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JABIL

CURRENT STATE OF ADDITIVE MATERIALS AND 3D PRINTING

A Survey of 3D Printing Stakeholders in Manufacturing

January 2019

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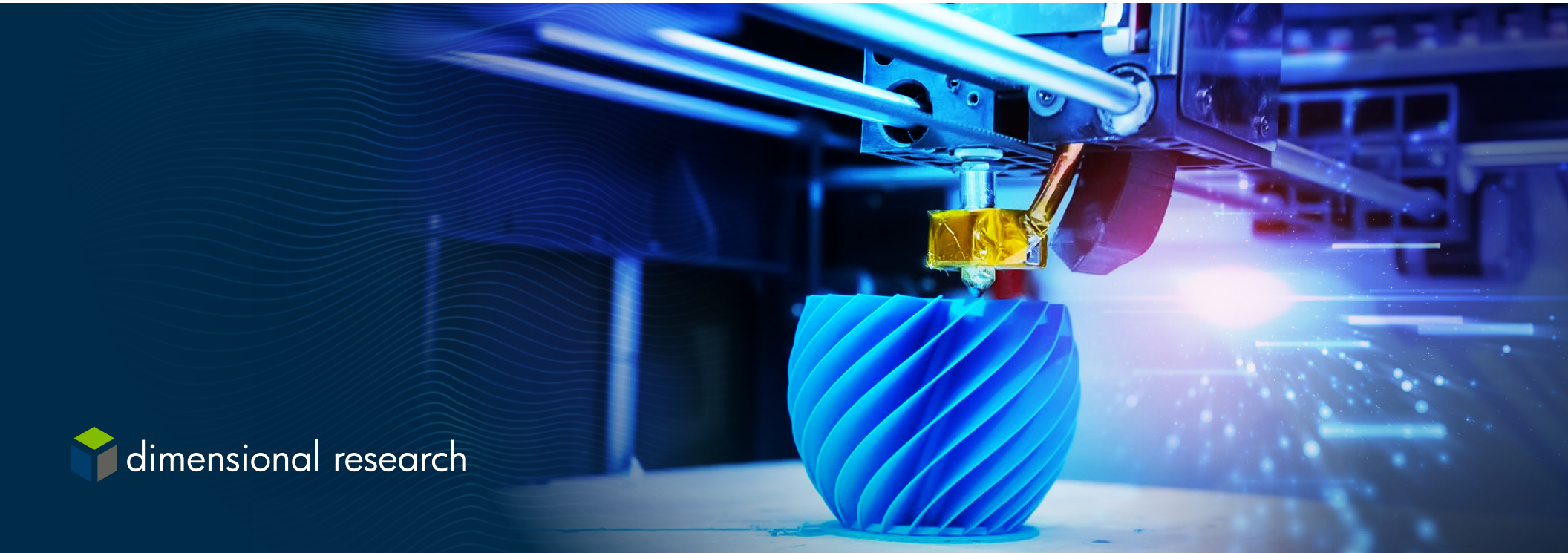


dimensional research

INTRODUCTION

As people write out their annual resolutions list, sign up for gym memberships, organize their budgets and reflect on the last 365 days, we're reminded of just how much can change in a year.

The history of 3D printing is not a particularly lengthy one, but it has been highly transformative in a wide range of industries. Since its initial conception, 3D printing has revolutionized the way we make everything. It offers the chance to craft blueprints into physical objects for almost any industry: aerospace, heavy equipment, even footwear.

The results we gathered at the beginning of 2019 contrast sharply with the information we gleaned during the fall of 2017. Over the course of a year, 3D printing utilization has skyrocketed. Our most recent research clearly demonstrates the upward trajectory of the popularity and applications of additive manufacturing.

Of course, there are still challenges to overcome, particularly when it comes to materials. Although 3D printing potential and capabilities are at an all-time high – one group of researchers has even figured out how to 3D print tools out of lunar dust in preparation for the colonization of Mars – many companies are still struggling to procure necessary materials; the price might be too high or the materials are not certified for 3D printing, among other reasons.

Nevertheless, it does not appear that 3D printing utilization is going to decrease any time soon; manufacturing stakeholders are very excited about the plethora of opportunities it offers.

The following report, sponsored by Jabil, is based on a survey of 308 individuals responsible for decisions around 3D printing at manufacturing companies. Questions were asked on a variety of topics related to the adoption of 3D printing, as well as opportunities and challenges.

KEY FINDINGS

3D PRINTING ADOPTION TRENDS

- All use cases (beyond prototyping) for additive manufacturing have risen dramatically in the last year.
- Expected growth rates for use of 3D printing have rocketed, with **39%** expecting their company's use of 3D printing to increase dramatically over the next two to five years and **47%** expecting it to increase somewhat.
- **59%** said 3D printing has already changed the way they think and operate.
- **61%** are currently using 3D printing to produce at least **10%** of their functional or end-use parts, whereas only **36%** were a year ago.
- **79%** expect their use of 3D printing for production parts or goods to at least double in the next three to five years.
- The number one thing preventing companies today from using 3D printing more in production is materials issues **(56%),** followed by workforce issues **(44%)** and process issues **(39%).**

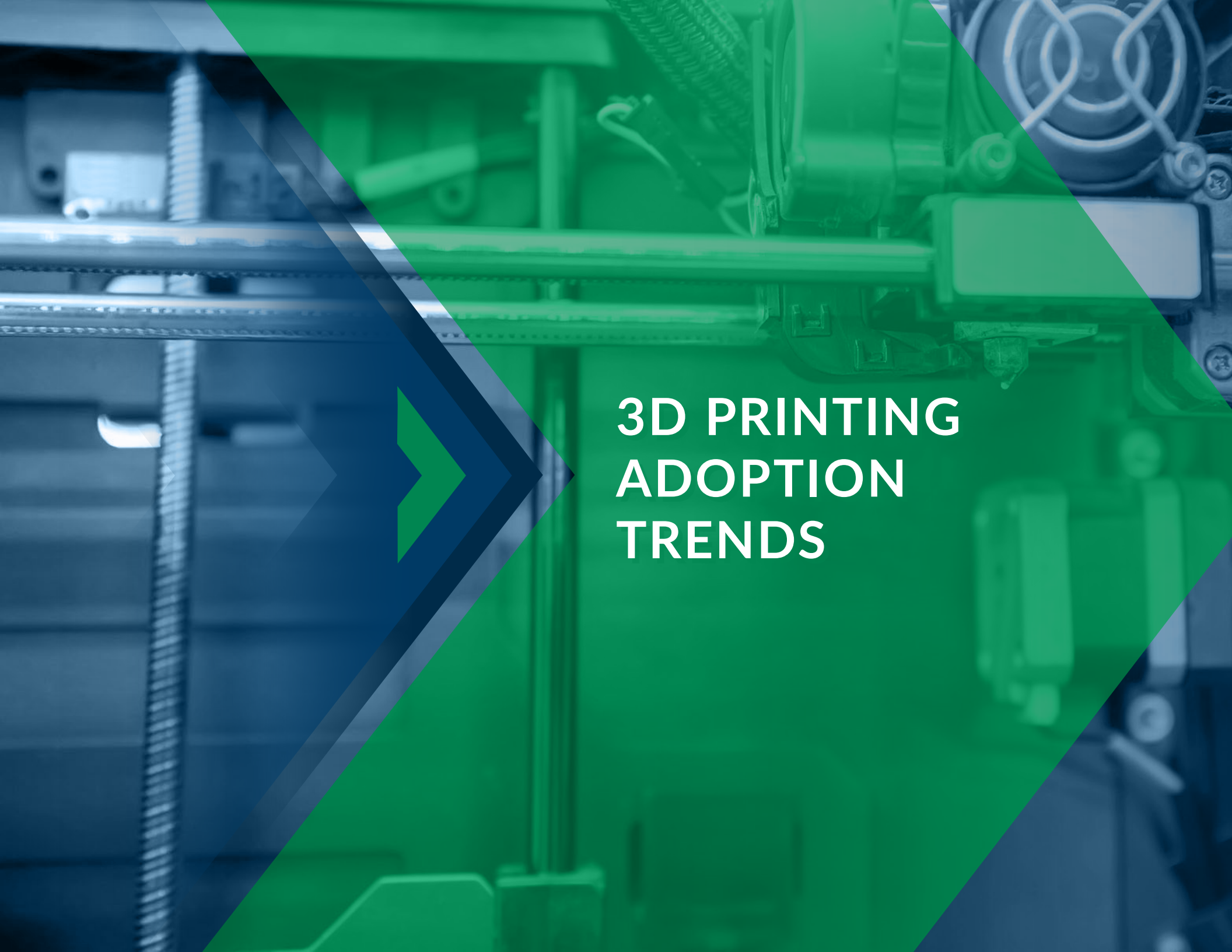
THE CURRENT STATE OF 3D PRINTING FINDING HERE

- **83%** say 3D printing can save at least **50%** of the time compared to conventional methods.
- All participants report benefits from 3D printing mass adoption. The top two benefits listed were the ability to produce personalized and customized goods **(50%)** and deliver parts faster **(50%).**
- **57%** report that their engineers were delighted with the increased design freedom available with 3D printing, **50%** have found new processes and approaches have increased creativity, and 34% mention an increased pride in workmanship. However, **30%** are frustrated by the lack of materials available in traditional methods.
- **71%** say that a lack of knowledge is the greatest factor on project-by-project choices to use 3D printing or traditional methods, while **29%** insist that it's a lack of confidence that 3D printing is reliable.

KEY FINDINGS

CURRENT STATE OF ADDITIVE MATERIALS

- Although **74%** currently use plastics or polymers, there is a large demand for better metal, ceramic and glass materials.
- **91%** report challenges with available materials, the top challenge being the expense of 3D printing at scale **(47%).**
- **60%** predict that when a greater variety of cost-effective, certified additive materials becomes available they will increase the types of applications that utilize 3D.
- **94%** say designers choose traditional manufacturing due to lack of additive materials.



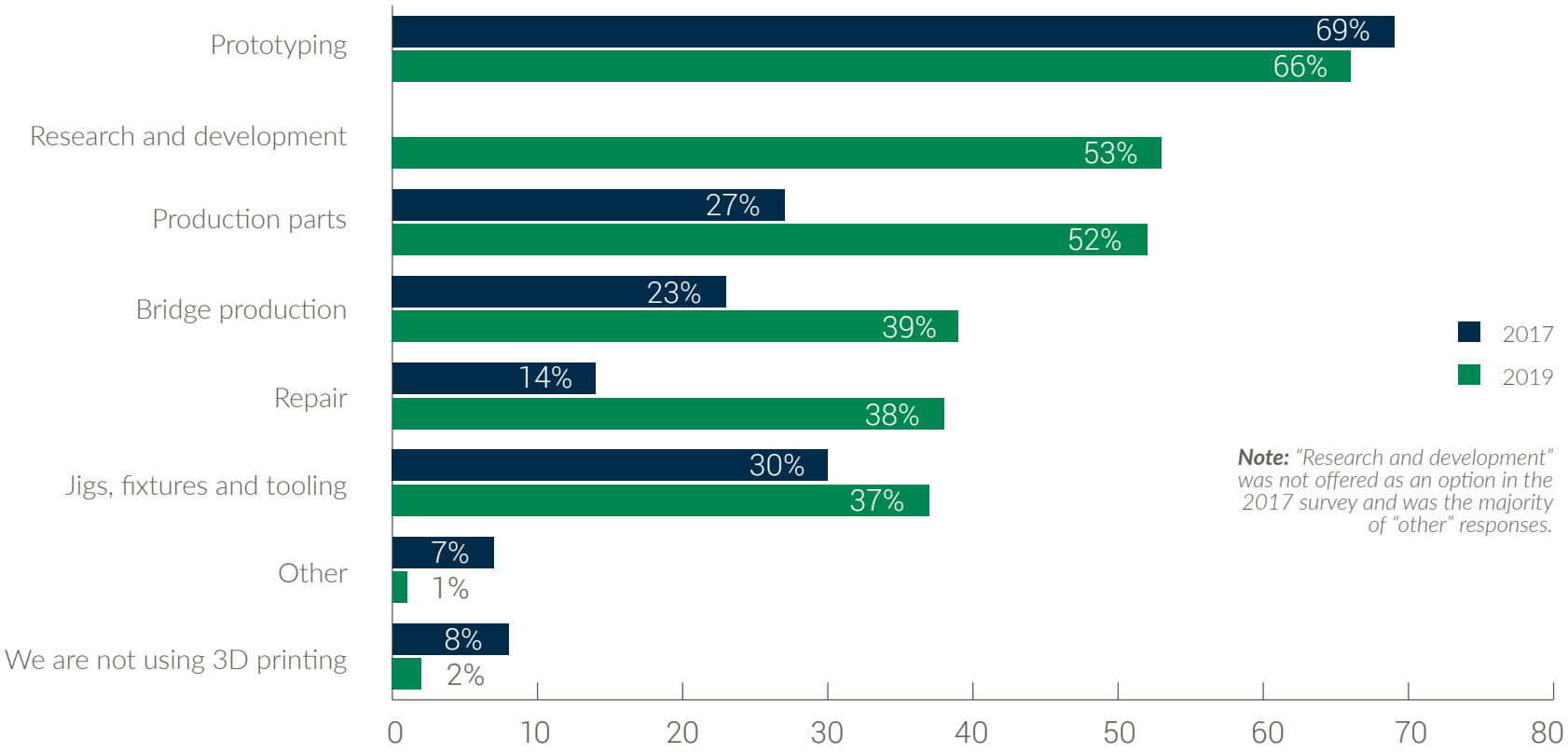
3D PRINTING ADOPTION TRENDS

ALL 3D PRINTING USE CASES UP DRAMATICALLY FROM 2017 – EXCEPT PROTOTYPING

The practical uses of 3D printing have expanded dramatically since 2017. Only one option – prototyping – decreased in popularity (66% from 69%), which is perhaps inevitable given how much usage has increased in every other category.

