# BREAKING THE MOLD

## How Toolmakers Are Transforming Operations to Stay Competitive

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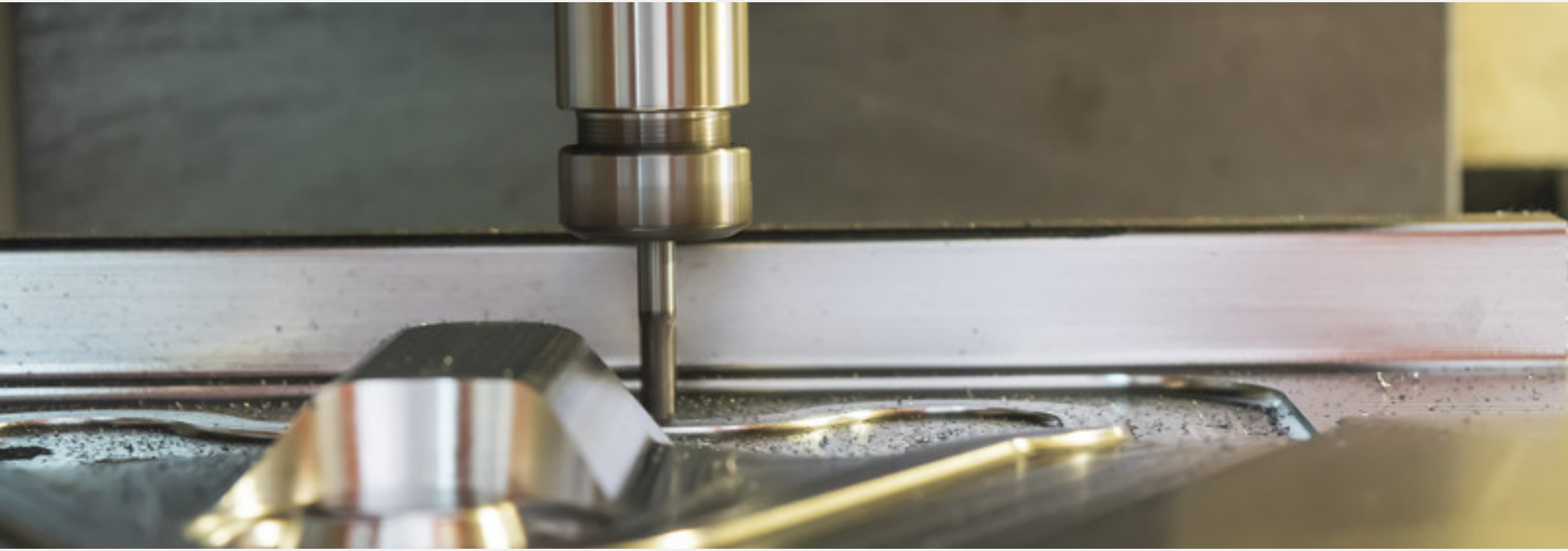
Tech-Clarity

# Helping Mold Makers Get Ahead

## What Does It Take for Mold Makers to Be Competitive?

Mold making is a tough business. You have to compete on many bids with an accurate price that doesn't compromise profit margins, but is competitive enough to win. The delivery date must also be accurate. So many factors impact the cost of the mold from the quality of the part design, ability to manage cooling, and machining requirements. An accurate quote requires significant effort. Yet, despite all the work that goes into the bid, there's a good chance you may not even win it as mold makers who responded to our survey report they only win half, 52%, of the jobs they quote.

Then once you win the bid, the challenges only multiply. Poor part designs, bottlenecks, complexity, changes, and more create obstacles to profitability. To identify how mold makers can transform their operations to become more competitive and boost profitability, Tech-Clarity surveyed over 370 mold makers. This report reveals the results and provides recommendations to improve your business.



