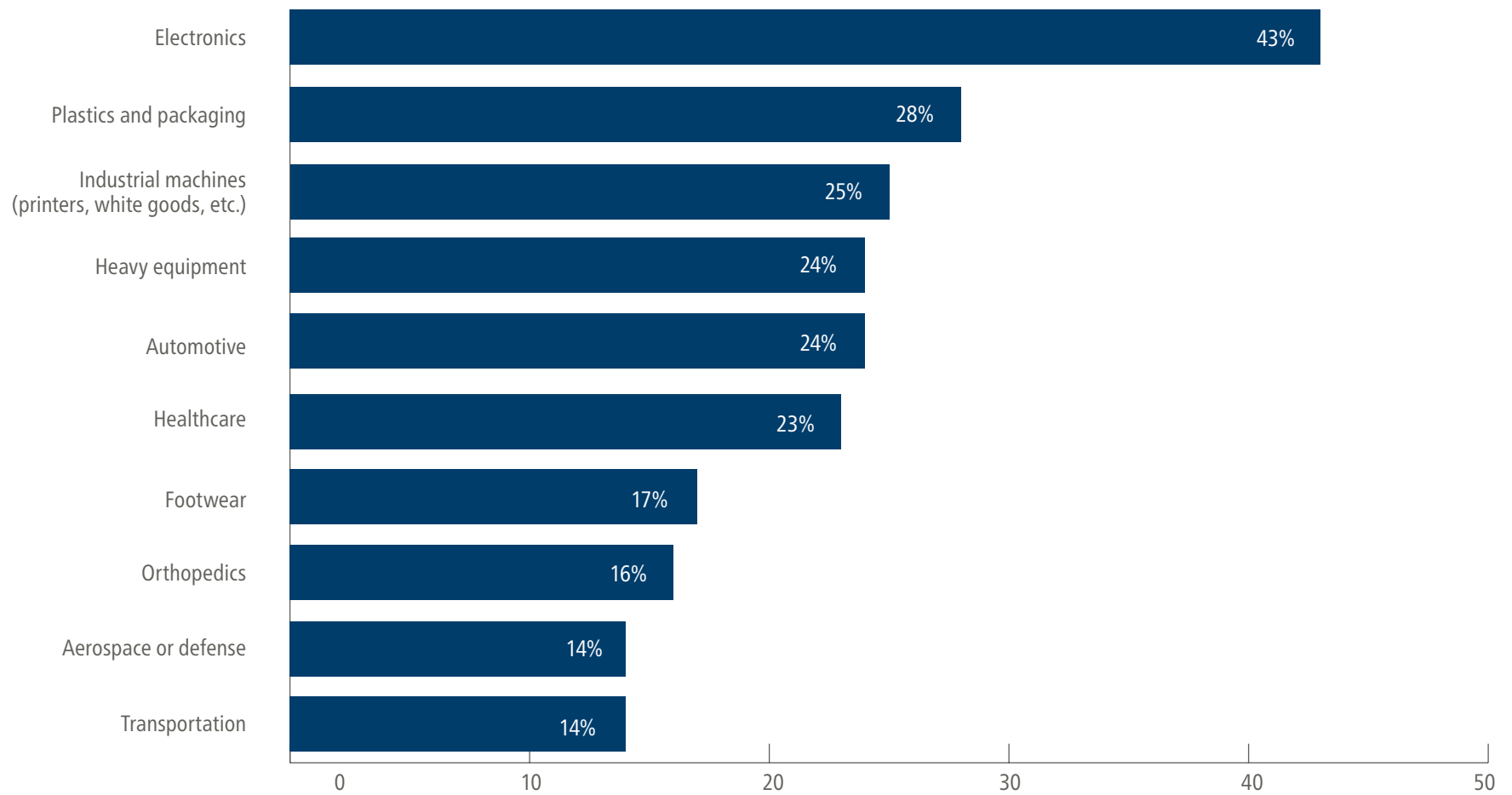
Job Level



■ Executive ■ Team Manager ■ Individual Contributor

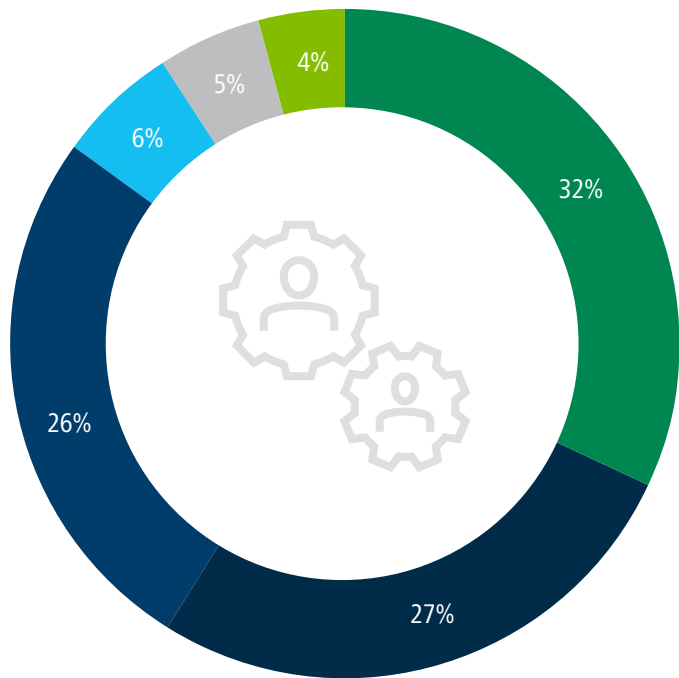
SURVEY PARTICIPANTS

Types of Goods



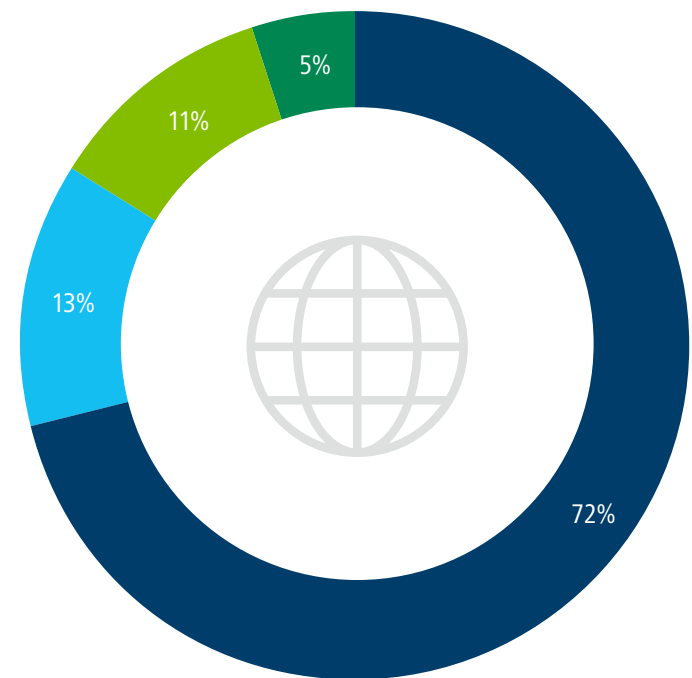
SURVEY PARTICIPANTS

Role



- Operations
- Design or engineering
- Production or manufacturing
- Research and development
- Procurement
- Product development

Region



- United States or Canada
- Europe, Middle East, or Africa
- Asia Pacific including Australia
- Mexico, Central or South America

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