

# Research Report: Simulation-Driven Design for Manufacturing (SDfM) Experiences



This report is sponsored by Altair, inc.

# EXECUTIVE SUMMARY

Product engineers are under consistent pressure to reduce the costs, improve the quality and increase the throughput of manufacturing processes. This fast-paced environment is not well suited for trial-and-error manufacturing engineering.

How are engineers responding to these challenges? Is simulation and simulation-driven design for manufacturing (SDfM) well established across the industry? When simulation is deployed, does it deliver on the promises of reducing costs while improving throughput and quality? And what are the barriers to the adoption of simulation during the early stages of product development?

In this survey report, we discuss those questions and discover:

- Top design priorities
- Top benefits of SDfM
- Top barriers to expanding and adopting SDfM
- Risks to staying competitive in the market
- And much more

Thanks to all our survey participants for sharing their experiences, and thanks to our readers.

Sincerely,  
Shawn Wasserman  
Senior Editor, [engineering.com](https://www.engineering.com)

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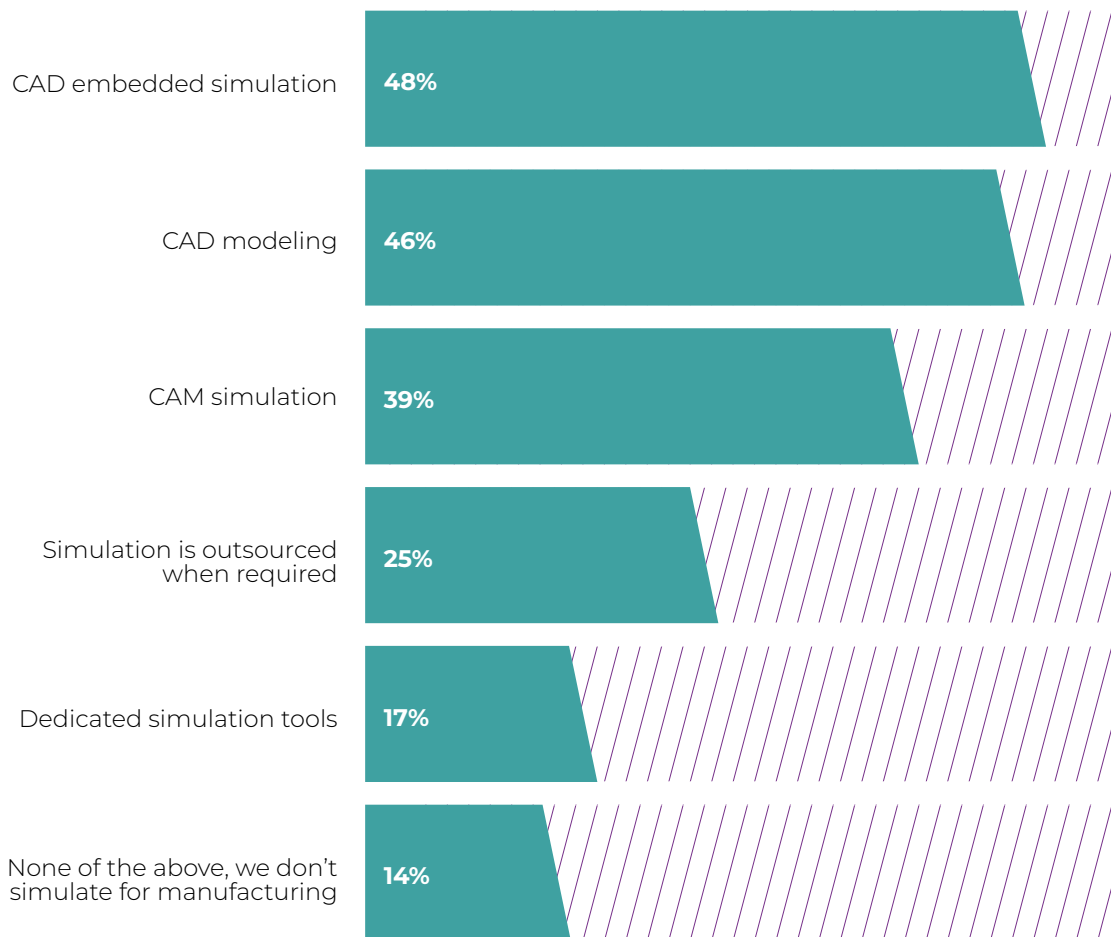
# **Manufacturing Simulation Tools and Users**

# WHAT MANUFACTURING SIMULATION TECHNOLOGY HAS YOUR COMPANY CURRENTLY ADOPTED?

Considering all the various manufacturing simulation technology options, our audience primarily uses CAD embedded simulations (48%), CAD modeling (46%) and CAM simulations (39%).

Only 17% have dedicated simulation tools, and 25% outsource simulation work to external firms. Meanwhile, 14% are not simulating manufacturing scenarios.

About 23% of respondents are unsure how to answer.



Q: What manufacturing simulation technology has your company currently adopted?

Select up to three.

The chart displays the percentage of respondents who selected each option.

Because respondents can select multiple options, the total can go above 100%..

N = 369

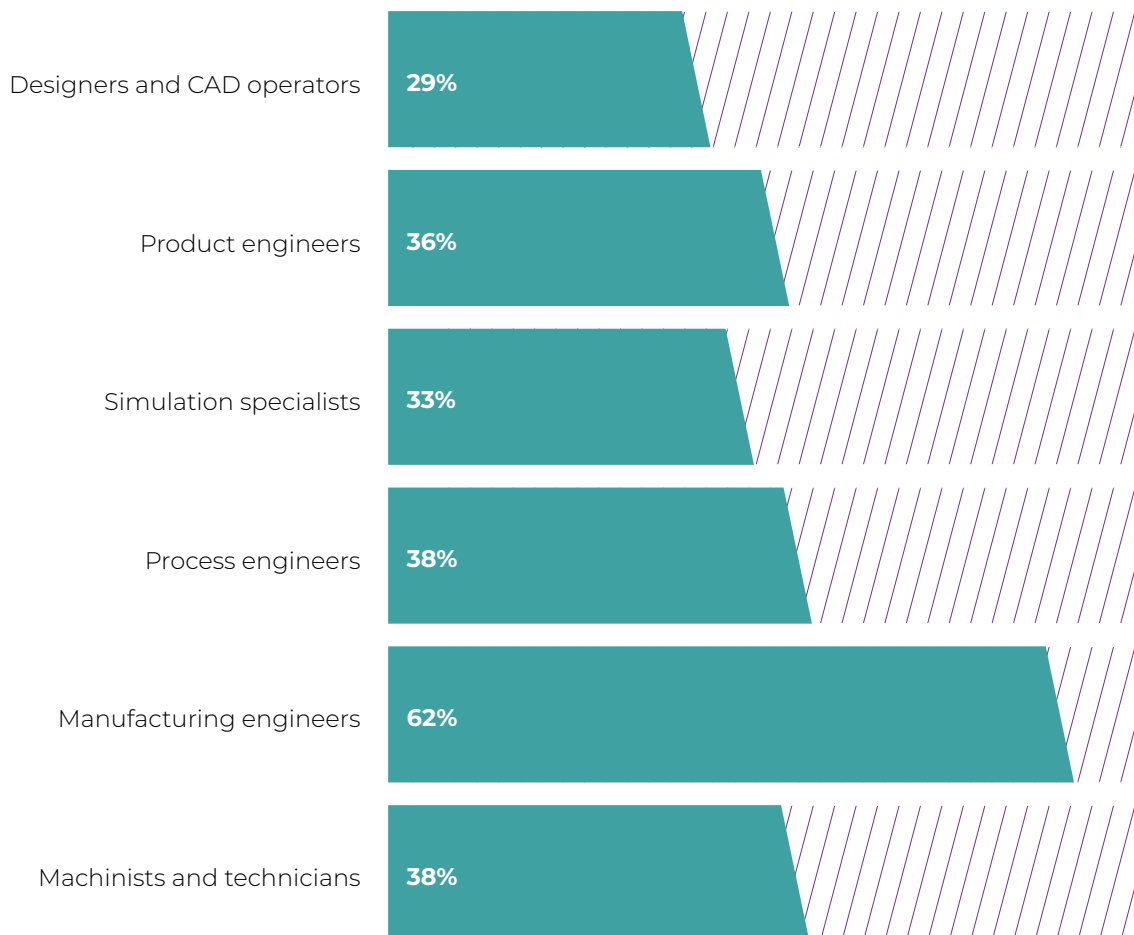
# WHO ARE THE PRIMARY USERS OF MANUFACTURING SIMULATIONS?

The majority (62%) of manufacturing simulation users are manufacturing engineers.

The rest of the users are almost equally spread between machinists and technicians (38%), process engineers (38%), product engineers (36%), simulation specialists (33%) and design/CAD operators (29%).