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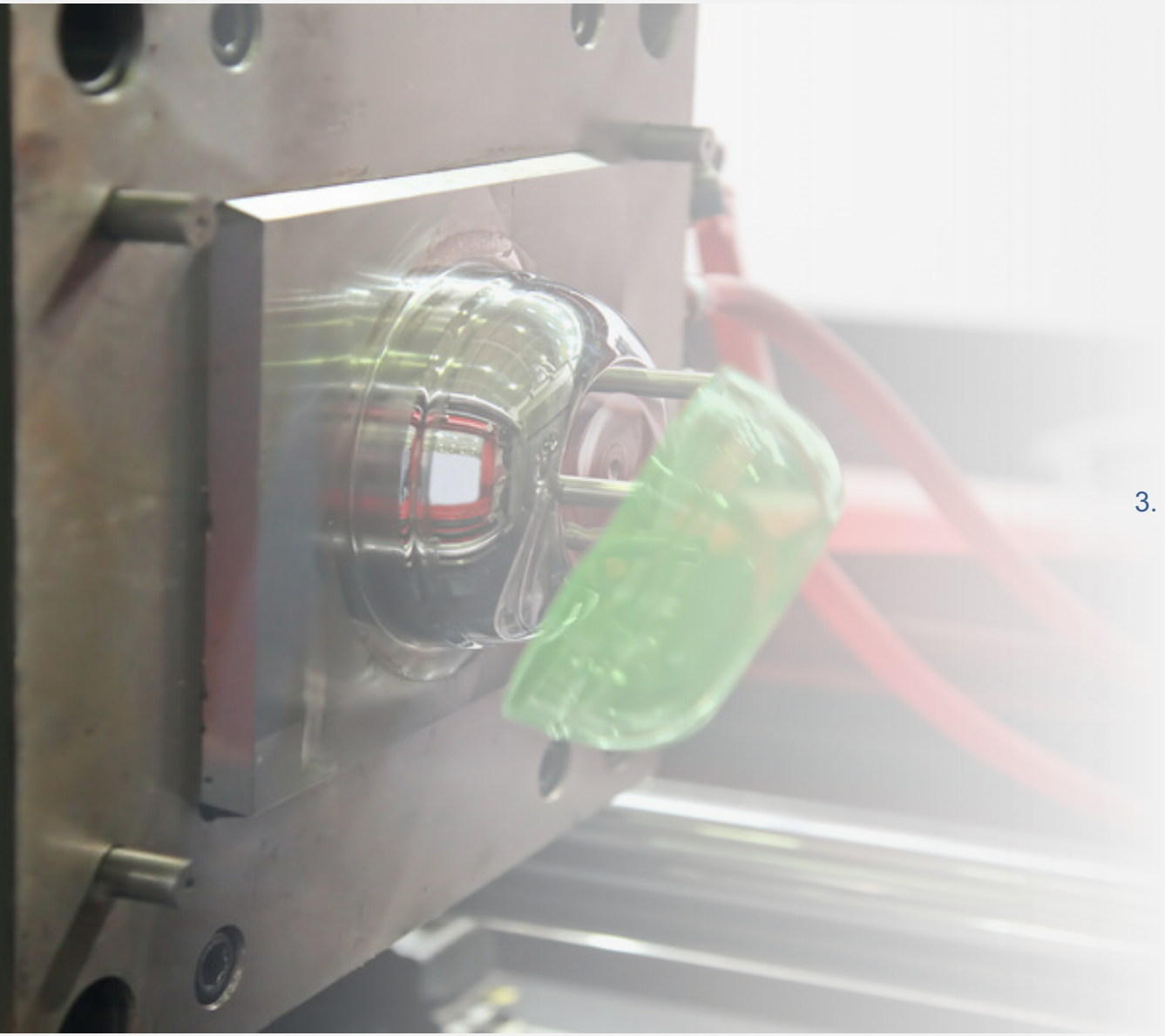
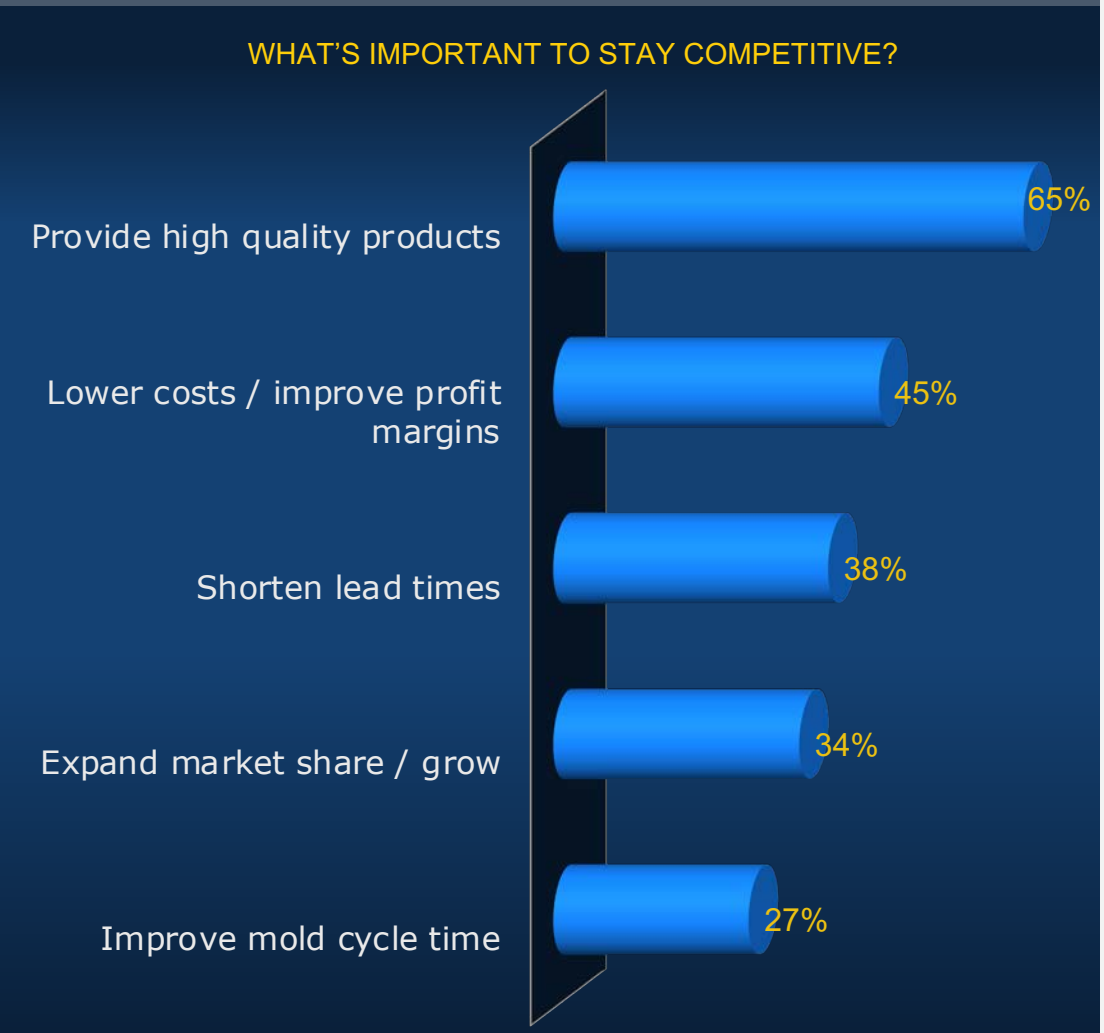


# What It Takes to Be Competitive

Ensuring the quality of your molds and the resulting parts can help you stand out from other mold shops.




## Objectives for Competitiveness

How can you become even more competitive? Where should you focus? The graph shows the top five areas. At a high level, it is about keeping customers happy.

## Quality

Ensuring the quality of your molds and the resulting parts can help you stand out from other mold shops. It gives customers a reason to do business with you. High quality helps you earn their loyalty because they know they'll be able to rely on you. However, injection molding is so complex, it is hard to predict exactly what will happen, so having the right systems and processes in place will help you catch problems as early as possible to ensure quality.

## Cost

Cost is also critical. If you can keep your costs low, you can afford to be price competitive without compromising your profit margins. However, as with quality, you need to catch potential problems as early as possible to avoid expensive mold rework. Efficiency will also help keep development costs down.