Although research and development was not an option on the 2017 survey, it placed second in 2019 with over half of respondents answering that they have found 3D printing useful for this purpose.

In what ways is your company currently using 3D Printing?

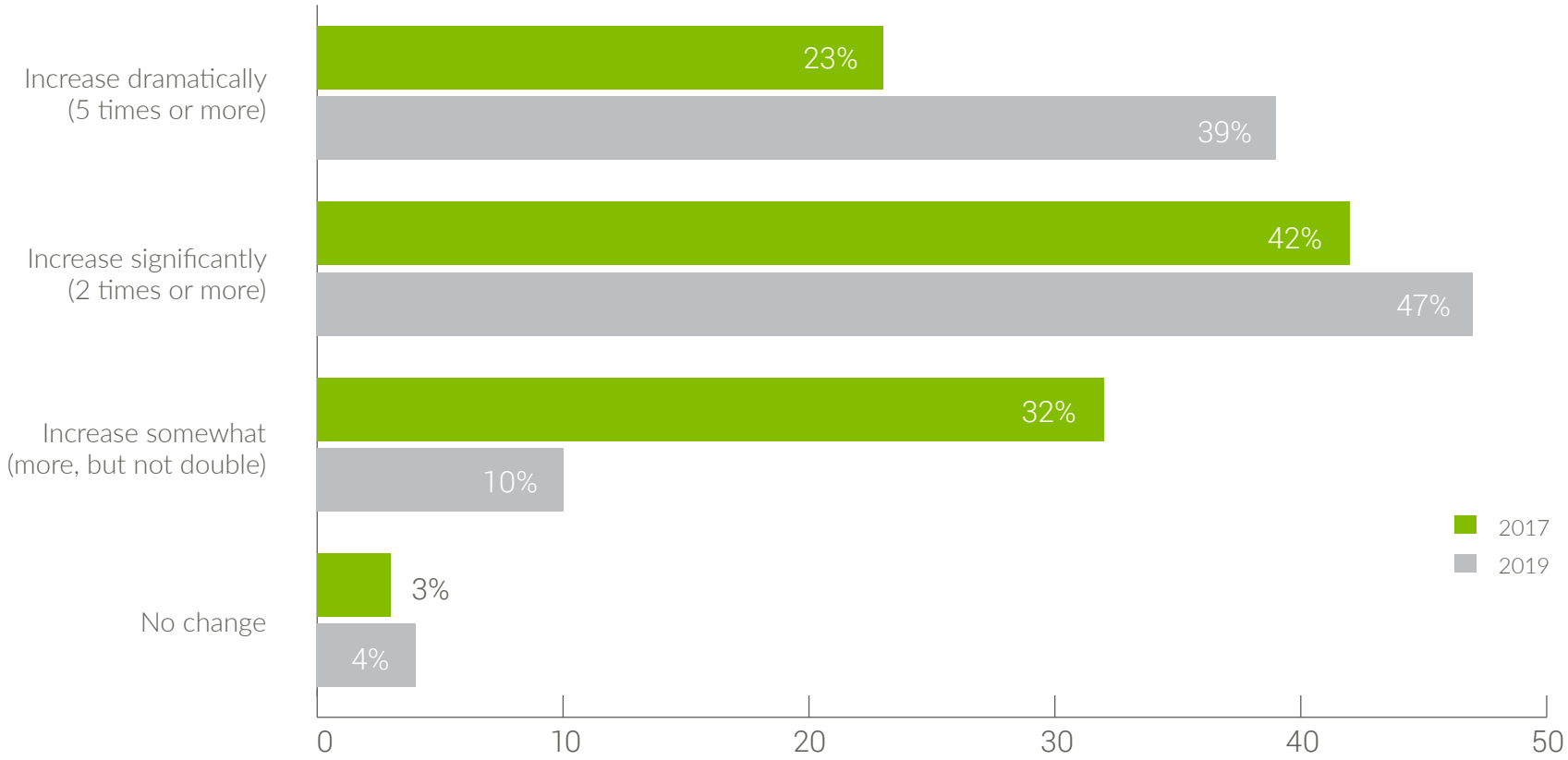


Note: *"Research and development" was not offered as an option in the 2017 survey and was the majority of "other" responses.*

EXPECTED GROWTH RATES FOR USE OF 3D PRINTING HAVE ROCKETED

Most additive manufacturing stakeholders (96%) do predict that their company's use of 3D printing will grow over the next few years. The majority expect this growth to be significant, including 39% that report that it will increase at least five times and 47% that think it will at least double.

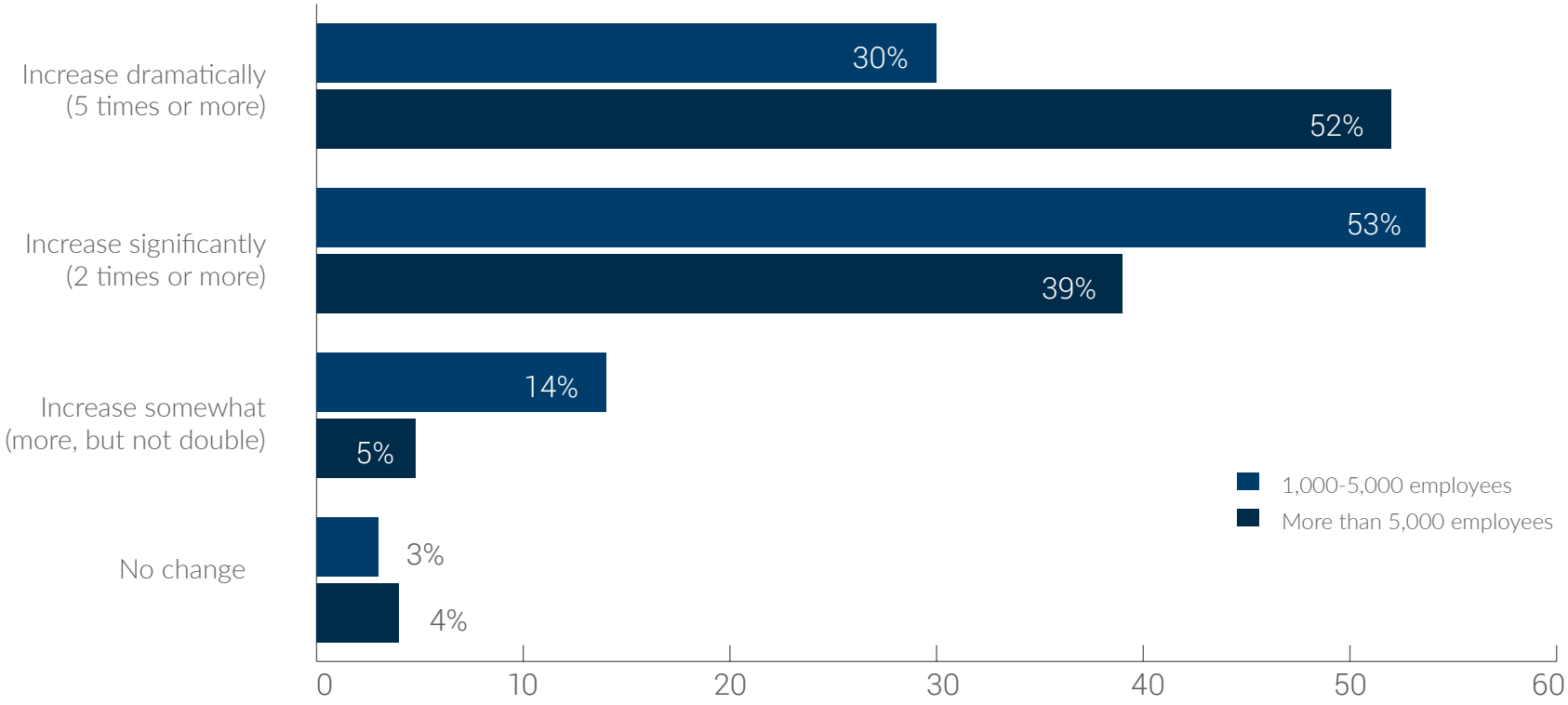
How do you expect your company's use of 3D printing to change in the coming 2-5 years?



LARGEST COMPANIES ARE MORE LIKELY TO REPORT DRAMATIC GROWTH PLANS

Breaking the previous finding down even further, we noted that large companies are much more likely to predict that 3D printing will increase dramatically. Almost all (91%) of stakeholders from a large company predicted that their company's use of 3D printing will at least double, and over half (52%) stated that it will increase dramatically (five times or more).

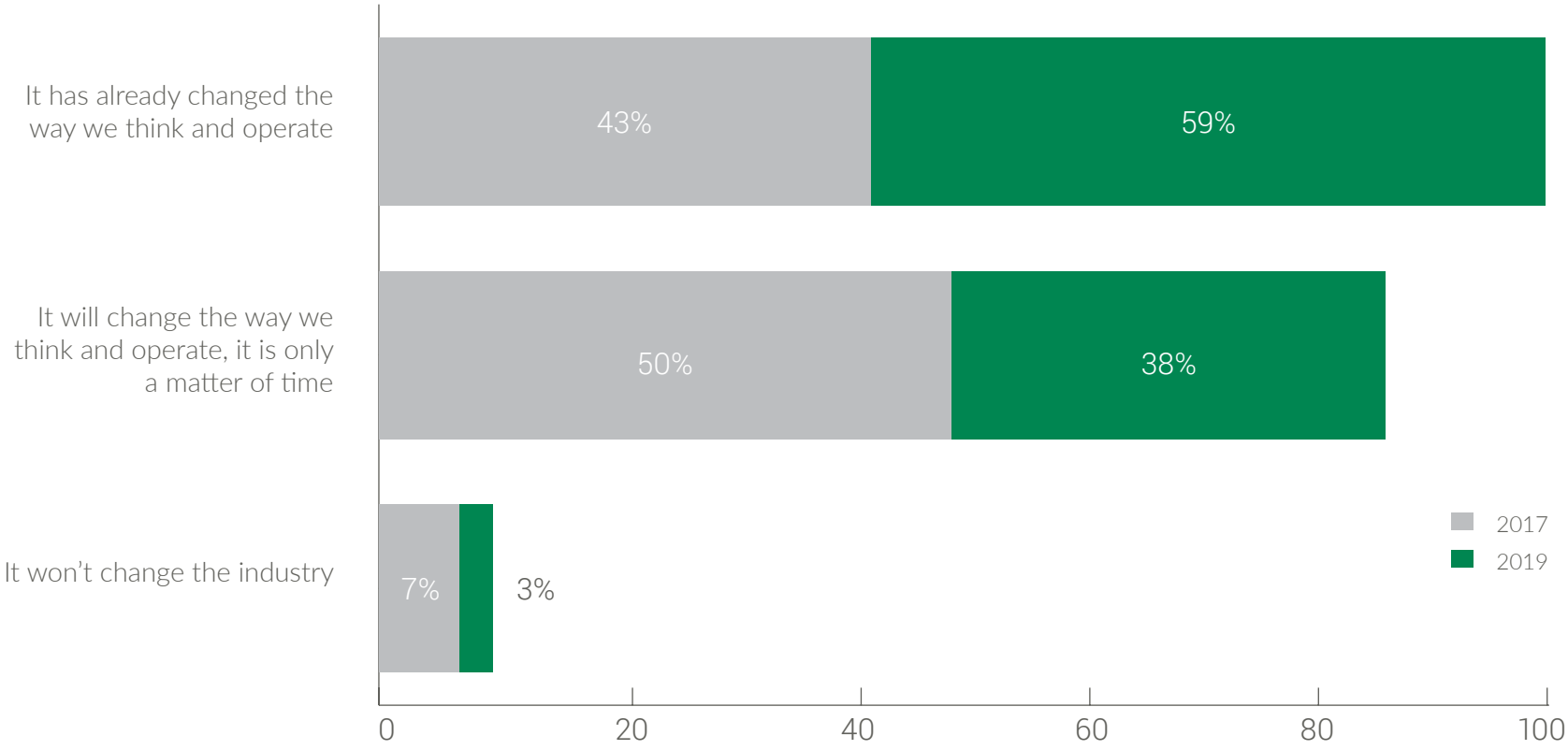
How do you expect your company's use of 3D printing to change in the coming 2-5 years?
By company size – 2019 only.