Based on these user numbers, it suggests that manufacturing simulations are produced late in the product development cycle.

Only 4% of users are business owners.



Q: Who uses manufacturing simulation within your company? Select all that apply.

The chart displays the percentage of respondents who selected each option.

Because respondents can select multiple options, the total can go above 100%..

N = 211

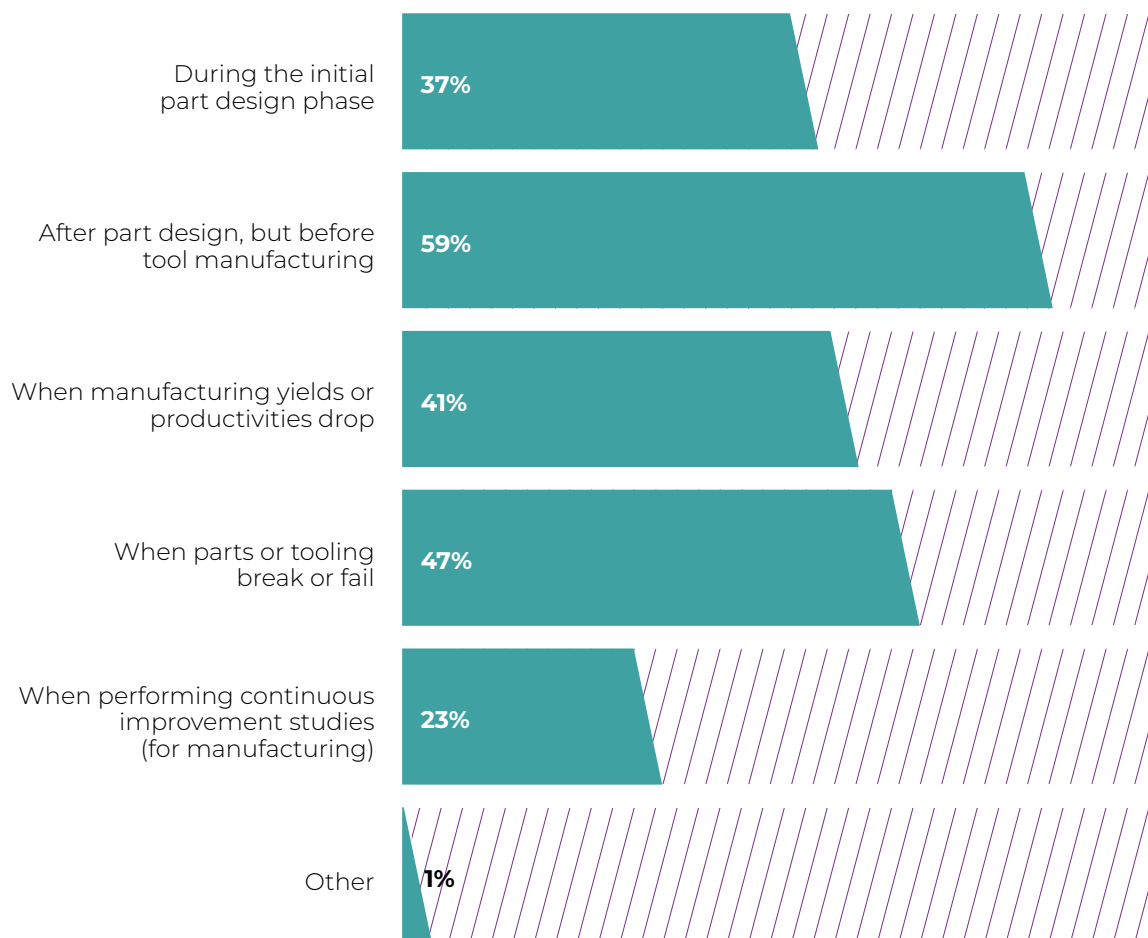
# WHEN DO ENGINEERS APPLY MANUFACTURING SIMULATIONS?

For 59% of respondents, simulating the manufacturing processes happens after parts have been designed but before tools are manufactured. Manufacturing simulation also occurs during production for diagnostic reasons such as:

- When tools break or fail (47%).
- When yields or productivity drops (41%).

However, SDfM is only used for continuous improvement by 23% of respondents. Additionally, only 37% run manufacturing simulations during the initial part design phases.

This also suggests that the respondents are more reactionary to manufacturing issues, which shows the opportunity for SDfM adoption.



Q: When do you typically apply manufacturing simulation? Select all that apply.  
The chart displays the percentage of respondents who selected each option.  
Because respondents can select multiple options, the total can go above 100%..

N = 210

# **Company Objectives and Manufacturing Simulation**



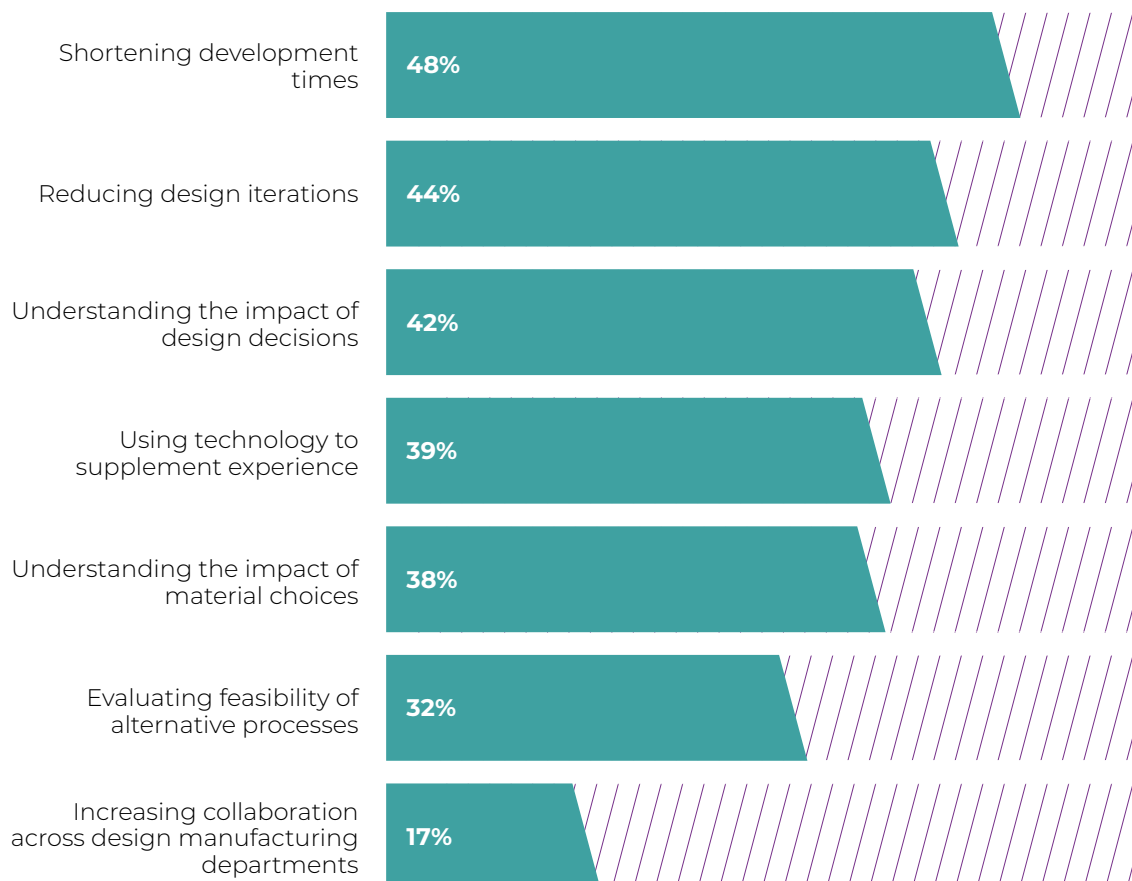
# WHAT ARE THE TOP DESIGN GOALS THAT DRIVE THE ADOPTION OF SIMULATION?

In order to understand the aspirations of our audience, we asked them to share how simulation supports their design goals.

About half of respondents want to shorten development times (48%), reduce design iterations (44%) and/or understand how design decisions impact the business (42%).

Over a third of respondents want to use simulation technology to supplement experience (39%), understand the impact of material choices (38%) and evaluate the feasibility of alternative approaches (32%).

Only 17% are looking to improve collaborations between design and manufacturing teams.



Q: What design objectives are driving your adoption of simulation? Select up to three. The chart displays the percentage of respondents who selected each option. Because respondents can select multiple options, the total can go above 100%.