## Speed

Efficiency also helps you meet delivery dates. Customers desire short lead times, so removing bottlenecks will help you win more bids.

Shorter cycle times also help. Shaving just a couple of seconds off can save your customer tens or even hundreds of thousands of dollars. That's certainly a reason for a customer to want to work with you!

## Market Share and Cycle Time

The more customers you win over, the bigger your market share, which will boost your visibility and reputation to help you win even more business.

# Challenges that Hold Mold Makers Back

## Challenges to Address

Unfortunately, many obstacles hold mold makers back (see graph).

## Globalization

Global competition is the most prominent challenge. When competing against a global field, it is hard to stand out. Plus, lower-cost regions can undercut prices more easily, putting downward pressure on margins.

## Staff

Staffing also creates several challenges. One, it is hard to find skilled workers. Not only is it hard to keep up with advancements in manufacturing technology, but these advancements require technologically savvy and highly skilled labor. Meanwhile, it is getting harder to find skilled labor as we are losing our most skilled and experienced staff to retirements.

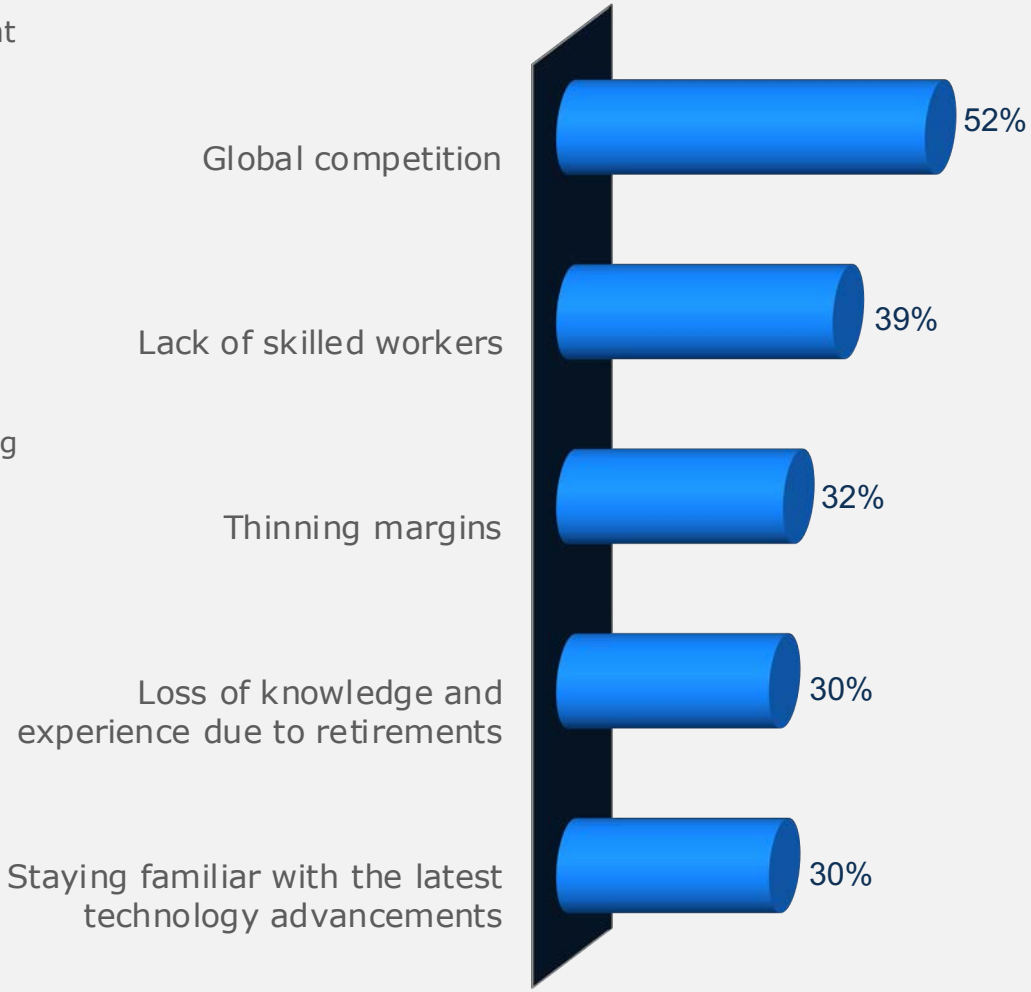
Another challenge is related to part designers. While there are many very skilled and talented engineers, they do not necessarily understand plastic behavior, the injection molding process, or machining. As a result, they often design parts that are either not manufacturable, or they will have so many defects, such as warpage, the final parts won't be usable. Therefore, it is often up to the mold designer to identify the problems. Often mold designers are not brought in until very late in the part design process when it is harder to provide advice to avoid some of these problems. Unfortunately, the high cost associated with correcting issues resulting from poorly designed parts hurts thinning margins even more.

Mold makers have to be exceptionally skilled at catching these problems, but since it is hard to find skilled labor, it's a severe problem. However, technology can help to supplement that missing knowledge. It can also help identify potential issues and make it easier to implement the resulting changes when you find problems

Let's explore what successful companies do to overcome these challenges.

**The high cost associated with correcting issues resulting from poorly designed parts hurts thinning margins.**

**CHALLENGES TO MAINTAIN A SUCCESSFUL BUSINESS**



# Identifying Best Practices

## How Top Performers Were Defined

To determine best practices, Tech-Clarity analyzed the behaviors of Top Performing companies. We defined Top Performers as the top 20% of companies who outperform their competitors in metrics that indicate a successful business:

- Revenue growth over the last 24 months
- Product margin expansion over the previous 24 months
- Product cost reduction

We then focused on what Top Performers do, especially what they do differently, to develop recommendations.

## The Top Performer Advantage

Top Performers do a better job of managing their business. Part of this is because they have processes in place that help them in the following areas:

- Ability to quickly implement design changes
- Ability to meet quality requirements

Survey respondents rated how well their company performs from a 5, meaning "Extremely Well" to a 1 for "Very Poorly." Top Performers rated their processes as working better than "Very Well" well while Others rated theirs as "Room for Improvement." These processes help Top Performers meet their required objectives to improve competitiveness.