3D PRINTING IS TRANSFORMING INDUSTRIES

The impact of 3D printing is expected to impact the way the entire manufacturing industry thinks and operates. Almost all manufacturing stakeholders (97%) report that it will transform the way they think and operate. Most remarkably, for almost two-thirds (59%), this impact has already happened. The remaining 38% believe it will come and is only a matter of time.

How would you characterize the impact of 3D printing technology on your industry?

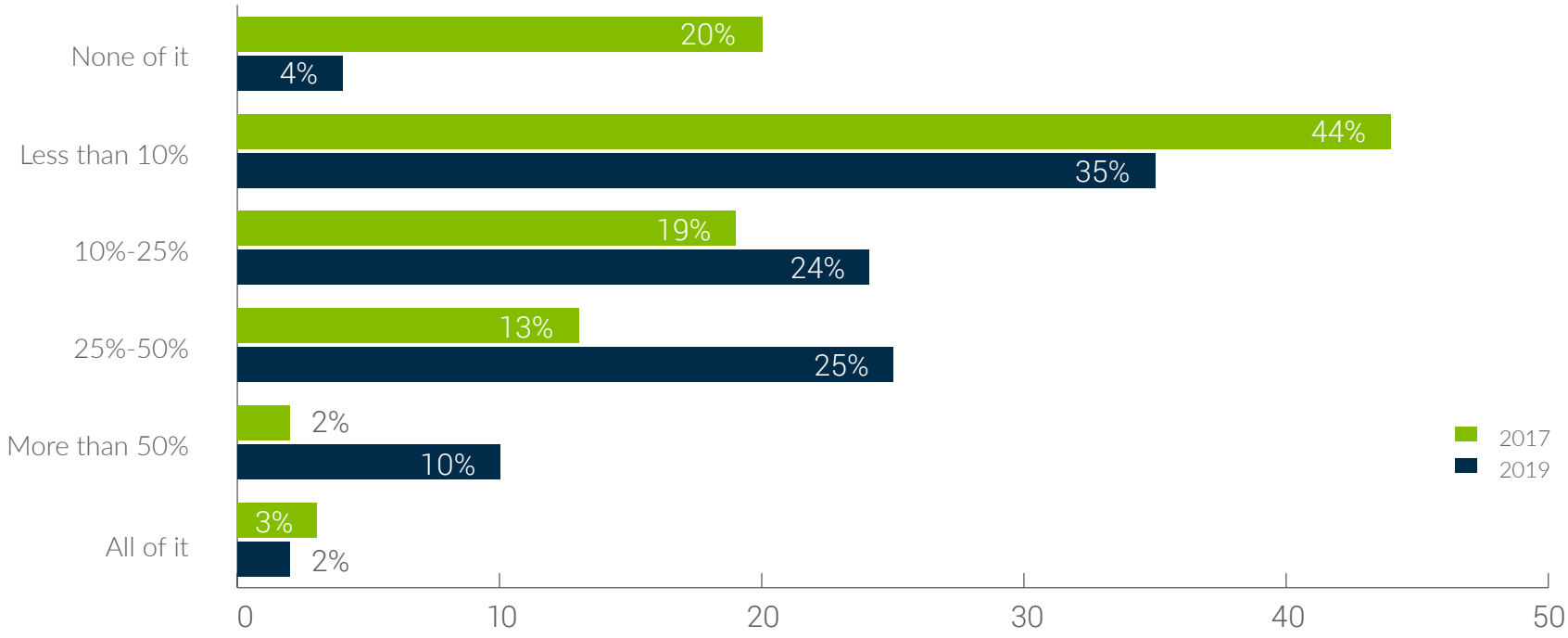


3D PRINTING FOR FUNCTIONAL OR END-USE PARTS GROWING

Using 3D printing to produce functional or end-use parts is an application that has grown significantly over the last year, from 80% in fall 2017 to 96% in the beginning of 2019. About two-thirds of companies use 3D printing to make at least 10% of these parts.

One possible concern in using 3D printing to create these parts could be that they won't have the strength such a vital component requires, but as we can deduce from the fact that usage of 3D printing has already risen significantly in this area, it seems likely that as manufacturers become more accustomed to utilizing 3D printers for this task, they will use them more for functional or end-use parts.

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

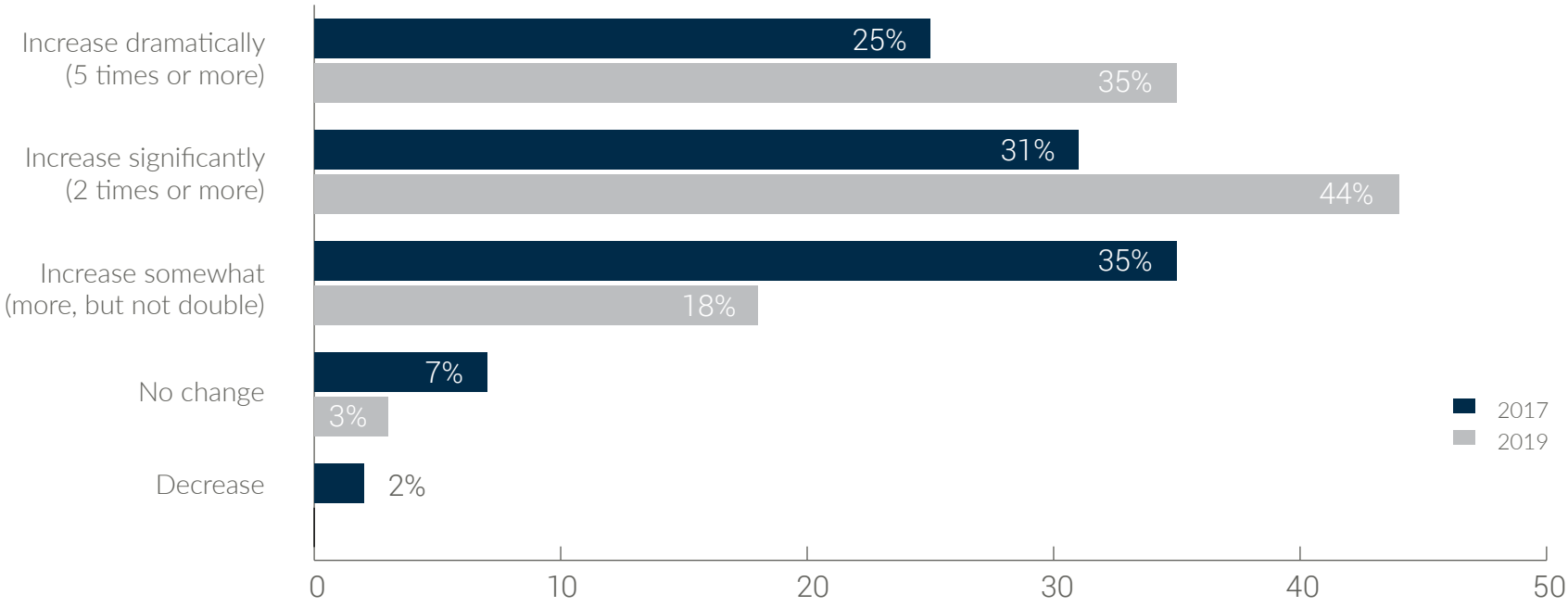


PLANS TO UTILIZE 3D PRINTING FOR PRODUCTION UP DRAMATICALLY

Using 3D parts for production is an area where growth is expected; as we've already seen, 3D printing is on an upward trajectory. Most manufacturing stakeholders (97%) report that they expect growth, including 79% that expect to at least double their use of 3D printing for production parts and 35% that expect their product use to increase dramatically by a factor of 5 or more.

These results are much more promising than in 2017, when 91% expected their usage to increase and 2% predicted that it would actually decrease.

How do you expect your company's use of 3D printing for production parts or goods to change in the coming 3-5 years?

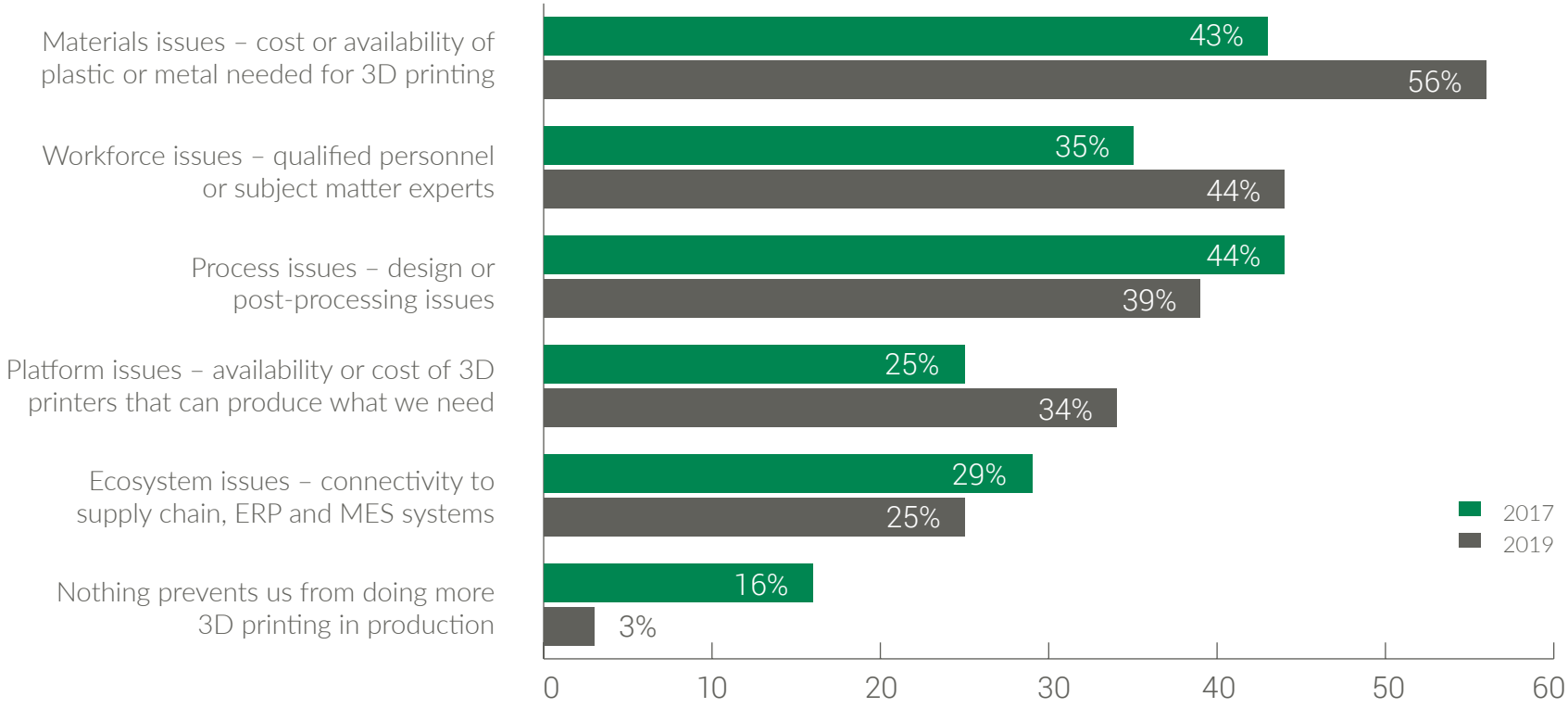


MATERIALS AND WORKFORCE ISSUES ARE 3D PRINTING OBSTACLES

Even though the popularity and use of 3D printing has been increasing rapidly, there are still several challenges that manufacturers must tackle.

Although process issues were the most significant obstacles cited in the fall of 2017, by the beginning of 2019, materials issues took a commanding lead as the most significant problem, followed by a lack of qualified personnel or subject matter experts (44%) and design or post-processing issues (39%).