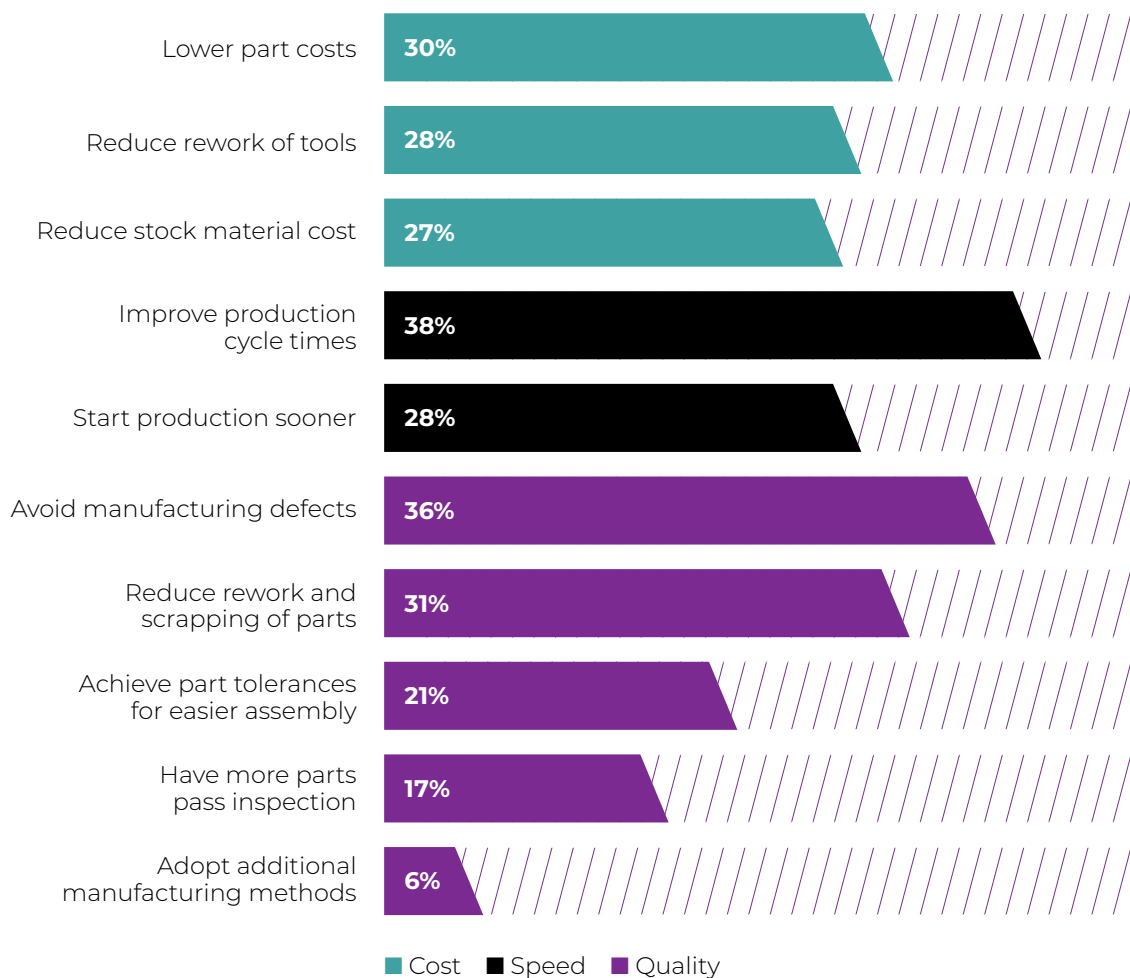
N = 212

# WHAT BUSINESS ADVANTAGES DRIVE SIMULATION ADOPTION?

Engineers are using simulations to fuel their business goals in several ways. For instance, 76% use simulations to improve at least one quality outcome. When broken down to individual tasks, this includes avoiding manufacturing defects (36%), reducing rework and scrapping of parts (31%), achieving part tolerances for easier assembly (21%), having more parts pass inspection (17%) and adopting additional manufacturing methods (6%).

About 67% use simulation to achieve a goal associated with bringing down costs. When broken down, this includes reducing the cost of tools (28%), parts (30%) and stock materials (27%).

Over half (57%) are using simulation to speed up their processes one way or another. Specifically, 38% look for faster production cycle times and 28% the ability to start production sooner.



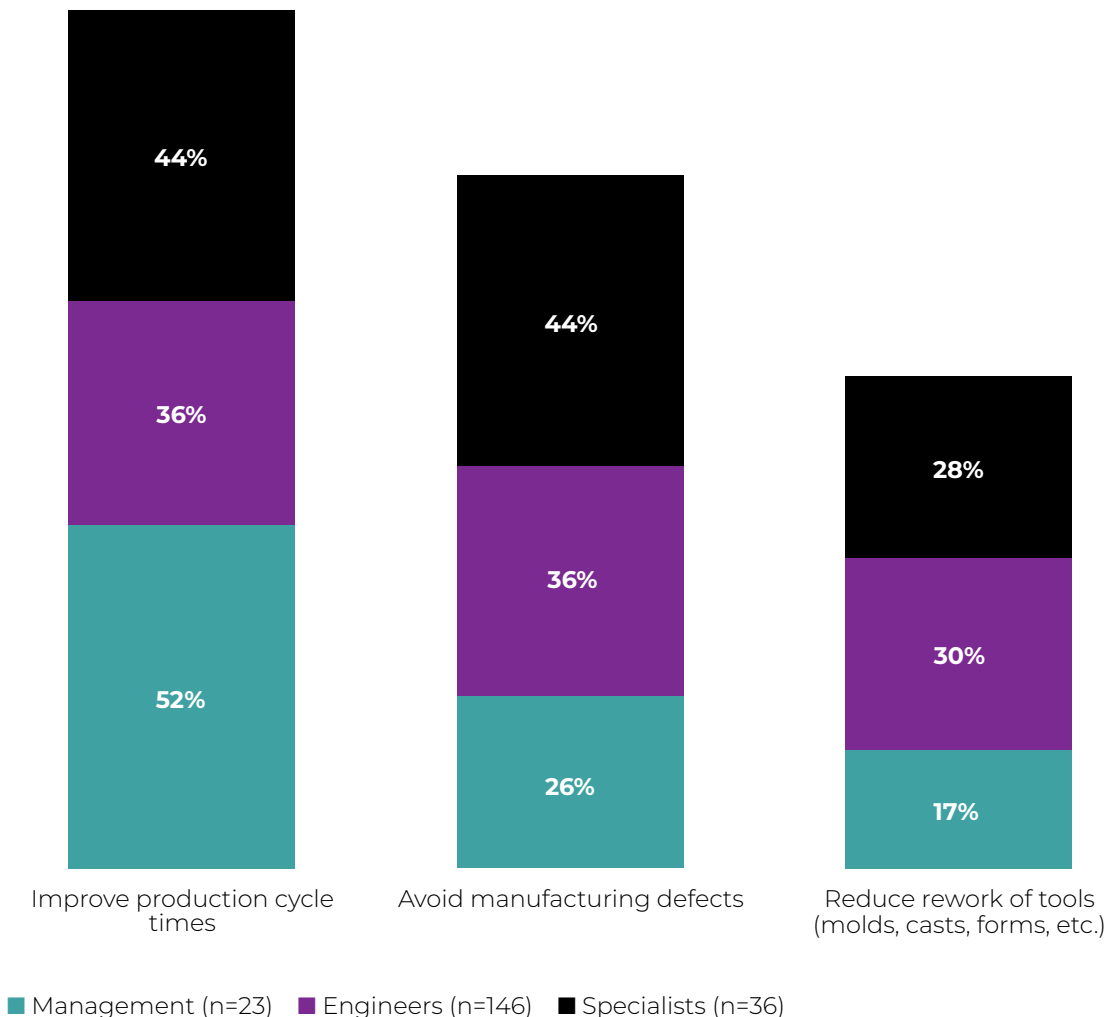
Q: What business goals are driving your adoption of simulation? Select up to three. The chart displays the percentage of respondents who selected each option. Because respondents can select multiple options, the total can go above 100%.

N = 212

# TOP 3 BUSINESS GOALS THAT DRIVE ADOPTION OF SIMULATION BY JOB ROLE

Based on job role, there is a gap in understanding of the benefits simulation provides. Engineers are consistent. About a third note the tool's ability to improve cycle time as well as reduce defects and rework.

Management, however, seems to focus more on simulation's ability to improve cycle times. Specialists agree with managements' view with respect to cycle time, but also note simulation's ability to avoid defects.