To determine best practices, Tech-Clarity analyzed the behaviors of Top Performing companies.

# Strategies to Overcome the Challenges

So how are Top Performing companies overcoming the challenges?

### The Power of Supporting an End-to-End Process

To meet the competitive demands for efficiency, quality, and affordability, Top Performers focus on supporting a more streamlined process. This starts with improving hand-offs between each phase, from bidding to production. For example, when the mold design is complete, it must be handed-off to generate tool paths and then transferred to manufacturing to produce the mold. Better hand-offs support improved collaboration and an end-to-end process.

### A Digital Thread

With mold making, each phase is dependent on work done by the previous phase. By implementing these strategies, each phase gets what they need, when they need it. Support for the end-to-end process means the details developed for the bid are used during design, and design information flows seamlessly to production.

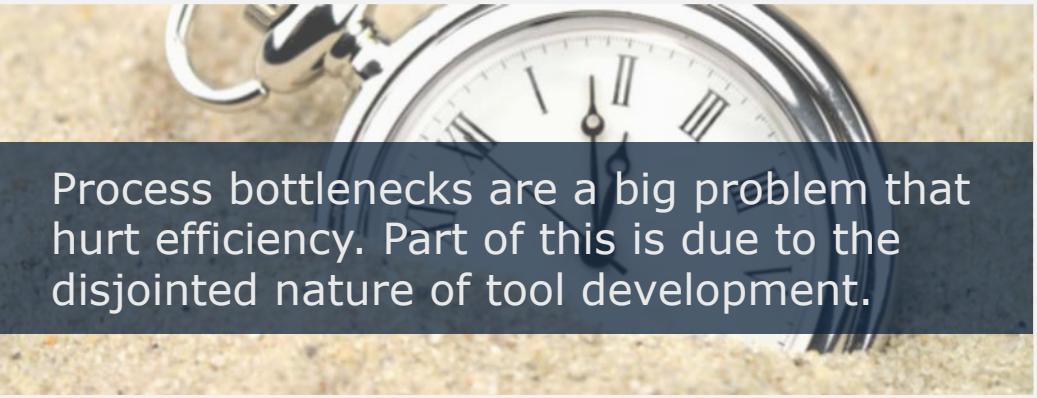
There is a single source of truth, and everyone has access to the latest information. This digital thread supports traceability across the entire lifecycle, so you avoid working with outdated information and duplicating efforts. To generate tool paths, no one should have to recreate any part of the mold design. Since design details do not have to be recreated, you improve efficiency, and the single source of truth means you avoid inadvertently introducing errors that hurt quality. The improved efficiency and reduction in errors also lower costs.

### Better Collaboration

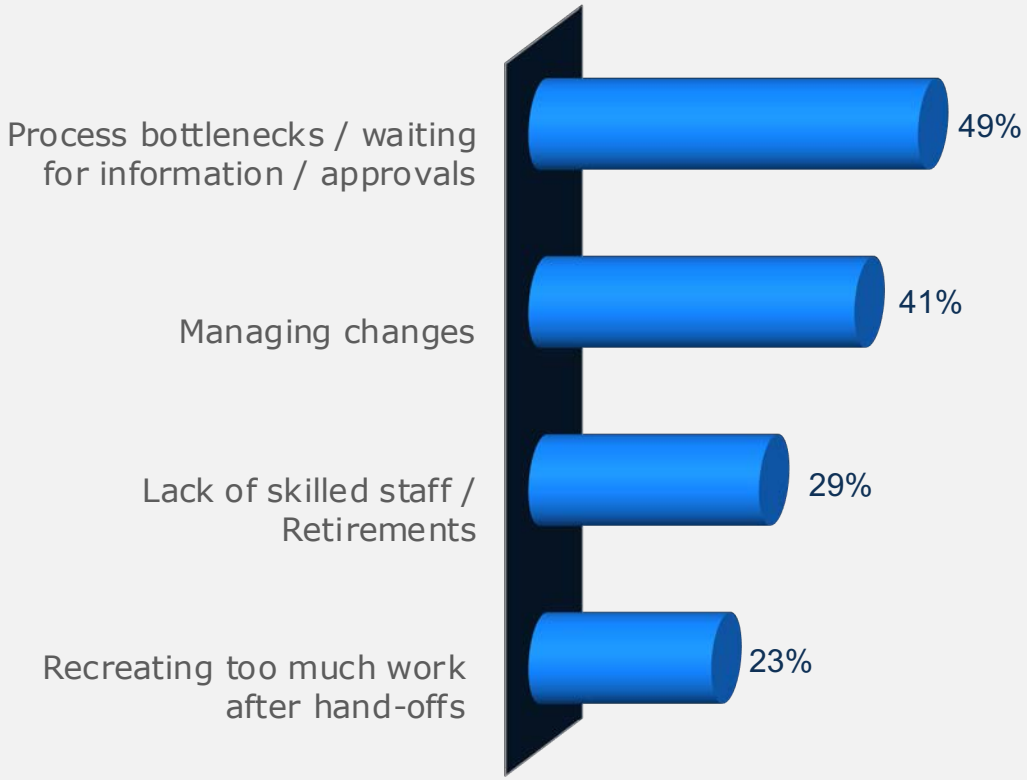
There are many opportunities for better collaboration. In addition to improving hand-offs and efficiency, it also helps address problems. For example, perhaps a late change requires an additional cooling line, but plates were already sent out for gun drilling. With proper collaboration, everyone impacted can be made aware of the change, the drawings updated, manufacturing notified, schedules adjusted, and the cooling line added before the plates come back, so the delivery date is never compromised.

Support for the end-to-end process means the details developed for the bid are used during design, and design information flows seamlessly to production.

# Challenges with the End-to-End Process




**GREATEST CHALLENGE OF END-TO-END PROCESS**




## Considerations to Improve the End-to-End Process

To implement those strategies and improve their end-to-end process, mold makers must address several challenges (see graph).