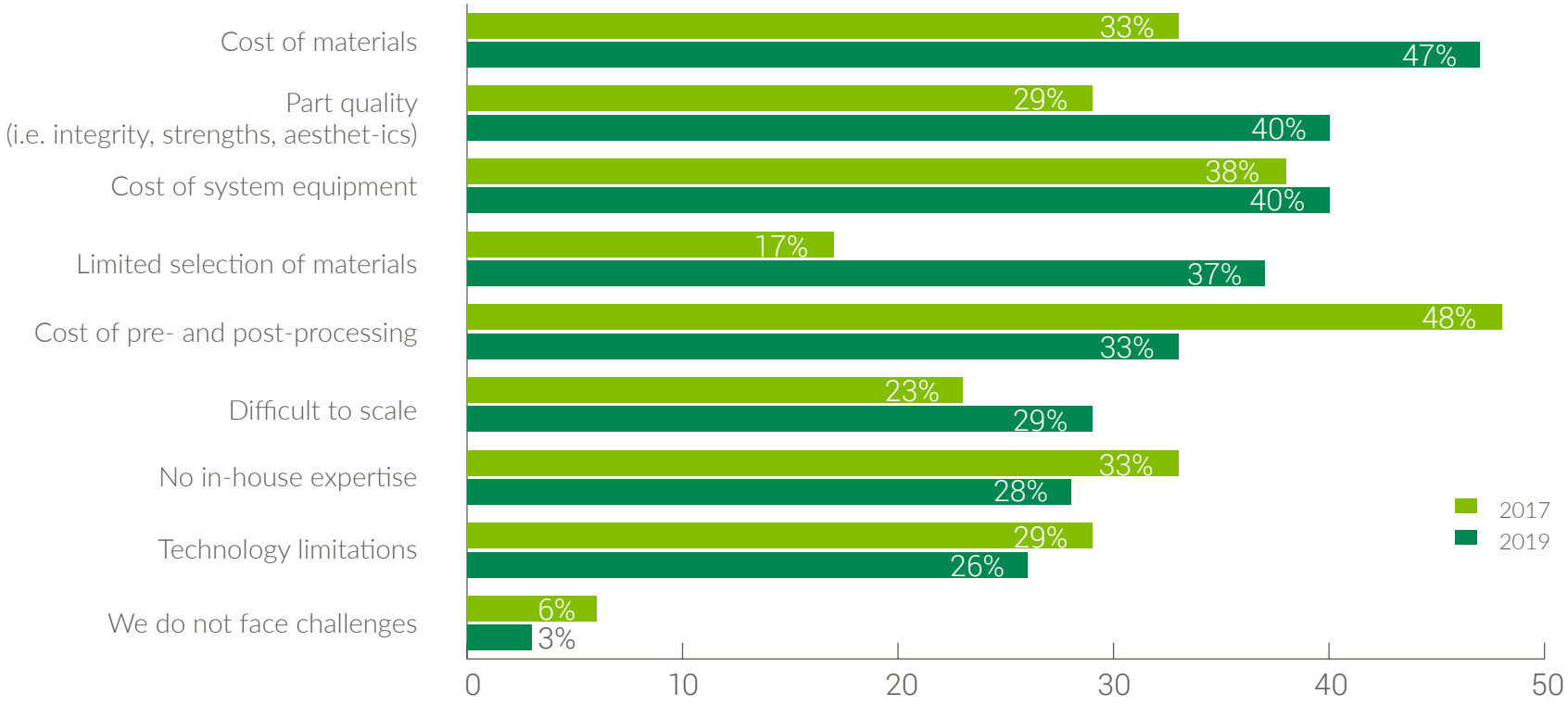
What prevents your company from doing more 3D printing in production today?

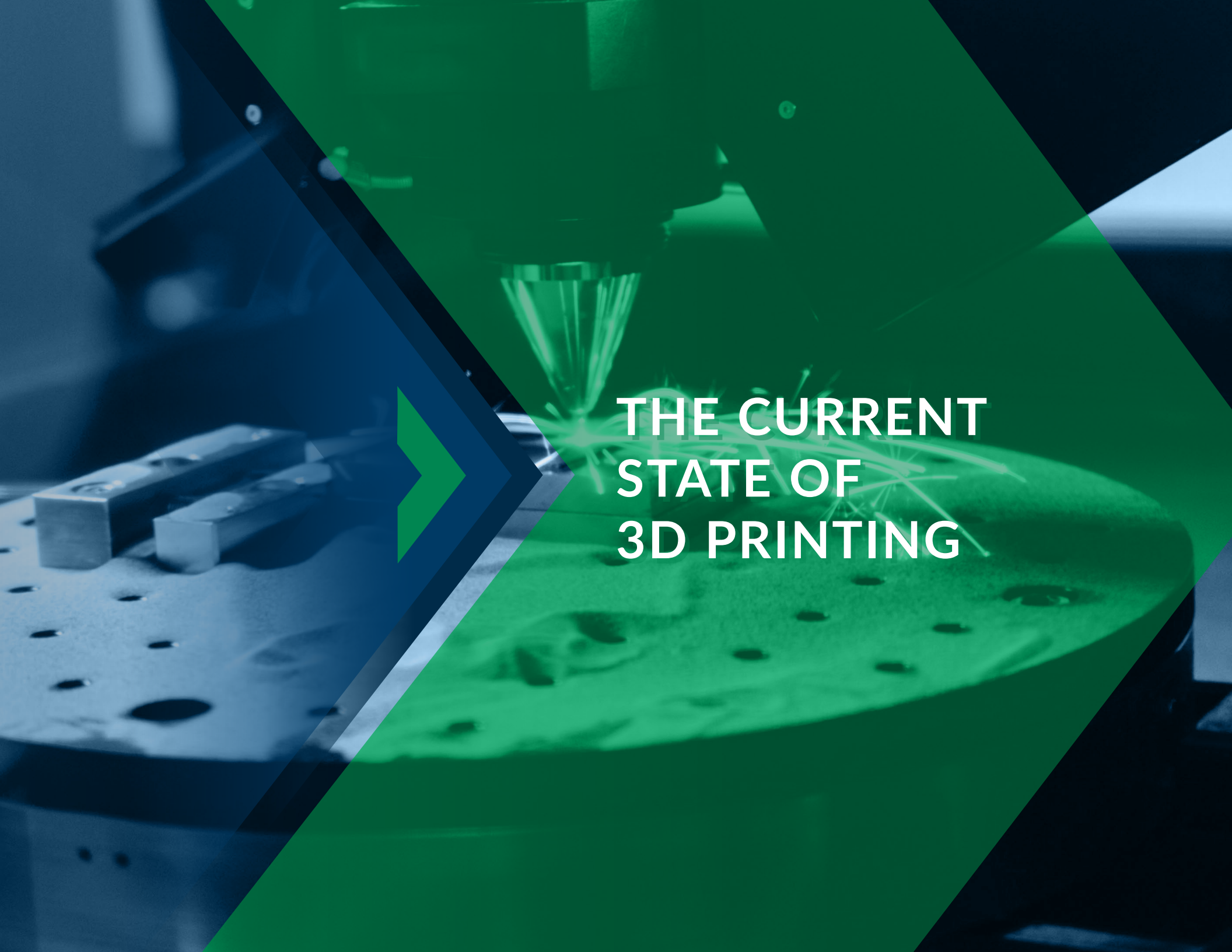


MATERIALS-RELATED CHALLENGES REPORTED MOST FREQUENTLY

Once again, respondents cited materials-related challenges as some of the most difficult to overcome. These include cost of materials (47%), parts quality (40%) and a limited selection of materials (37%). The number of companies experiencing difficulties pertaining to materials has risen significantly since 2017; 15% more reported a problem with the cost of materials, 11% more found issues with the quality of the parts and another 20% were limited by the selection of materials.

What challenges does your organization face with 3D printing?



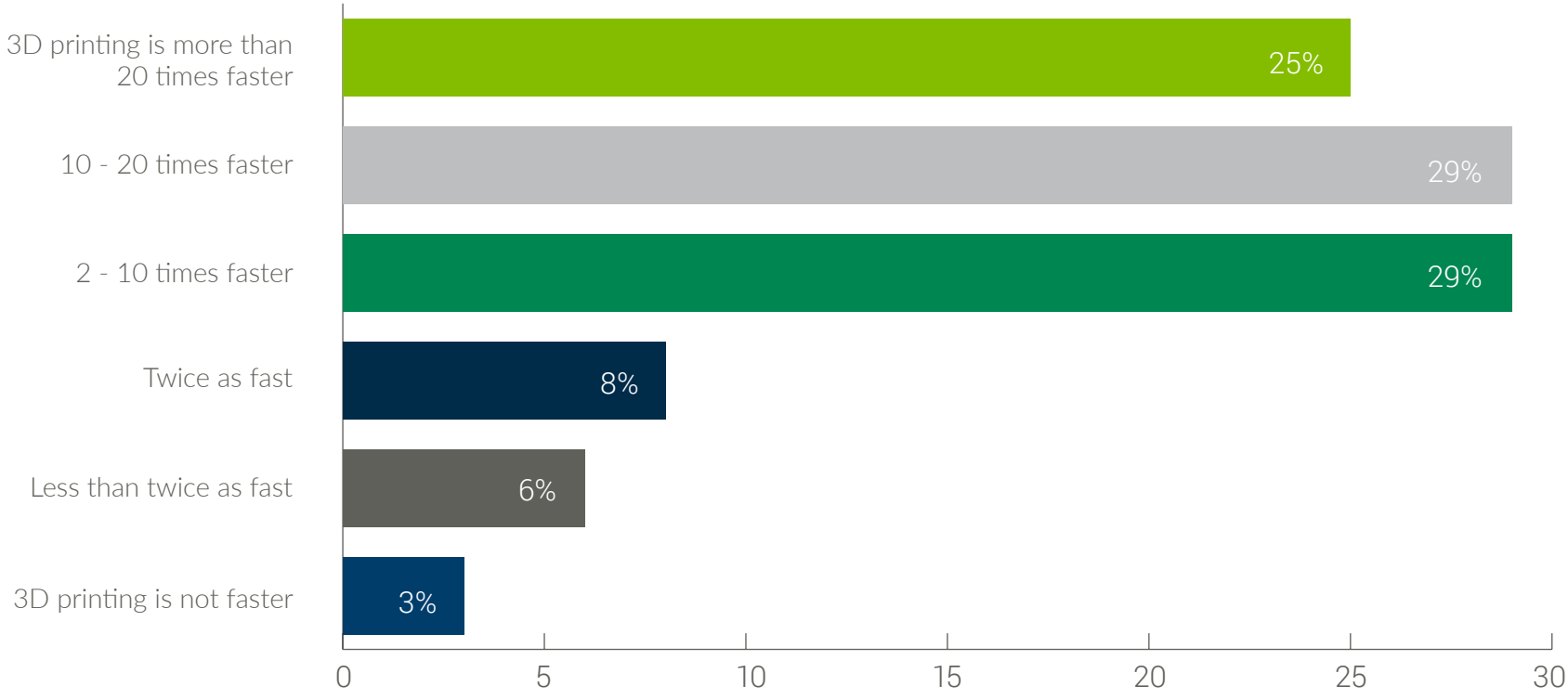


THE CURRENT STATE OF 3D PRINTING

83% SAY 3D PRINTING CAN SAVE AT LEAST 50% OF THE TIME COMPARED TO CONVENTIONAL METHODS

One of the biggest benefits of 3D printing is the amount of time it can save. With this method, prototyping, production, repair and other applications can be finished quickly and effectively. Although 3% of respondents stated that 3D printing is not faster than conventional approaches, 83% argued that 3D printing takes at least half the time of other methods, while 54% asserted that it is at least 10 times faster.

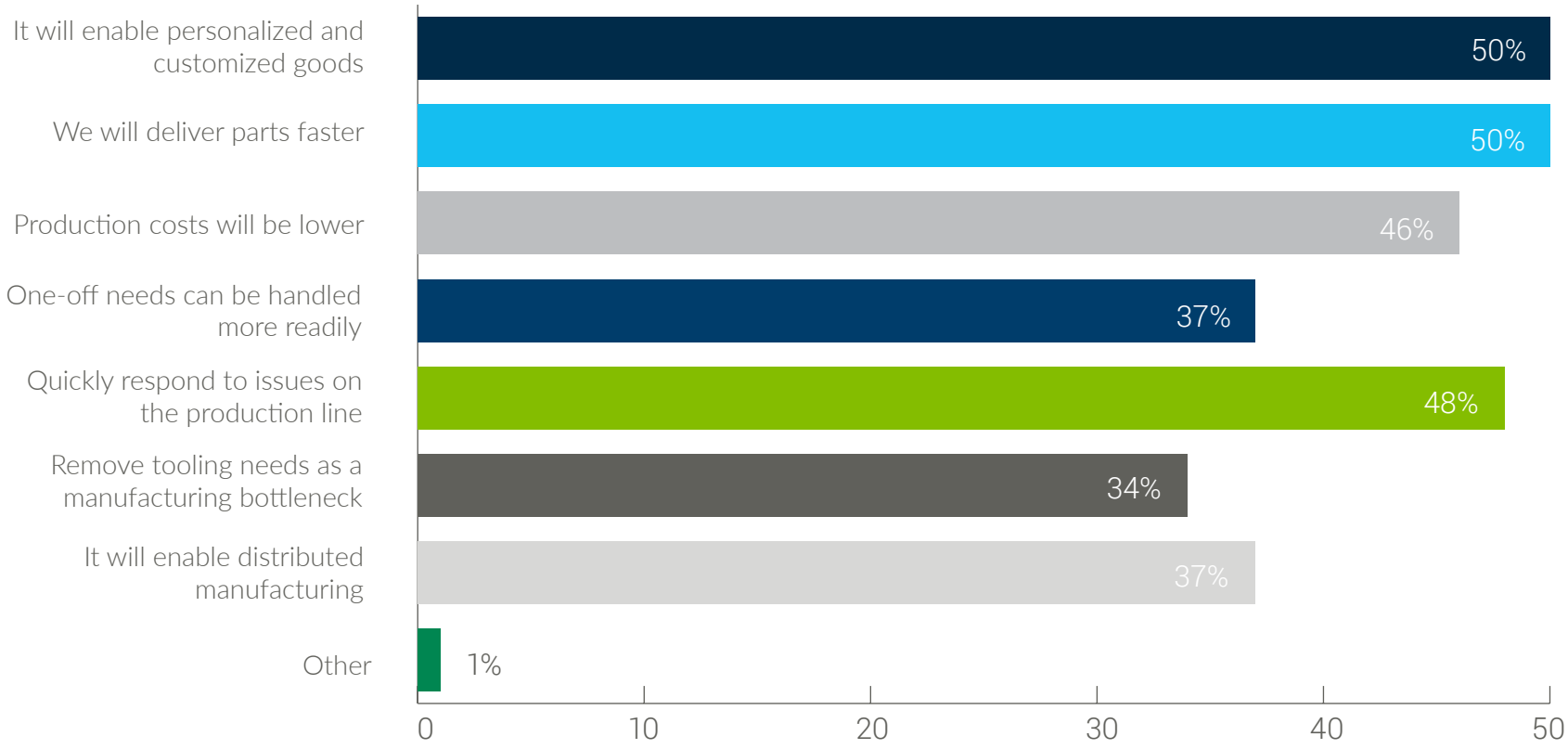
In general, about how much time can be saved by producing production parts or jigs/fixtures/tooling using 3D printing compared to the time it would take using conventional approaches?