Q: What business goals are driving your adoption of simulation? Select up to three.  
[SHOWING TOP 3 OPTIONS]

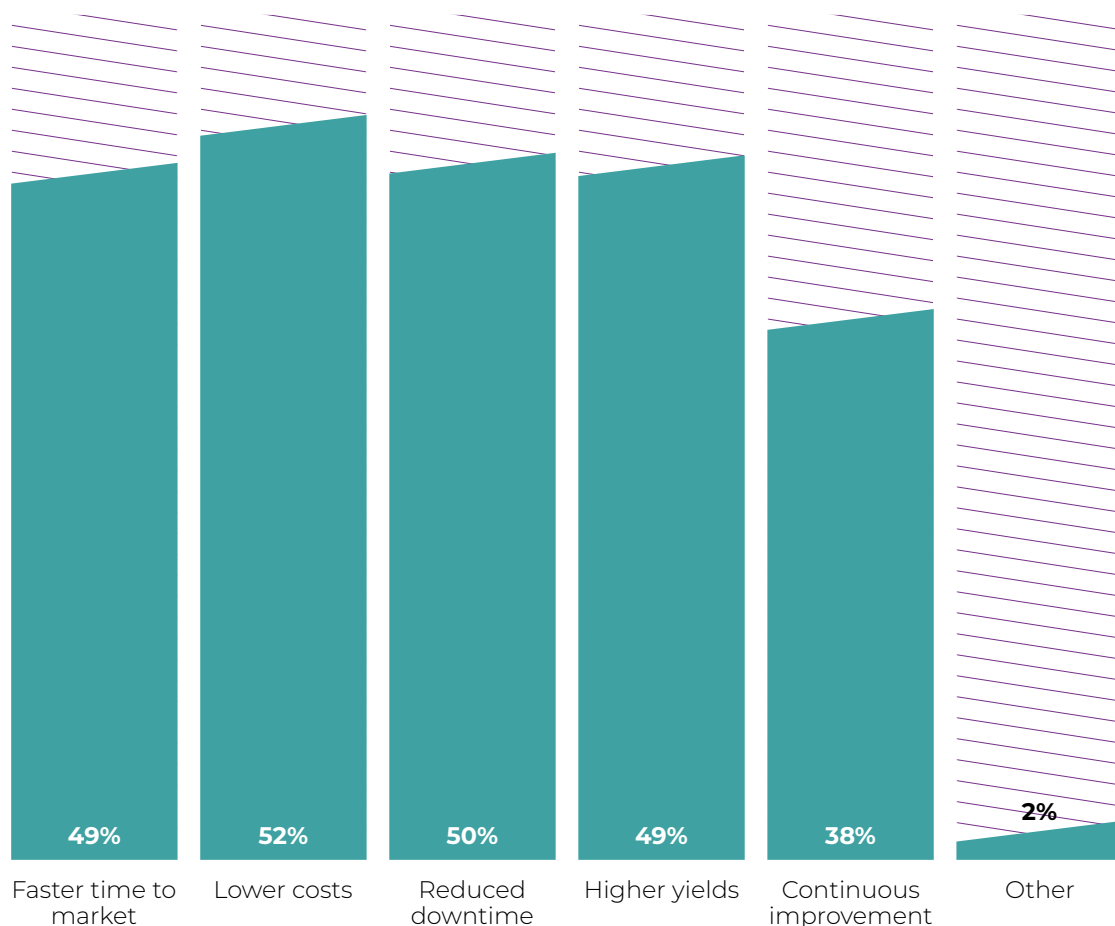
The chart displays the percentage of respondents who selected each option. Because respondents can select multiple options, the total can go above 100%.

What is your job role?.

# WHAT BENEFITS ARE COMPANIES EXPERIENCING FROM CONDUCTING PRODUCT MANUFACTURABILITY SIMULATIONS?

When it comes to the simulation of manufacturing systems, about half of respondents have reported the ability to lower their cost (52%), reduce downtime (50%), speed up time to market (49%) or produce higher yields (49%). Meanwhile, only 38% uses it to drive continuous improvement.

As previously discussed, many do not use SDfM proactively. However, those early adopters, who use it during the initial development steps and for continuous improvement, are reaping the benefits.



Q: How has simulating the product manufacturability benefited your organization? Select up to three.

The chart displays the percentage of respondents who selected each option.

Because respondents can select multiple options, the total can go above 100%.

N = 212

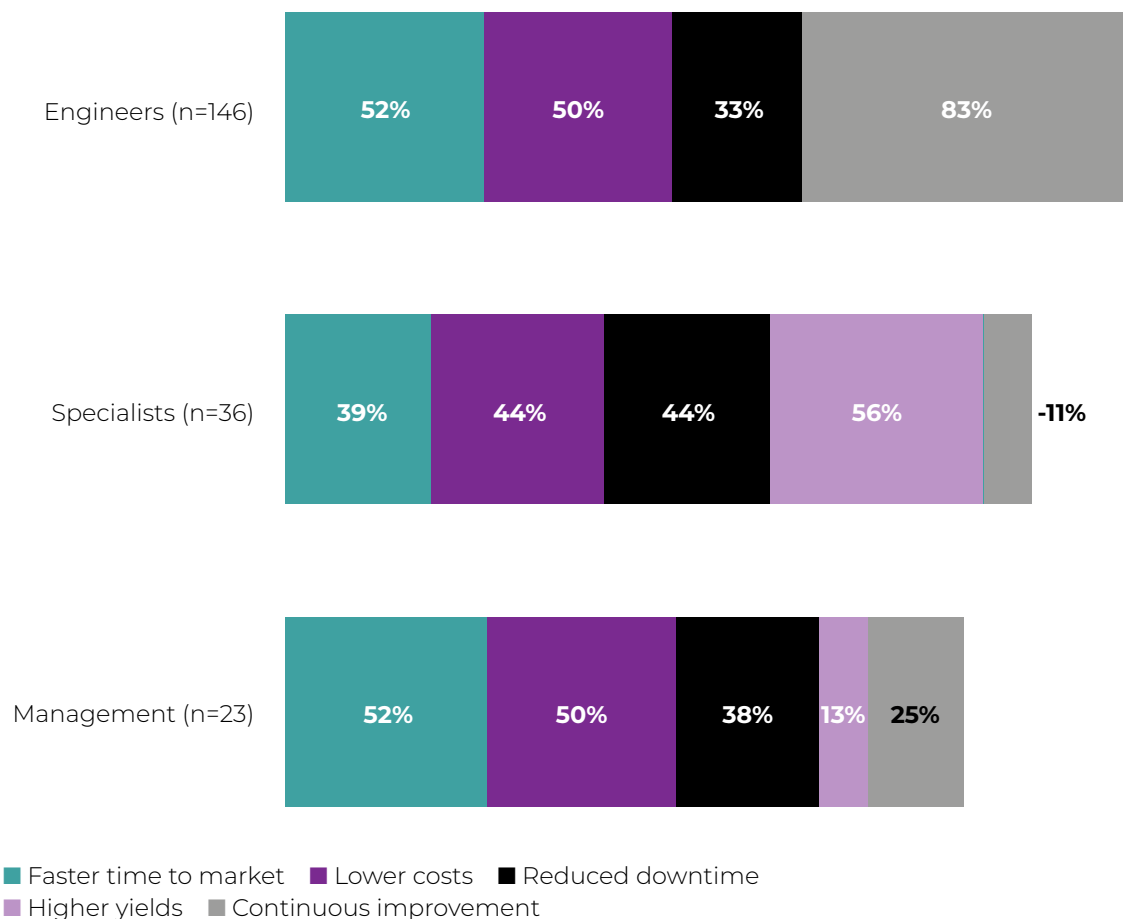
# TOP SIMULATION BENEFITS FOR ORGANIZATIONS BY JOB ROLE

Though many are not using SDfM proactively, those early adopters, who use it during initial development, reap the benefits.

What is interesting is how there is a gap in consensus, based on different job roles, as to the importance of these benefits. Continuous improvement is a significant benefit to engineers, but not for specialists and management.

Specialists seem to note the benefits of higher yields, but management and engineers seem not to value this benefit, if at all.

The two things that engineers and management agree on is simulations' ability to get to market faster and to lower costs.



Q: How has simulating the product manufacturability benefited your organization?  
Select up to three.