## Process Bottlenecks and Changes

Process bottlenecks are a big problem that hurt efficiency. Part of this is due to the disjointed nature of tool development from bidding to production. As each phase waits for what they need, delays sending required data, incomplete information, and conflicting details all slow down the process and put delivery dates at risk. On top of that, data incompatibility creates additional bottlenecks. Part designs are often in one CAD format, the mold design may be in another, and CAM may require another translation. Each step requires a painful export/import process. Surfaces that don't translate correctly need to be cleaned up and repaired. With each change, that tedious process must be repeated. Sometimes changes are made in one place and not in others, which leads to errors. Other times it is just too much work to deal with the export/import/repair process, so data is recreated.

## Skilled Staff

The lack of skilled staff hurts mold makers in multiple ways. Staff must be knowledgeable about plastics, injection molding, and machining. Starting at the quoting level, they need to identify any special requirements based on the type of resin and filler used. Mold designers need to know where to place cooling lines to optimize cooling. Thermocouples must be placed in the right location for proper temperature readings, but not in a spot that doesn't have clearance for the drill. During machining, speeds and feeds must be optimized to achieve the desired surface finish. Due to the unique and complex nature of molded parts, it can take years to develop this level of expertise.

# Supporting the End-to-End Process

### Automate Hand-Offs

To overcome the challenges with the end-to-end process, Top Performers are 28% more likely than their peers to use automation to support hand-offs. They automate those hand-offs between each phase of the process by leveraging a single digital model throughout the whole process. This way, they avoid manually recreating work with each step in the process, which wastes time and risks introducing errors.

### The Power of Reuse

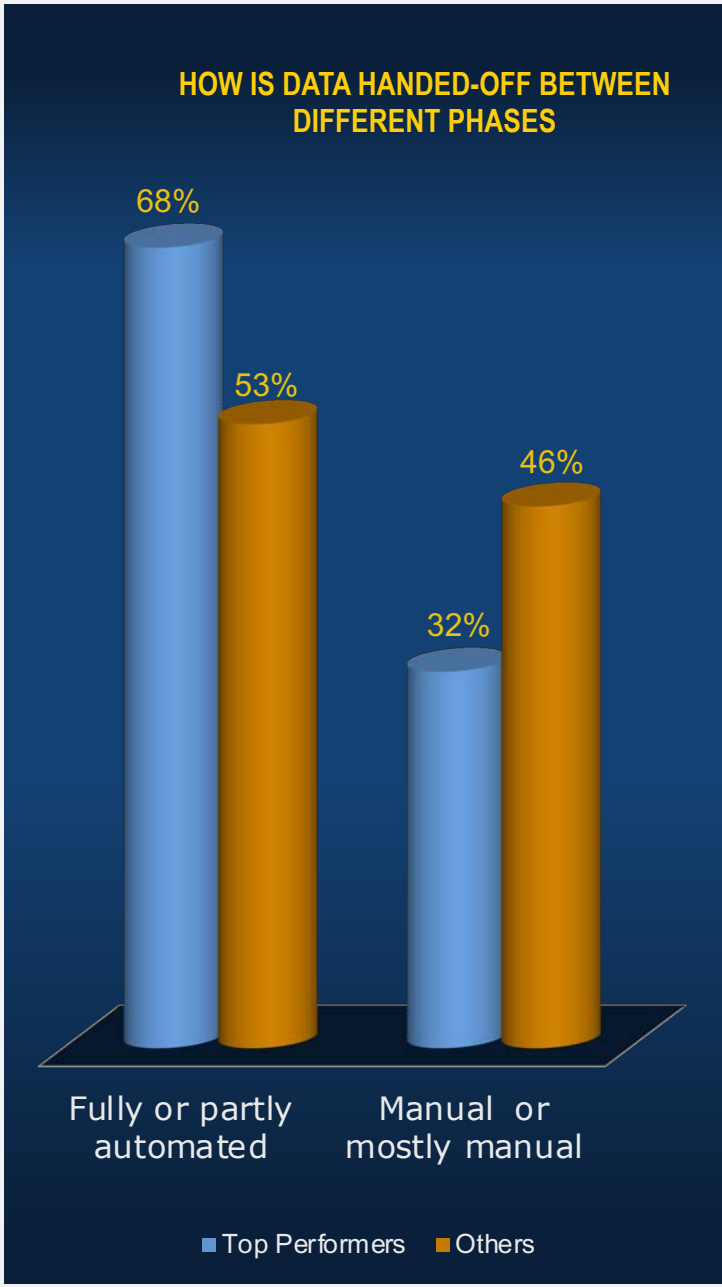
Molds are so complicated; accurate bidding typically requires completing some level of design work. Once the bid is won, this work is automatically handed off to design. The engineering team can then leverage the existing work to start theirs. Not only does reusing the data save time, but it also helps prevent errors, ensuring that was quoted is what is designed. The design can be reused during simulation to identify any potential problems to reduce delays during the mold trials. The design is also reused to develop toolpaths. Again, more time is saved by using the same data throughout the process. Plus, you will be more confident that what was designed will be what is produced.

### Overcoming Challenges

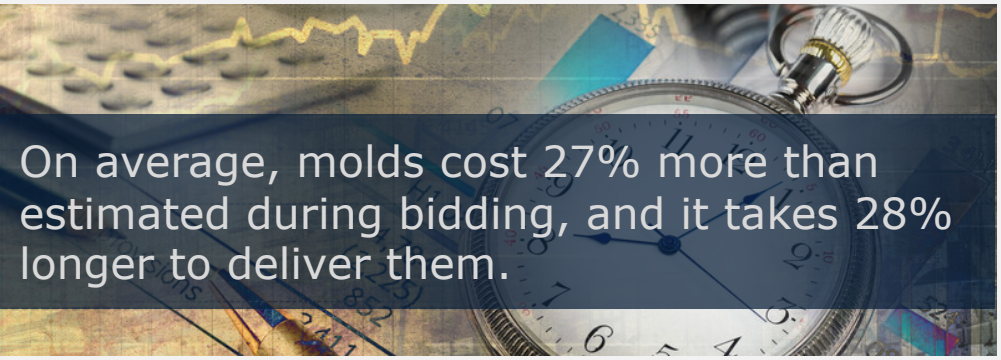
This process avoids the painful export/import process. Even more importantly, the automation means that with each design change, toolpaths automatically update.