ALL PARTICIPANTS REPORT BENEFITS FROM 3D PRINTING MASS ADOPTION

Personalization and shorter production cycles are two of the most prominent trends in manufacturing. Not surprisingly, manufacturing stakeholders consider the ability to deliver personalized and customized goods (50%) and faster delivery (50%) as two of the biggest benefits of 3D printing. This means that manufacturers can produce goods such as customized shoes in a fraction of the time previously required.

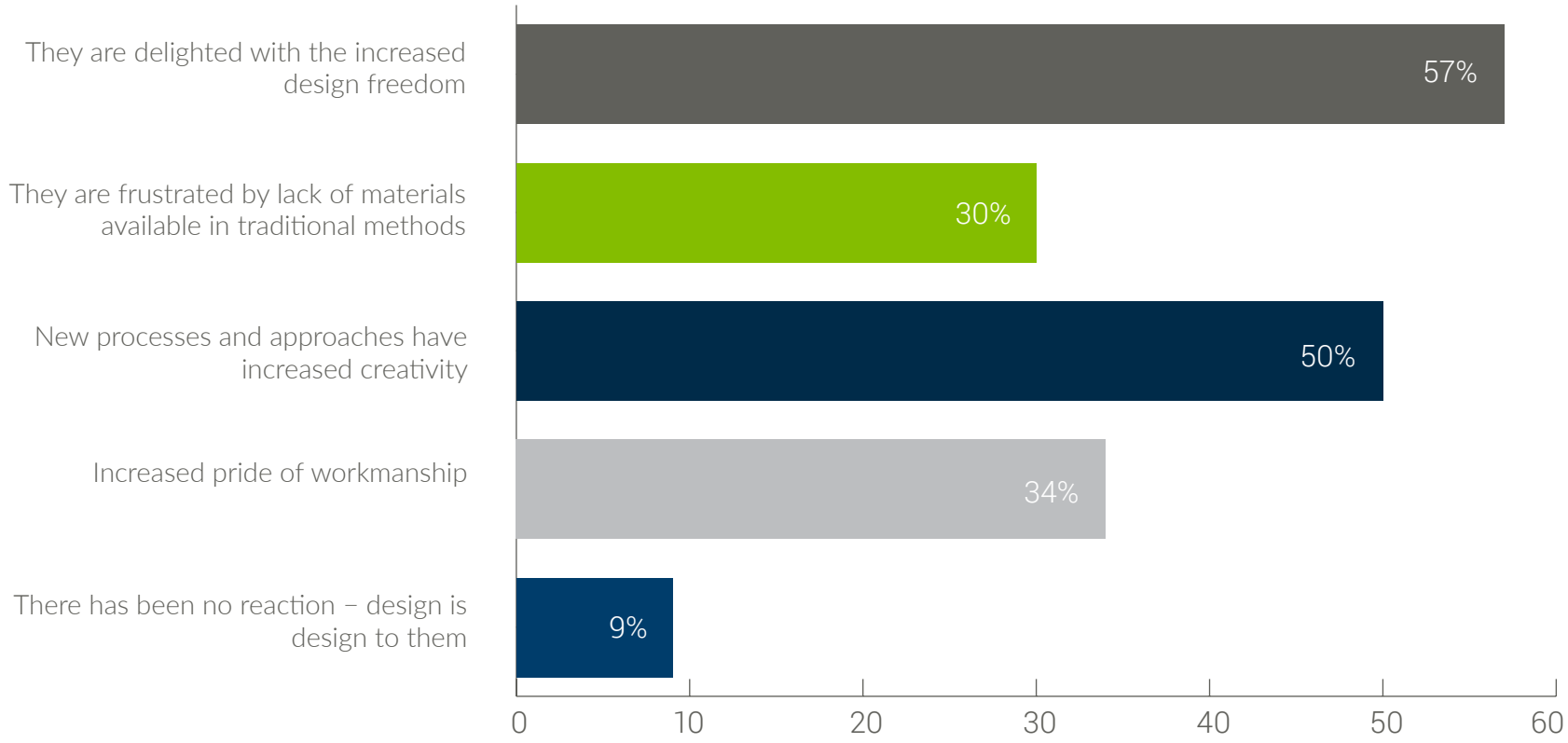
What benefits do you expect will be gained from 3D printing mass adoption for manufacturing?



DESIGNERS AND ENGINEERS RESPOND POSITIVELY 3D PRINTING EXPERIENCES

Overall, designers and engineers are enthusiastic about the applications of 3D printing. As they experiment more with 3D printing, they are delighted with the increased design freedom (57%), creativity inspired by new processes and approaches (50%) and growing pride of workmanship (34%). Although 30% expressed frustration with the lack of materials, less than 10% reported no reaction at all.

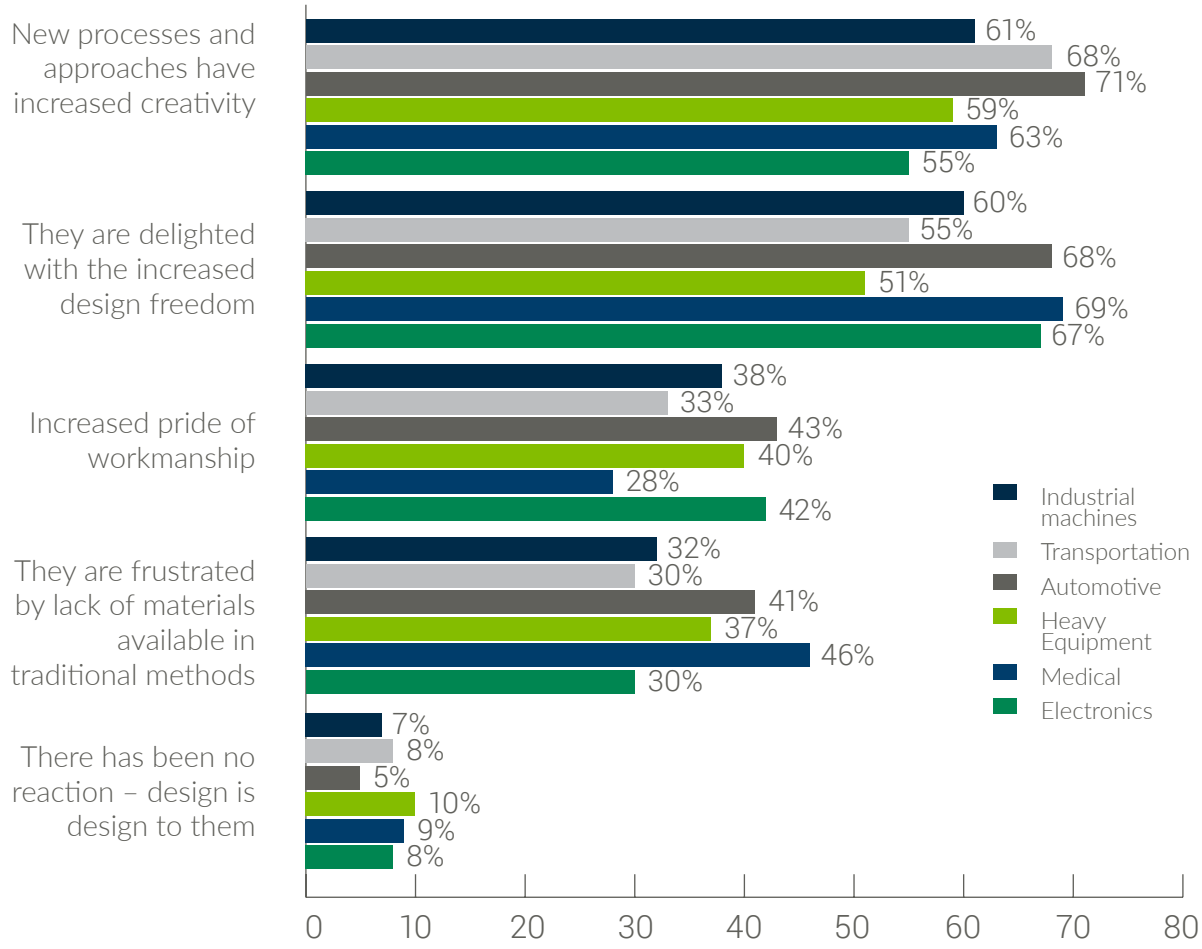
As your designers and engineers have gained experience with 3D printing, how have they reacted?



MEDICAL GOODS DESIGNERS MOST FRUSTRATED BY LACK OF MATERIALS

A more in-depth inspection of the data reveals that designers and engineers of medical products are the most frustrated by the lack of materials (46%). However, they are also the most delighted by the increased design freedom (69%), while automotive designers found that new processes and approaches allowed by 3D printing have increased creativity (71%).

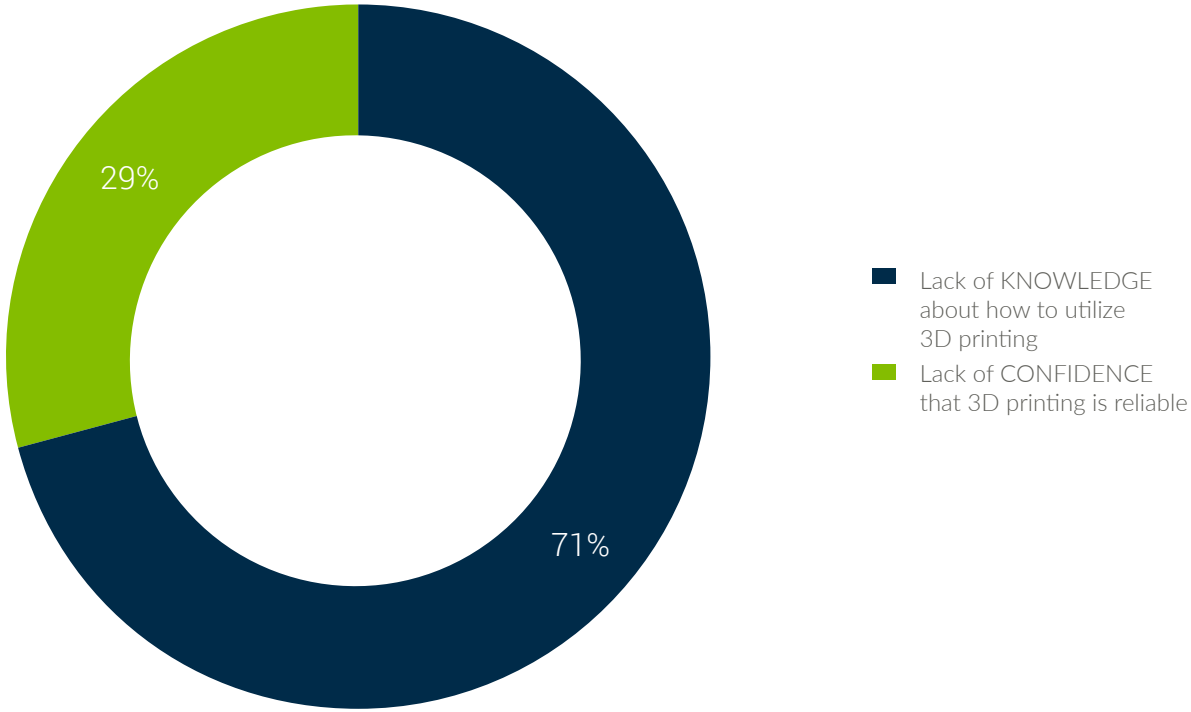
As your designers and engineers have gained experience with 3D printing, how have they reacted? *By goods manufactured.*