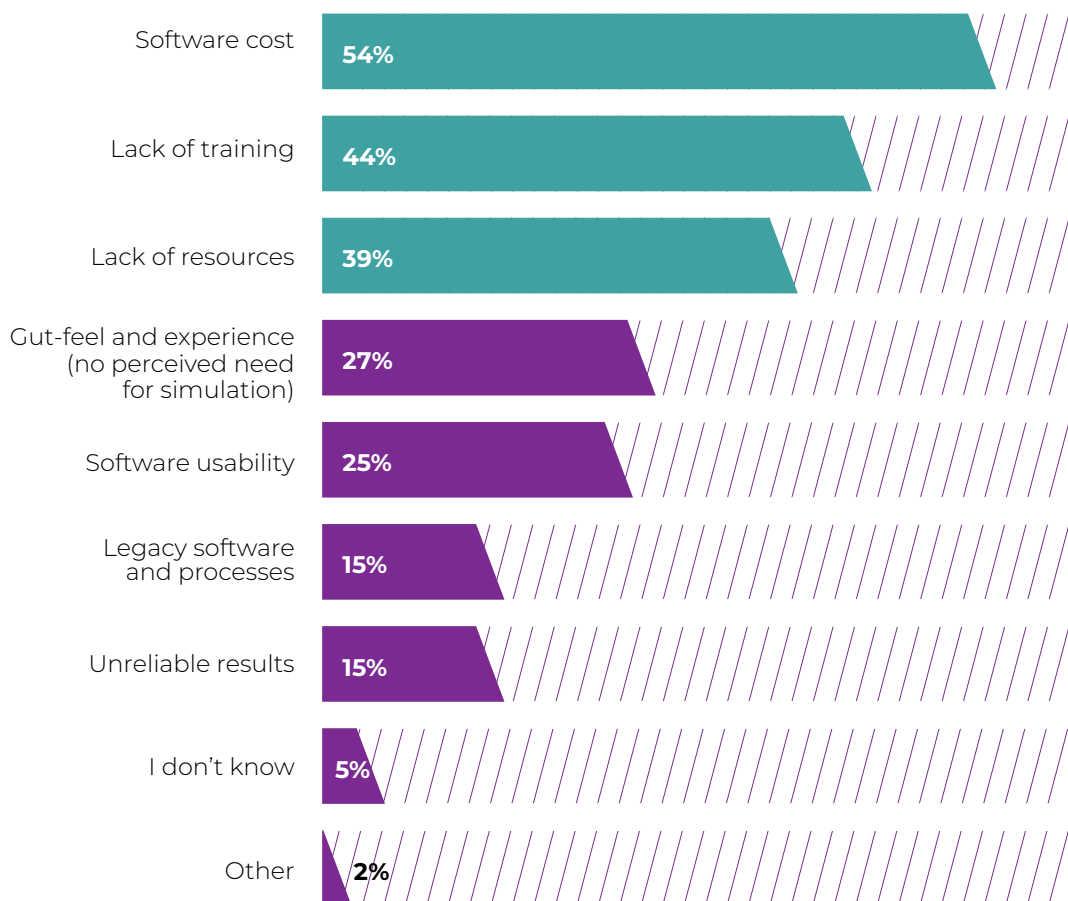
The chart displays the percentage of respondents who selected each option. Because respondents can select multiple options, the total can go above 100%.

What is your job role?

# WHAT KEEPS ORGANIZATIONS FROM ADOPTING AND EXPANDING THEIR SIMULATION OPERATIONS?

We asked respondents to reflect on factors that hinder the adoption and expansion of simulation within their companies. We discovered that for the majority (54%) cost is the top barrier, followed by a lack of training (44%) and/or resources (39%). Some are finding it challenging to convey the need for simulations (27%), while others find issues with software usability (25%).

Amazingly, 15% still work with legacy tools and get unreliable results, proving that engineering is not safe from “this is how we always do things” mentalities.



Q: Which are the main barriers for your company to adopt or expand the use of Simulation? Select up to three.

The chart displays the percentage of respondents who selected each option.

Because respondents can select multiple options, the total can go above 100%.

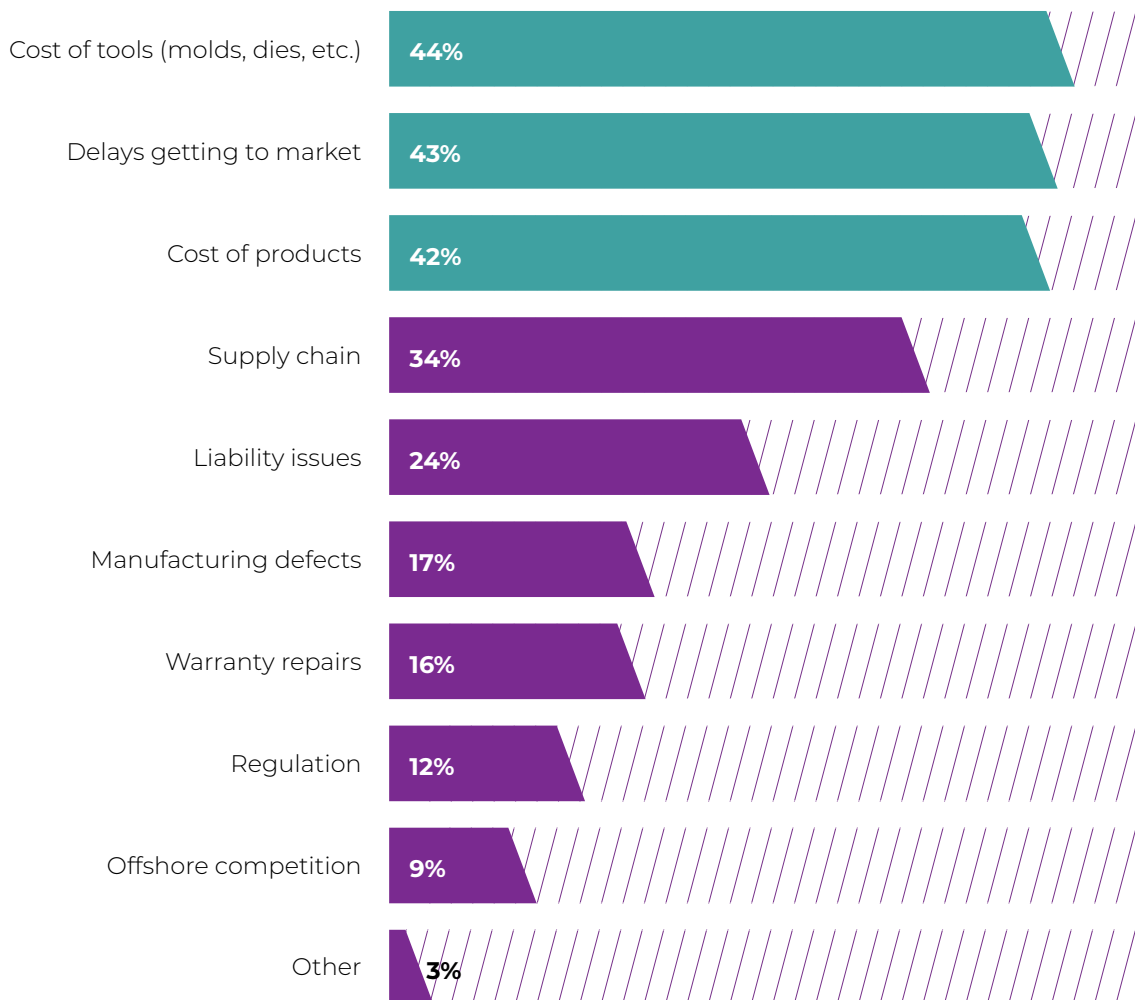
N = 369

# WHAT ARE THE TOP RISKS TO STAY COMPETITIVE IN THE MARKET?

We wanted to know what our audience considers the top risks to their ability to dominate the market. The top 3 risks are cost of tools (44%), delays getting to market (43%) and the costs of products (42%).

As previously discussed, all these concerns can be improved using SDfM. Additionally, the gap in the technology's adoption, for proactive uses, suggests a market opportunity.

Our audience is less concerned with manufacturing defects (17%), warranty repair requests (16%), regulations (12%) and offshore competition (9%).



Q: What are the biggest challenges to your products' competitiveness? Select up to three challenges.

The chart displays the percentage of respondents who selected each option.

Because respondents can select multiple options, the total can go above 100%.