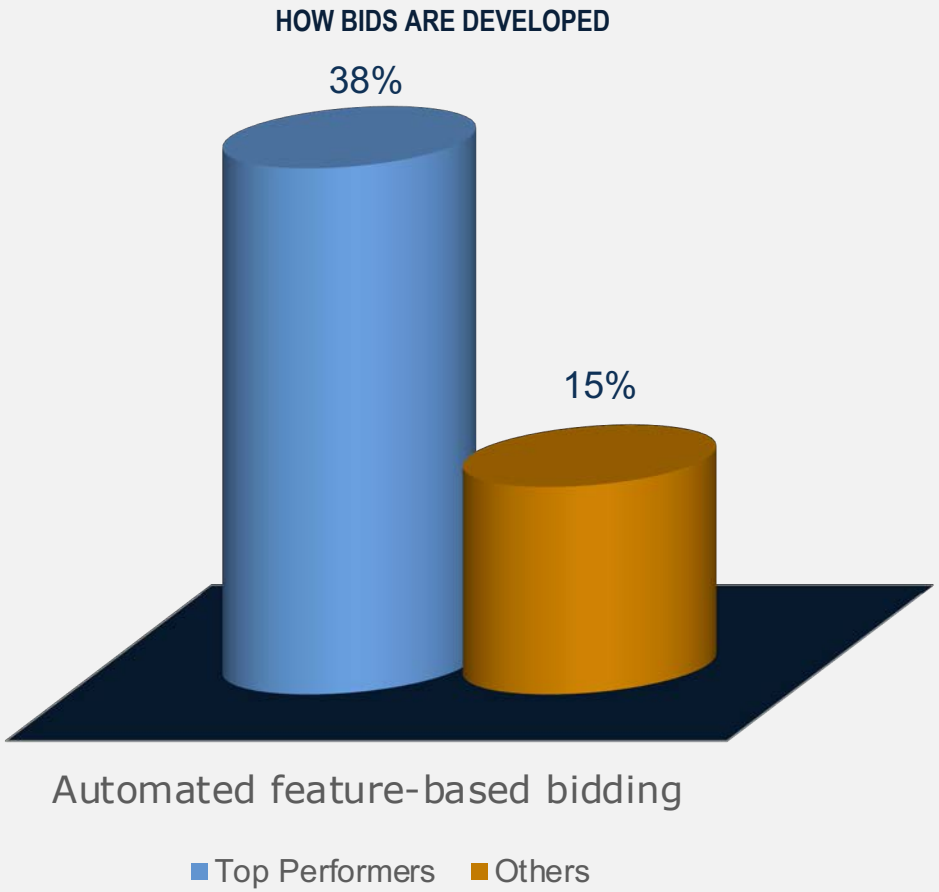
Now will reveal seven recommendations to help you become even more competitive.

Top Performers are 28% more likely than their peers to use automation to support hand-offs.



# 1. Streamline Bidding




## Bidding Obstacles

Survey respondents report that the top two challenges of bidding are that is it is a manual process that takes too long, and significant training is required. You have to know what's going to drive up pricing and how to accurately estimate lead time while keeping the quote competitive, so you win the job. It takes a substantial amount of effort to achieve this. Often preliminary design work must be started to create an accurate quote.

Even still, respondents report that on average, molds cost 27% more than they estimated during bidding, and it takes 28% longer to deliver it than they expected when they bid for the job.

## Best Practices

To overcome these challenges, Top Performers are 2.5 times more likely than their competitors to use automated feature-based bidding. Automated feature-based bidding recognizes part/mold features and automatically assigns a cost to them. For example, the part design may have an undercut which the software would identify and map the proper cost for a slider. This helps to overcome the training issue and makes the process more automated so they can avoid manual steps.

This automated process allows them to create initial CAD models. All that effort is not wasted though. Top Performers are 26% more likely than their peers to develop initial CAD models during bidding that are reusable by engineering. This is the first step in creating the digital thread from the bid to the design. It saves engineering time since they can take advantage of the work already done during the bidding stage. It also improves the hand-off from sales to engineering as everything included in the bid is captured in the model. This way you know what engineering is working on matches what was quoted. There is no worrying sales forgot to check something off on the form or waiting for all the bid paperwork. All the parameters and engineer criteria are embedded in a single model.

# 2. Support Collaboration During Tool Design

### Cost of Poor Communication

As discussed earlier in this eBook, one of the top challenges of tool design is implementing changes. Improving the ability to implement changes can help you avoid quality issues, save time, and keeps costs low. In fact, poor communication can add 26% to the cost of the tool. These costs can come from many places. For example, consider a change that is not adequately communicated and major design work is based on outdated information, or maybe the wrong size steel is ordered, or perhaps the wrong version of a drawing is released to manufacturing. All of this can result in scrap and rework that adds to the mold cost.

### Best Practices

Top Performers are 50% more likely than their peers to support collaboration between design and production. This includes things like ensuring changes get to production, so they are not working with outdated information. Also, given the significant challenges with the lack of skilled workers, improving communication between design and manufacturing can help overcome the knowledge gap. Manufacturing will have a perspective on manufacturability and can help offer advice to avoid later problems. For example, they can catch issues such as unnecessarily tight tolerances that will drive up machining costs, or perhaps there is not enough clearance to drill a deep pocket in the cavity.

### Associativity

Top Performers are also 52% more likely to have associatively between the part and tool design. This will help ensure that changes made to the part, automatically update the tool design. This will be especially helpful when you notice part design flaws that will lead to inferior quality parts. For example, perhaps the injection molding simulation reveals the part will warp as designed, so the mold designer suggests adding a rib. With associativity, the part designer can make the change, and the mold design will update to reflect the changes in the part. If an associative CAM solution, any toolpaths that had been generated will also update. This also allows you to get a head start on some design work as you can begin before the previous phase is complete since changes will automatically update everywhere.