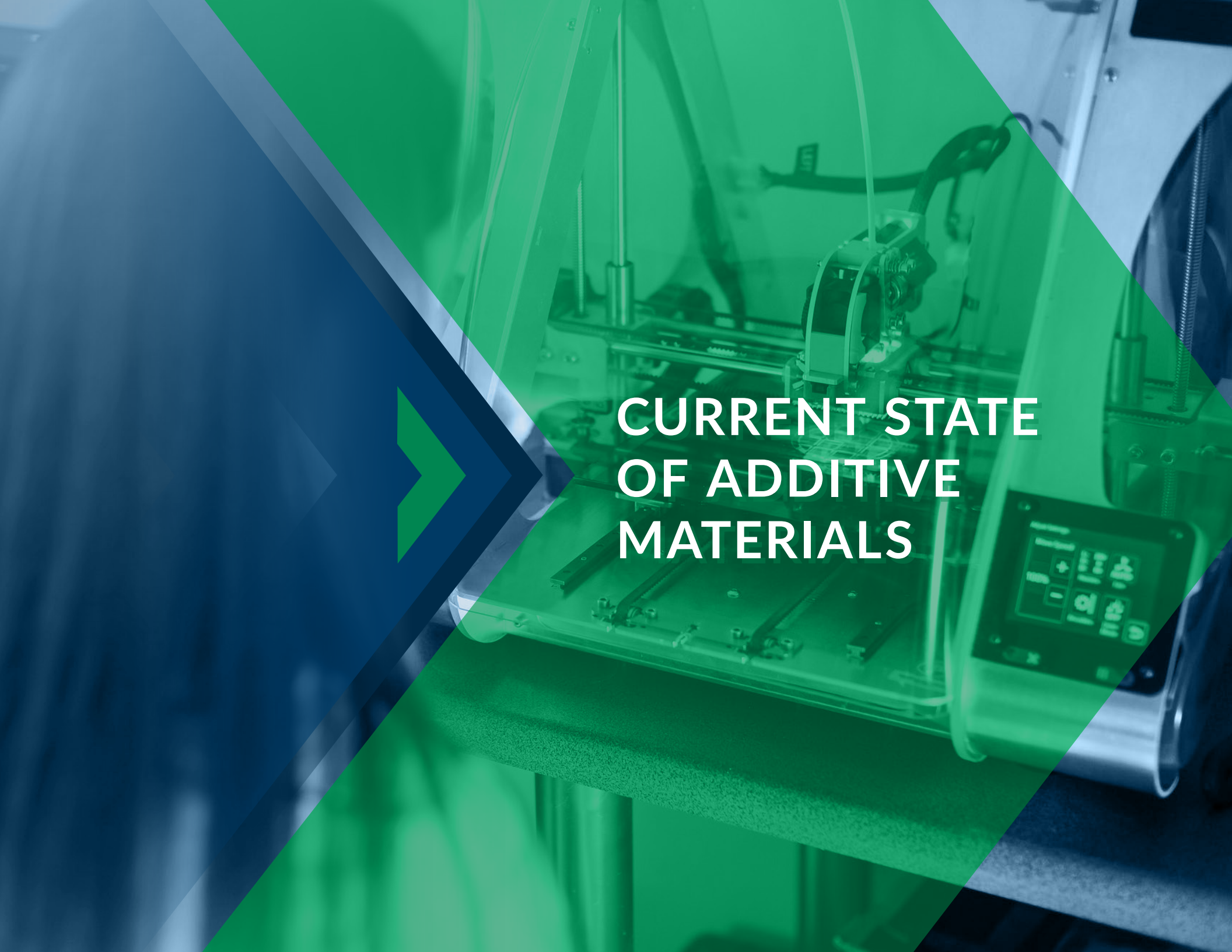


KNOWLEDGE IS A GREATER ISSUE THAN CONFIDENCE IN 3D PRINTING ADOPTION

Overall, respondents seemed to indicate that they are confident in the reliability of 3D printing. After all, there are a plethora of applications. The larger issue is a lack of knowledge about how to most effectively utilize 3D printing. Of course, as we have seen, the popularity of 3D printing is on a steadily upward trajectory. As its usage continues to increase, the knowledge, applications and capabilities will rise.

In your opinion, which of these factors has a greater impact on project-by-project choices to use 3D printing or traditional methods?



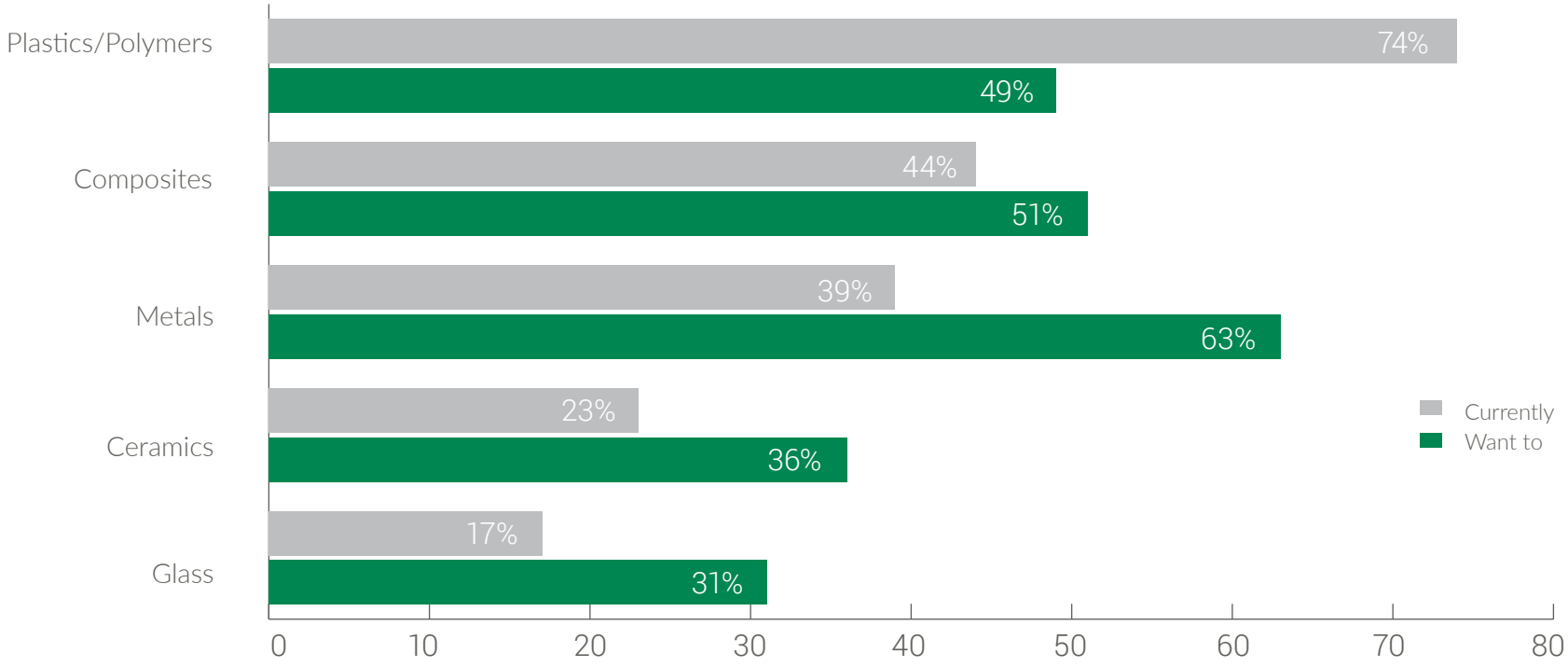


CURRENT STATE OF ADDITIVE MATERIALS

THERE IS DESIRE FOR BETTER METAL, CERAMIC AND GLASS MATERIALS

Some of the most dramatic innovation in recent years has been the evolution in the materials available for 3D printing. Researchers, designers and engineers are using a wide variety of materials: human tissue, pizza dough, even lunar dust. The ability to work with metals, ceramics, and composites instead of just plastic opens a world of potential. However, despite this, the mainstay material for 3D printing remains plastics and polymers (74%), although companies would prefer to use metals (63%) and composites (51%) more.

What types of additive materials is your organization CURRENTLY using for 3D printing and what types of additive materials would your organization WANT TO use if there were certified versions available at a reasonable cost?

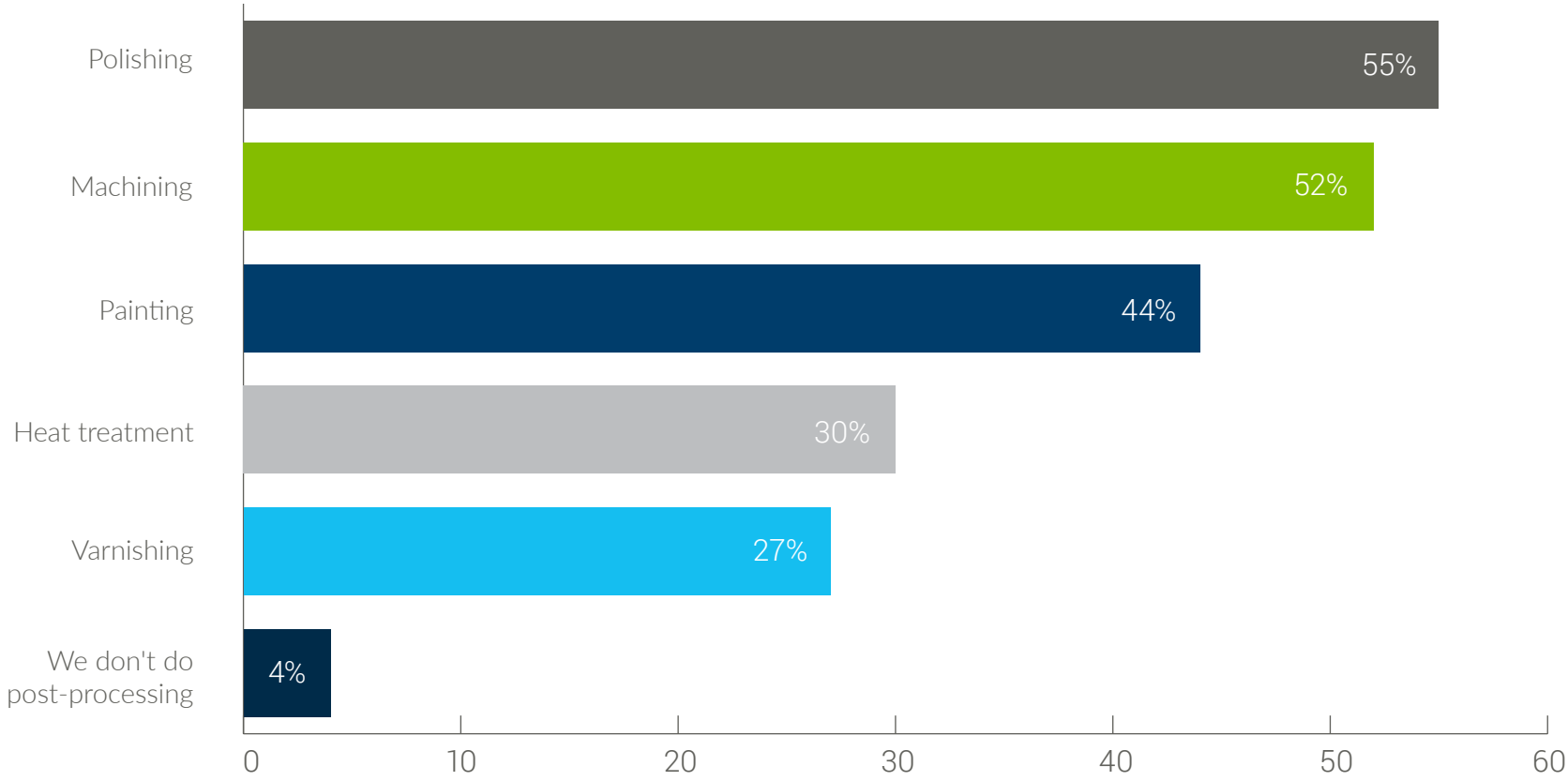


MOST PARTICIPANTS UTILIZE POST-PROCESSING

Currently, post-processing is a standard procedure to ensure the most aesthetically pleasing and refined product possible, as 96% of manufacturing stakeholders affirmed.

The most common methods for post-processing are polishing (55%), machining (52%), painting (44%), heat treatment (30%) and varnishing (27%).