N = 369

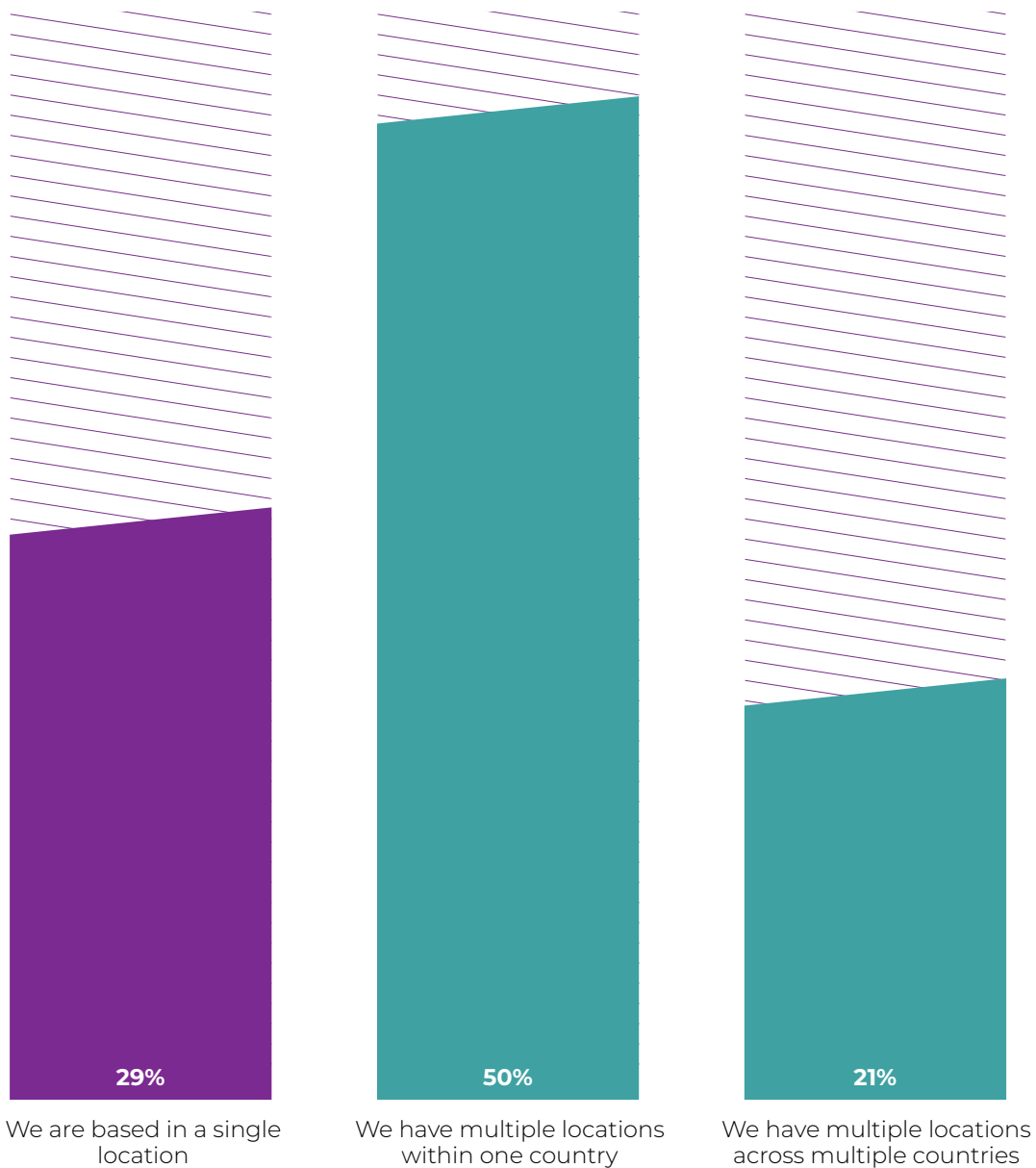
# Demographics



# GEOGRAPHIC POSITIONING

Survey takers were split between a single facility (29%) and multiple facilities (71%).

Of those companies that had multiple locations, some locations were spread across multiple countries (21%) and others were domestically positioned within one country (50%).



Q: How is your organization positioned geographically?

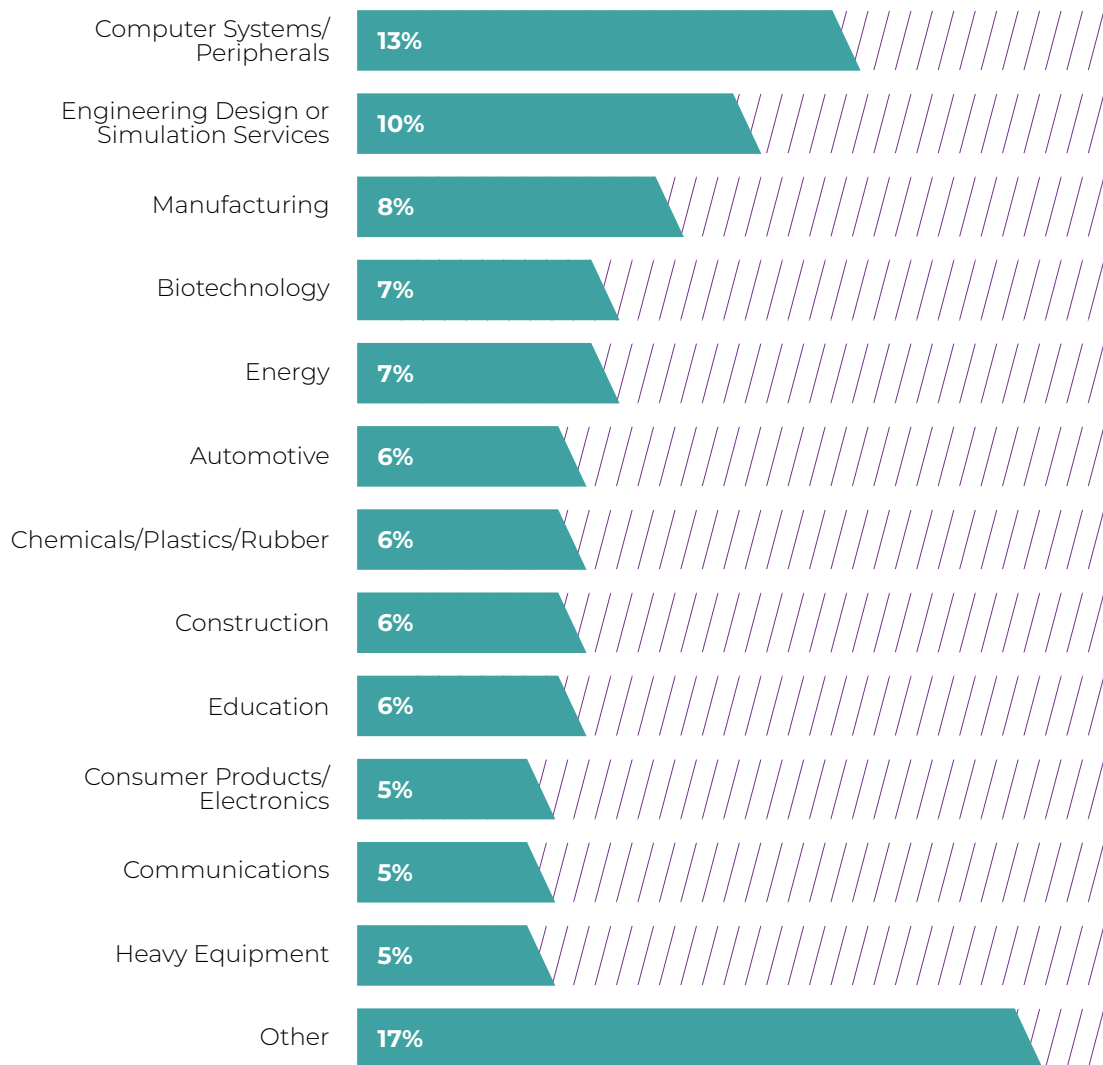
N = 365

# INDUSTRIES REPRESENTED

Though respondents work in a diverse range of industries, the largest industries represented here are computer systems/peripherals (13%), engineering design or simulation services (10%), manufacturing (8%), biotechnology (7%), energy (7%), automotive (6%), chemicals/plastics/rubber (6%), construction (6%), education (6%), consumer products/electronics (5%), communications (5%) and heavy equipment (5%).

17% of respondents were spread across various other industries, including:

- Industrial machine tools (4%)
- Aerospace, food & beverage and medical equipment/devices (each representing 3%)
- Oil & gas, government (each representing 1%)



Q: What industry do you work in?