To support associativity, Top Performers are more likely to collaborate with native CAD models. The challenge with that is not everyone will be using the same CAD tool, so a CAD tool that has excellent support for multi-CAD data can be beneficial.

Poor communication can add 26% to the cost of the tool.

# 3. Ensure Quality by Verifying Manufacturability

### Avoiding Part Defects Is Tough

Given how critical quality is to competitiveness, the third tip is ensure quality by verifying manufacturability. Tied with implementing design changes, the top challenge of tool design is avoiding part defects. Defects include things like warpage, weld lines, sink marks, and more. Part defects are so challenging; they can add 42% to the length of the mold trial as the team tries to troubleshoot and correct the issue. The problem for the mold designer is that even though these challenges are typically the result of poor part design, the mold maker is often blamed.

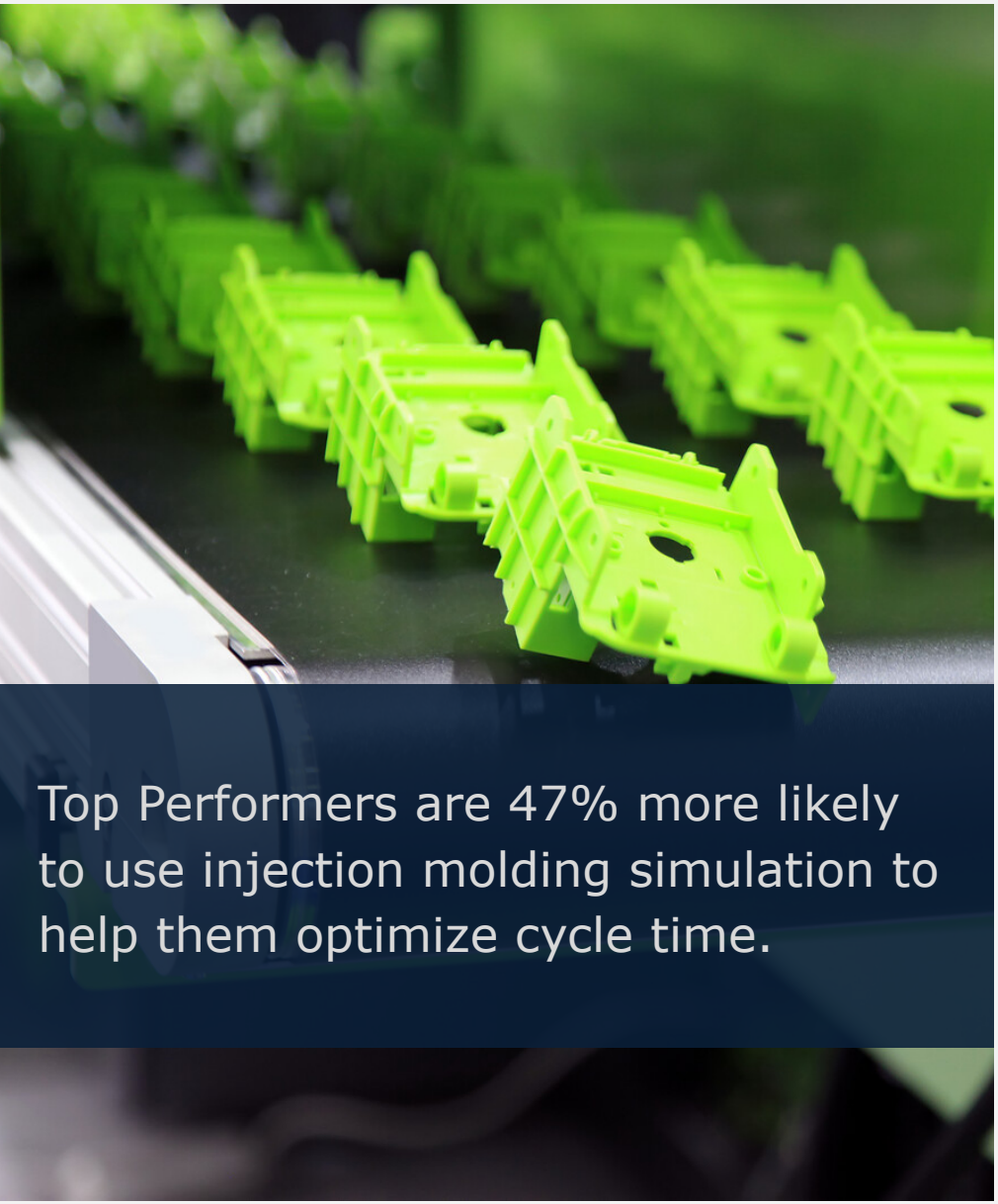
Injection molding is a giant thermodynamics problem with so many variables; it's hard to predict precisely what will happen, even with years of experience. With the lack of experienced talent becoming even harder to find, this becomes an even bigger problem without help.

### Best Practices

To address this, Top Performers are 16% more likely to use software simulation to help them catch problems. By identifying issues during design through the use of simulation, they avoid finding those problems during the mold trial. Consequently, they can prevent the associated delays related to rework or experimenting with different processing parameters.

Part defects are so challenging, they can add 42% to the length of the mold trial.

# 4. Optimize Cycle Time



Top Performers are 47% more likely to use injection molding simulation to help them optimize cycle time.

### Importance of Cycle Time

As revealed in the survey results in the graph on page 4, one of the top things mold makers need to do to stay competitive is reduce cycle time; thus, our fourth tip is optimize cycle time. While all survey respondents viewed cycle time as important, Top Performers are 2.1 times more likely to consider it a highly critical consideration.