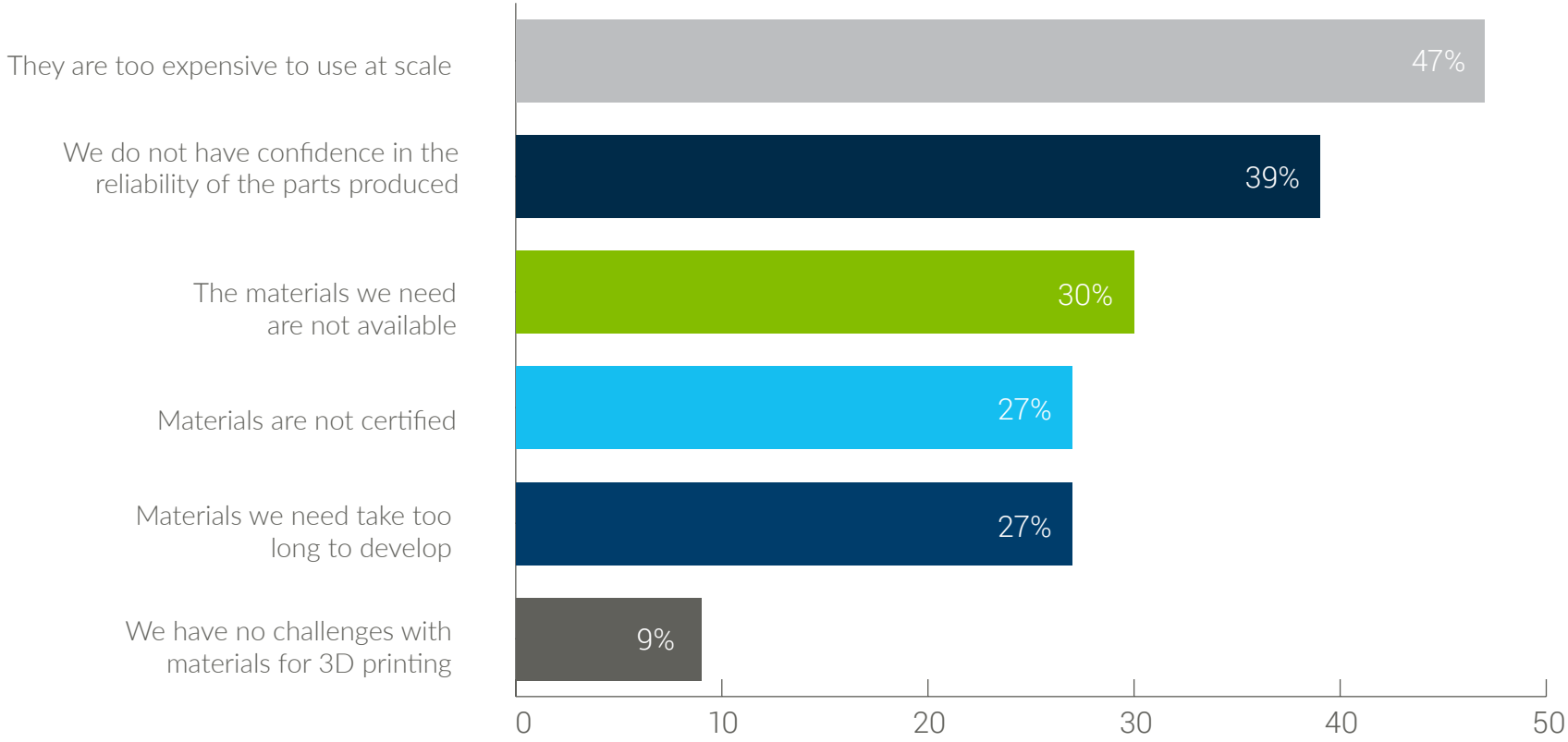
What types of post-processing are you currently using for 3D printing?



91% REPORT CHALLENGES WITH AVAILABLE MATERIALS

3D printing can be used to make almost anything – shoes, aerospace components, parts of machinery. While there is a wide range of materials to choose from, that does not mean that all needed materials are available or easily at hand; 91% reported material-related challenges. They listed obstacles such as expense (47%), lack of confidence in the reliability of printed parts (39%) and unavailable materials (30%).

What challenges does your organization face with 3D printing materials?

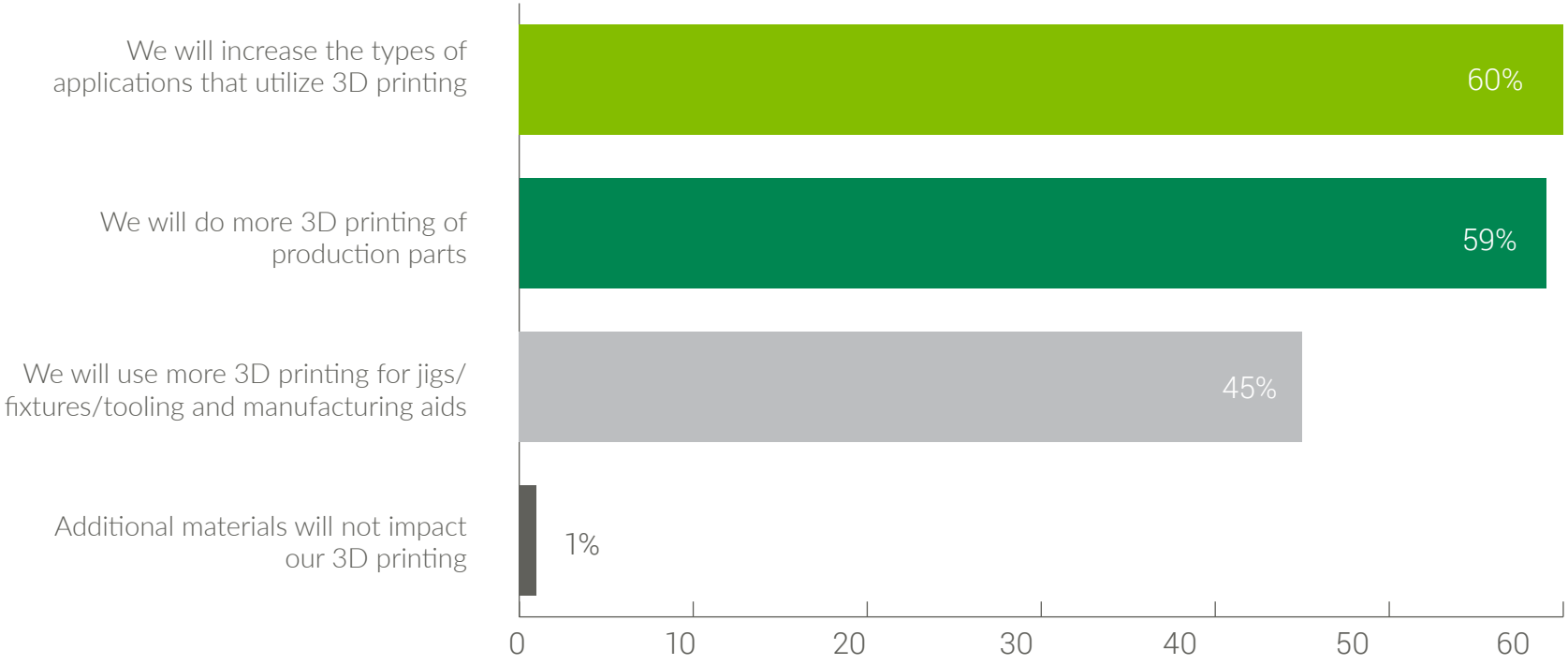


BETTER ADDITIVE MATERIALS WILL LEAD TO MORE 3D PRINTING USE

Given the challenges and frustration manufacturers must grapple with when it comes to materials for 3D printing, it follows that 99% of survey participants stated that access to a greater variety of cost-effective, certified additive materials will lead to greater utilization of 3D printing.

This will allow manufacturers to increase the types of applications that leverage 3D printing (60%), do more 3D printing of production parts (59%) and use 3D printing for jigs, fixtures, tooling and manufacturing aids (45%).

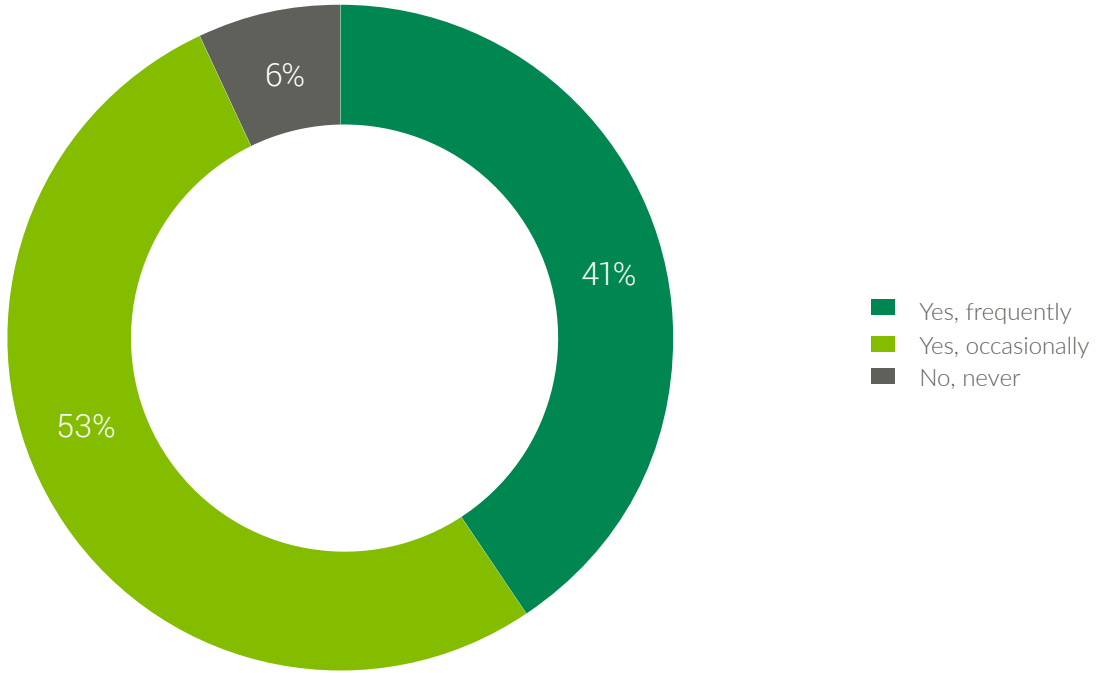
How do you anticipate your 3D printing use to change when a greater variety of cost-effective, certified additive materials become available?



94% SAY DESIGNERS CHOOSE TRADITIONAL MANUFACTURING DUE TO LACK OF ADDITIVE MATERIALS

We have already seen that manufacturers recognize a range of benefits with 3D printing. If the issue of a lack of available materials is solved, 94% or experts agree that it would lead to an increase in 3D printing over traditional manufacturing approaches.

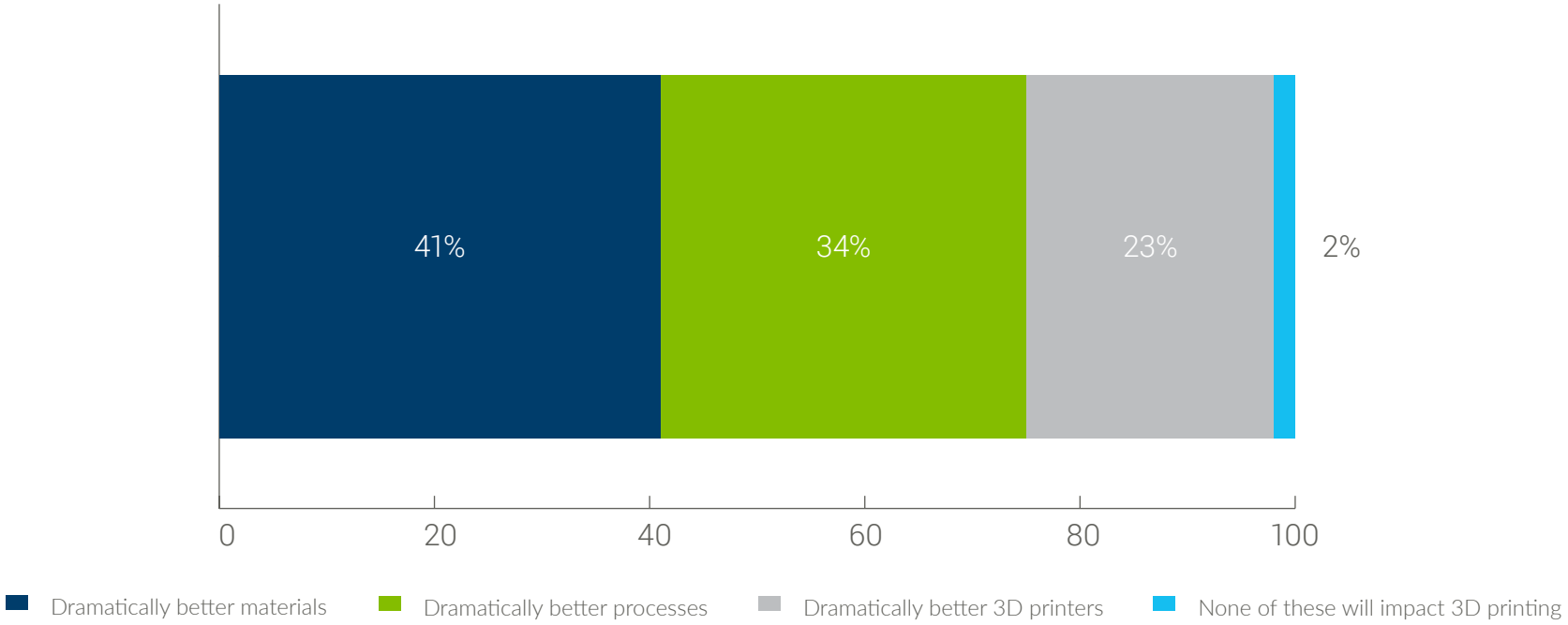
In your experience, do designers choose traditional manufacturing approaches rather than 3D printing PRIMARILY because they do not have an easily accessible library of materials?