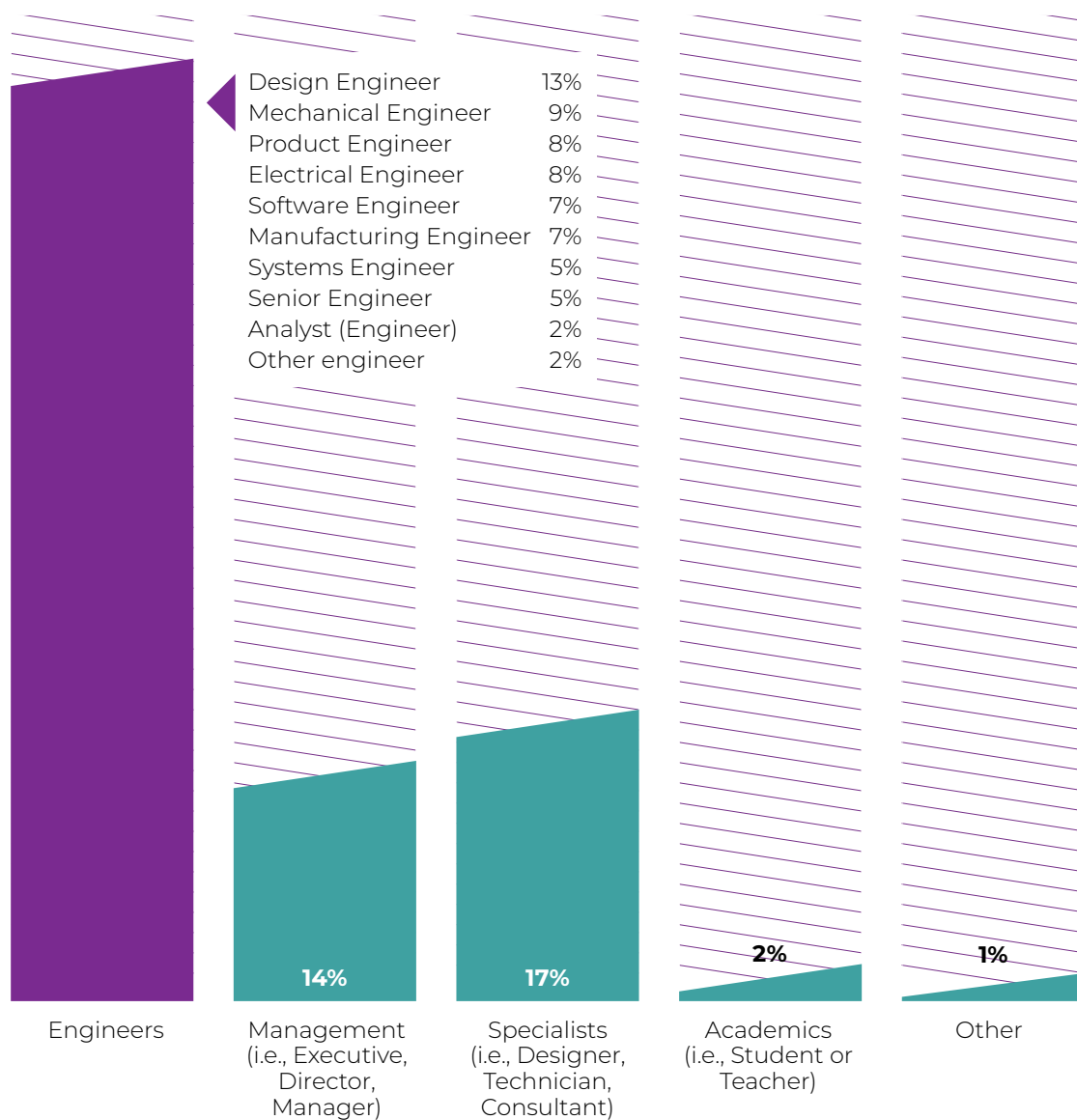
[CHART SHOWING INDUSTRIES WITH 5%, OR MORE, RESPONDENTS]

N = 366

## JOB ROLES REPRESENTED

The majority of respondents included in this survey are Engineers (66%). Of those, 13% are design engineers and 9% mechanical engineers. Meanwhile, 8% are product or electrical engineers, respectively; 7% are software or manufacturing engineers, respectively; and 5% are systems or senior engineers, respectively.

There is good representation from those in management (14%), as well as specialist roles (i.e., designers, technicians and consultants) at 17%. Only a small portion of respondents work in academia (2%).



Q: What is your job role?

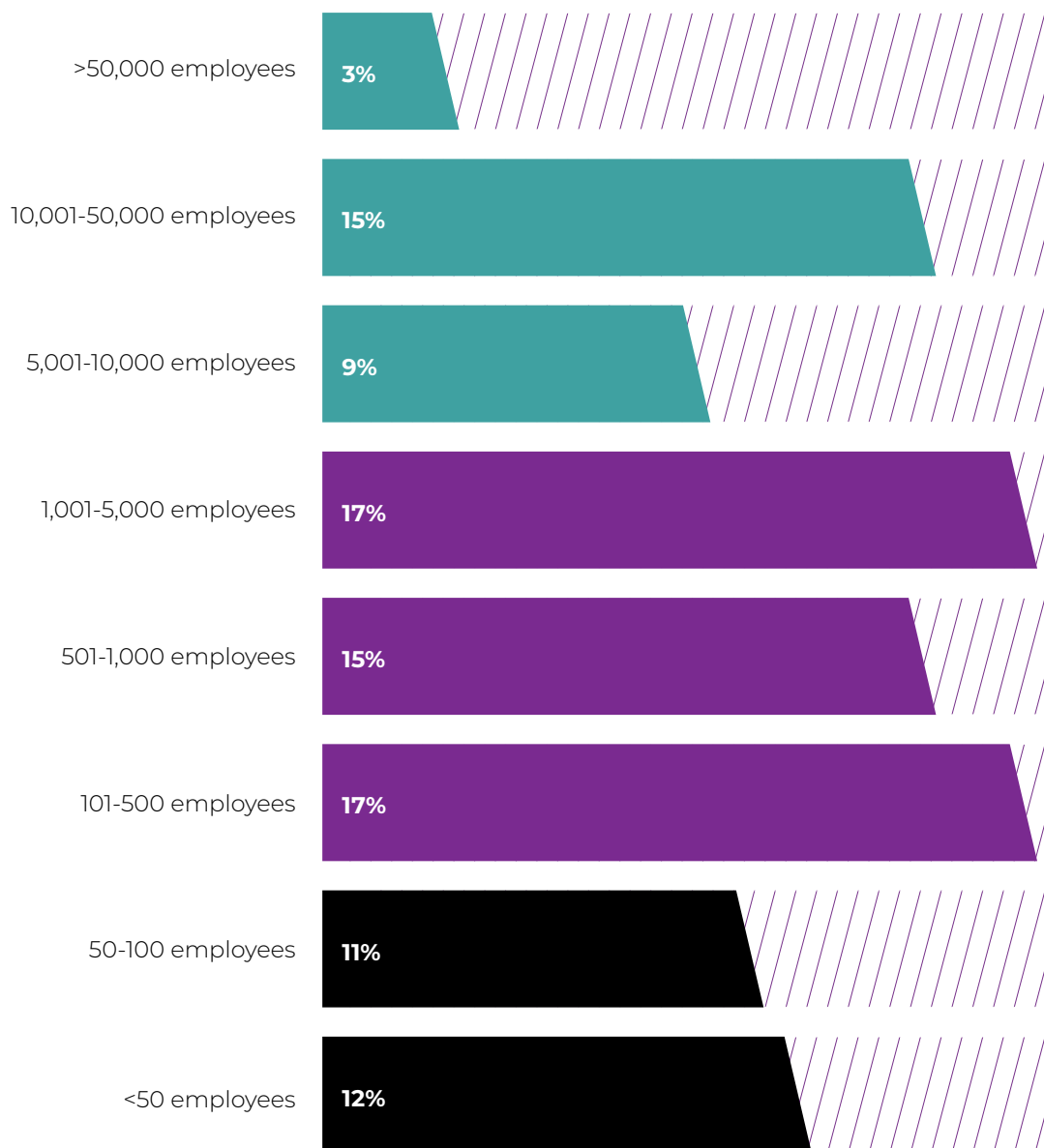
N = 369

# ORGANIZATION SIZE

The survey sample represented large and small organizations alike.

Our respondents work primarily for larger organizations (44%) with over 1,000 employees. Meanwhile, mid-sized organizations of 101 – 1,000 employees are represented by 32% of respondents.

Small firms are represented by 23% of respondents.