BETTER MATERIALS WILL HAVE GREATEST IMPACT ON 3D PRINTING FOR PRODUCTION

Given that the stated challenges when it comes to materials as well as the opportunities that better and more easily available materials, it logically follows that the advancement that would make the greatest impact on encouraging the mass adoption of 3D printing for production is dramatically better materials (41%), followed by improved processes (34%) and upgraded 3D printers (23%).

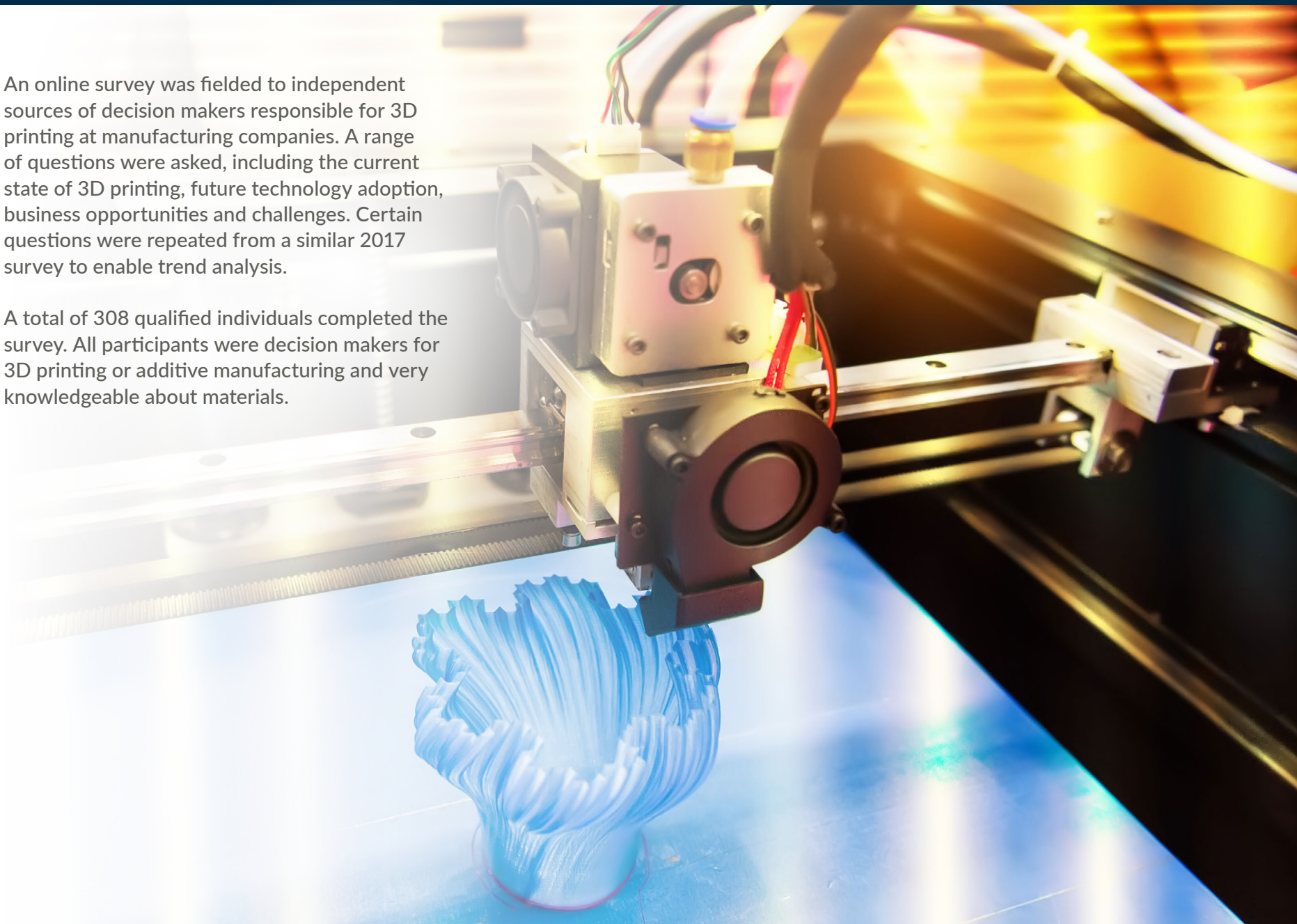
In your opinion, which of these types of advances will have the greatest impact on increasing the mass adoption of 3D printing for production?



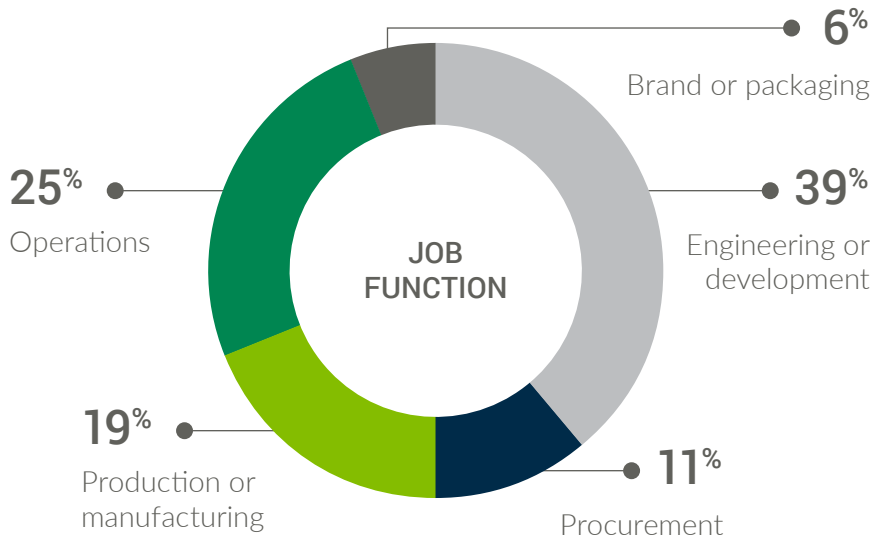
SURVEY METHOD AND PARTICIPANTS

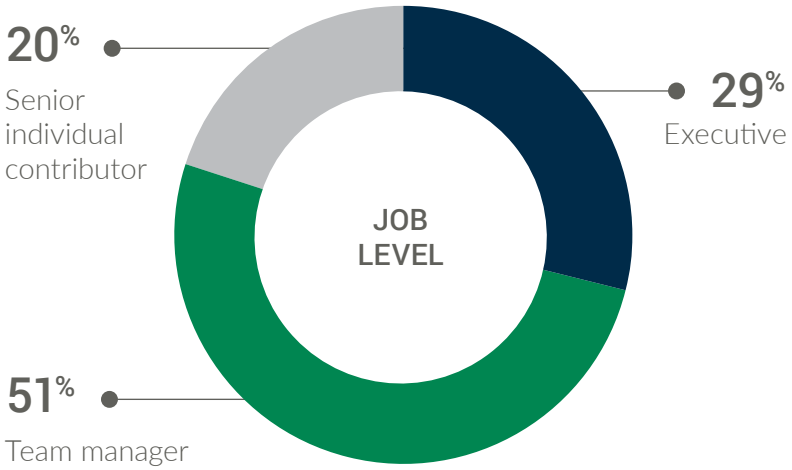
An online survey was fielded to independent sources of decision makers responsible for 3D printing at manufacturing companies. A range of questions were asked, including the current state of 3D printing, future technology adoption, business opportunities and challenges. Certain questions were repeated from a similar 2017 survey to enable trend analysis.

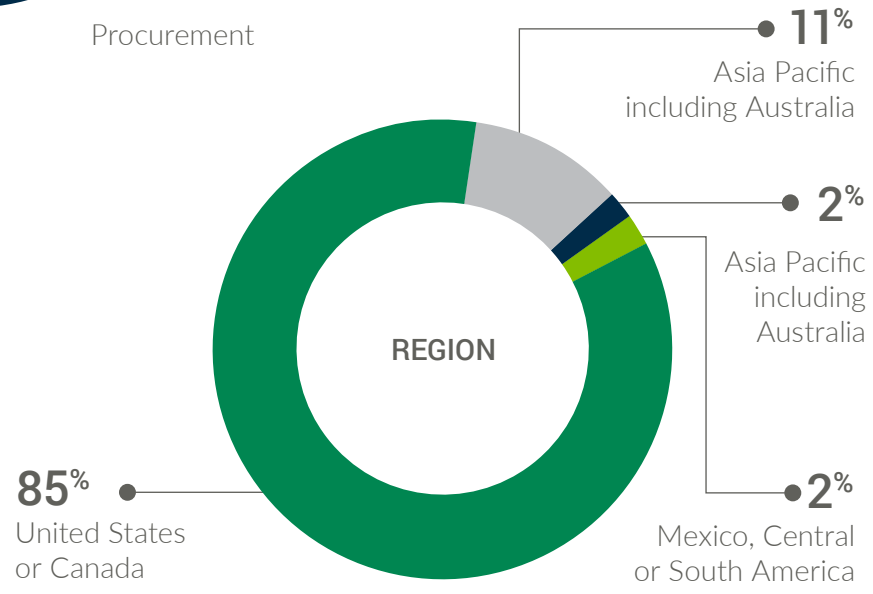
A total of 308 qualified individuals completed the survey. All participants were decision makers for 3D printing or additive manufacturing and very knowledgeable about materials.



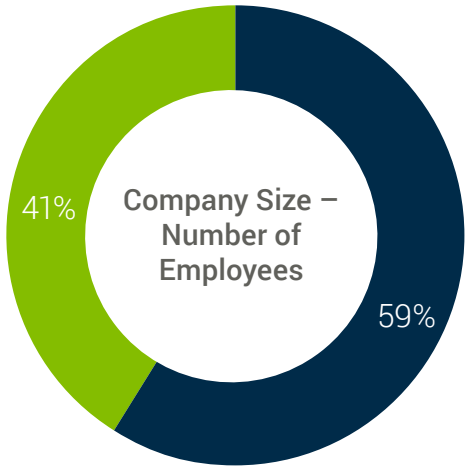
INDIVIDUALS REPRESENTED



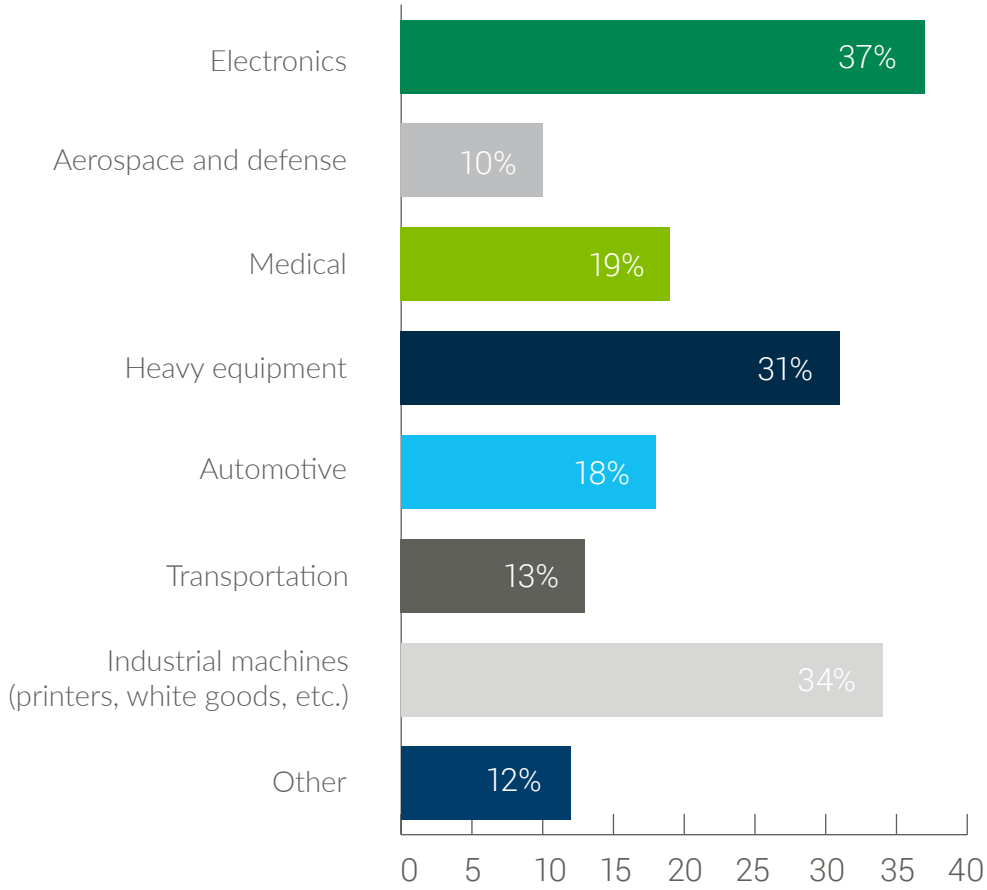




COMPANIES REPRESENTED



More than 5,000
1,000 - 5,000



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