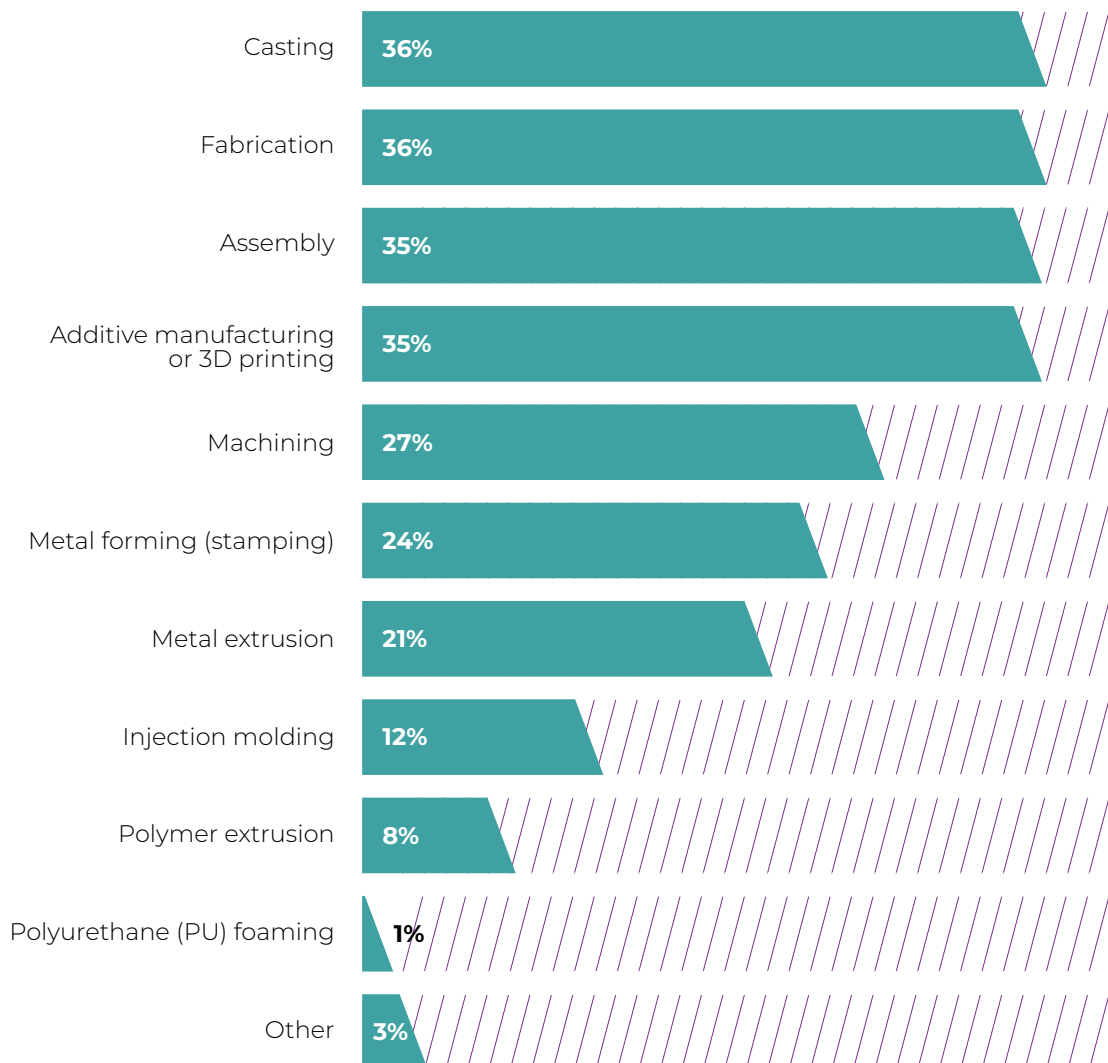
Q: What is the approximate size of your organization?

N = 362

# THE MANUFACTURING PROCESSES THAT RECEIVE ATTENTION FROM ENGINEERS?

Casting (36%), fabrication (36%), assembly (35%) and additive manufacturing (35%) are the most popular manufacturing options the engineers surveyed are focusing on. There are also a considerable number focusing on machining (27%), stamping (24%) and metal extrusion (21%).

Meanwhile, injection molding (12%), polymer extrusion (8%) and polyurethane foaming (1%) fall to the bottom of the popularity list.



Q: Which manufacturing processes are your primary focus? Select up to three processes.

The chart displays the percentage of respondents who selected each option.

Because respondents can select multiple options, the total can go above 100%.

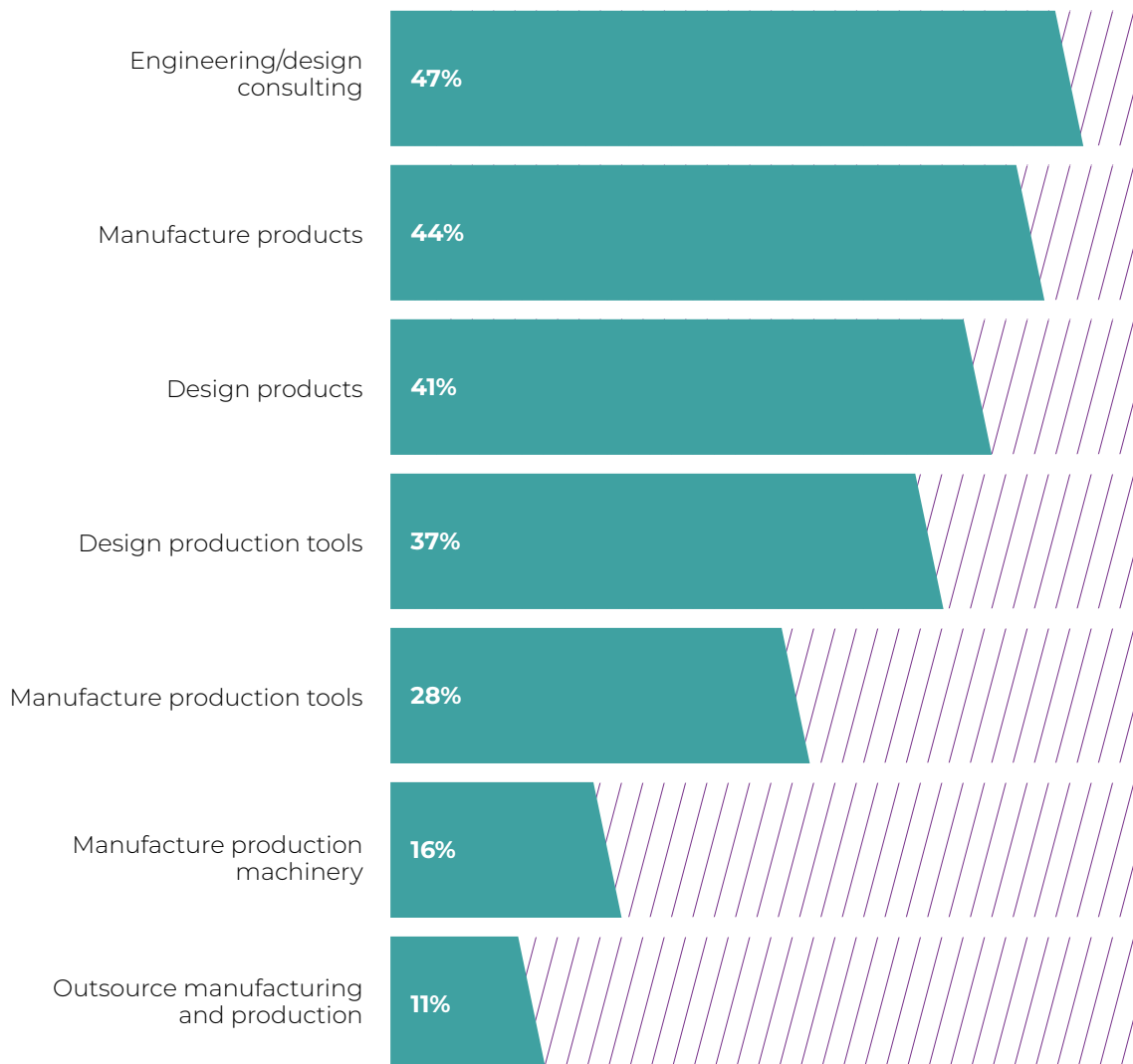
N = 369

# ACTIVITIES ORGANIZATIONS ENGAGE IN

Engineering/design consulting (47%) is the top activity engineering organizations engage in. This is followed by manufacturing products (44%), designing products (41%) and designing production tools (37%).

Less than a third of organizations manufacture production tools (28%) or production machinery (16%). Only a small portion (11%) outsource both manufacturing and production.

These results suggest that much of the engineering focus is on the product design as opposed to its manufacturing.



Q: What activities does your organization engage in? Select all that apply.  
The chart displays the percentage of respondents who selected each option.  
Because respondents can select multiple options, the total can go above 100%.

N = 363

## CLOSING COMMENTS

The survey shows that product engineers are concerned about the risks that costs, quality and throughput pose to the manufacturing process. Without simulation, engineers must solve issues with trial and error. The survey shows that those that use simulation, and simulation-driven design for manufacturing (SDfM), see improvements to the manufacturing and development process.

Here are a few takeaways from the survey:

- Manufacturing simulation is used the most after parts are designed, but before manufacturing tools (59%). It is used for continuous improvement 23% of the time and in early design stages 37% of the time. This indicates a reactionary usage gap.
- The benefits companies have experienced from SDfM include lower costs (52%), reduced down-time (50%), faster time to market (49%), higher yields (49%) and continuous improvement (38%).
- Based on job role, there is a gap in the understanding the benefits simulation provides and the perceived importance of these benefits.
- The top three risks to competitiveness are cost of tools (44%), delays getting to market (43%) and the costs of products (42%).
- The top risks, the positive SDfM experiences and the reactionary usage gap suggests an opportunity in the market.
- The reasons organizations don't expand/adopt simulations include cost (54%), training (44%) and resources (39%). About 15% use outdated systems.

Engineering.com would like to thank the participants of this study. By sharing their knowledge and allowing others to see how they compare, they have enriched the entire engineering community.

Thanks for reading,

Shawn Wasserman  
Senior Editor, engineering.com



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