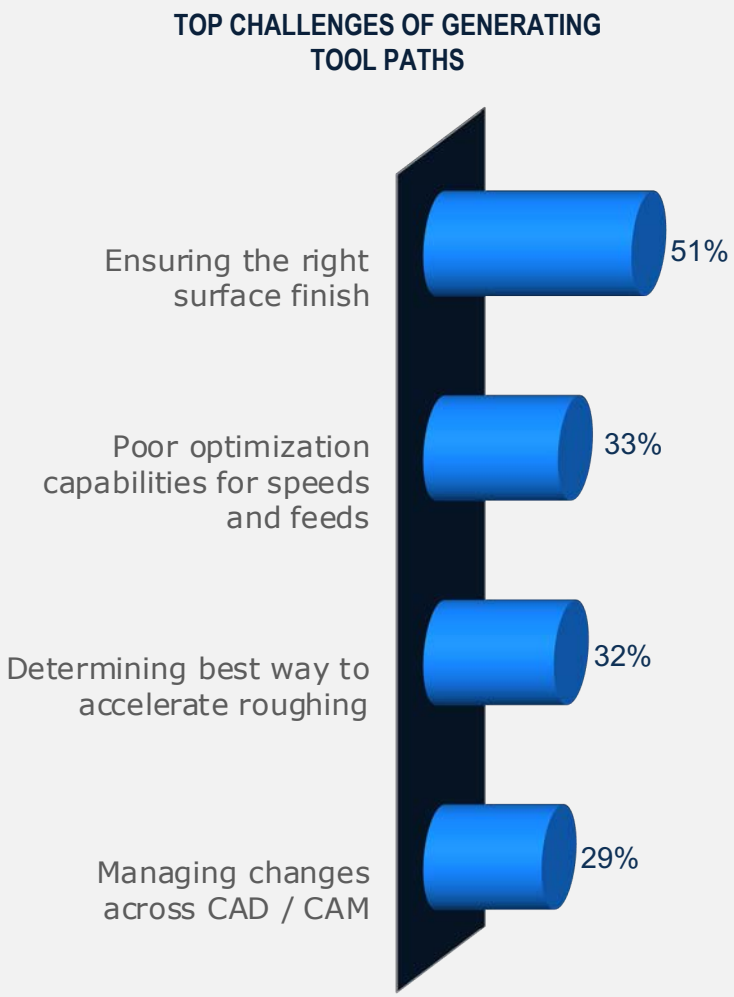
### Best Practices

As with manufacturability, to make better decisions to optimize cycle time, Top Performers rely on simulation. They are 47% more likely to use injection molding simulation to help them optimize cycle time. Many variables can impact cycle time, so making those adjustments in your digital model can save a ton of time during the mold trial. Also, in a digital environment, you can experiment with many more options rather than just adjusting processing parameters or minor rework. Plus, it takes far less time in a digital environment than during a mold trial, and you will not produce any scrap.

# 5. Automate Production Planning

### Production Planning Challenges

Our fifth tip is to automate production planning. The top production challenges can be seen seen in the graph below. These things can all be improved with the right CAM software.




### Automation

In a CAM solution, compared to their industry peers, Top Performers are 34% more likely to value more automation to reduce programming time. This is another way to support changes as it will be easier to update tool paths when they are automated.

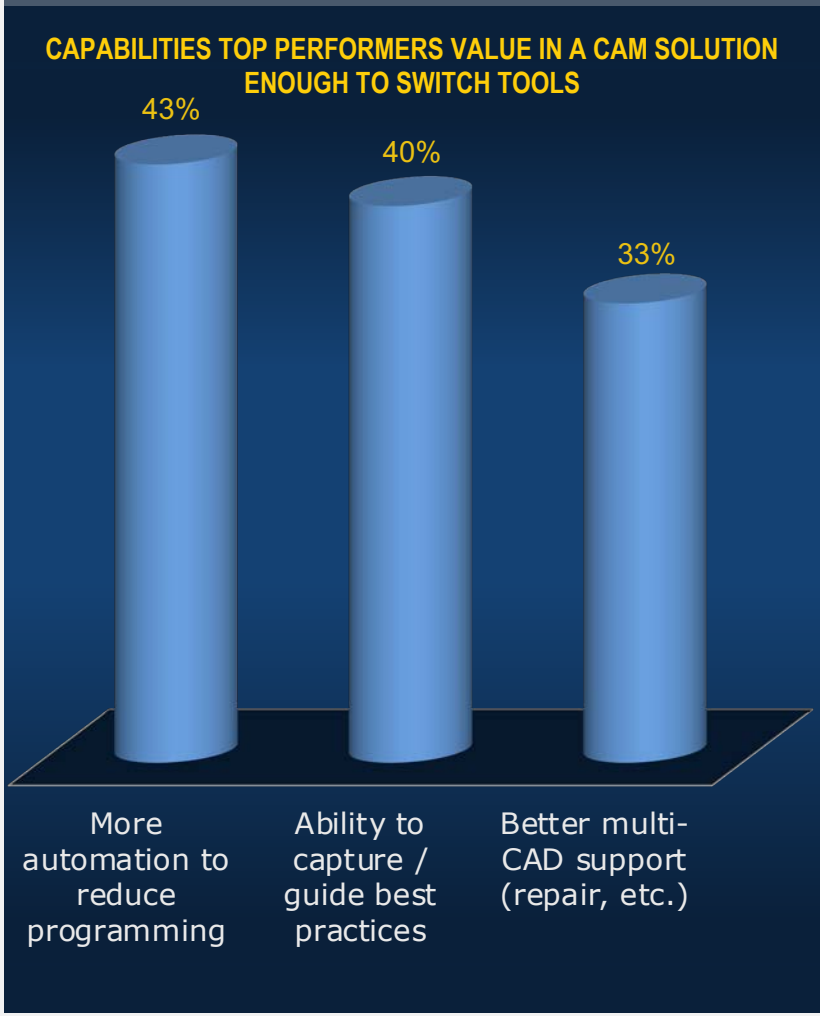
### Best Practices

Overcoming the challenges requires knowledge, experience, and rules of thumb. With the lack of skilled workers, it can be hard to develop this expertise. Company machining guidelines may be documented in a handbook, but it can be inconvenient to look them up. Top Performers are 33% more likely to use a CAM solution that captures best practices and provides guidance.

### Multi-CAD

Top Performers also look for better multi-CAD support. This gives them more flexibility to support a variety of customers and suppliers. It is especially useful when there are changes since it will limit the tedious process of exporting and importing CAD data multiple times or perhaps avoid it altogether.

Top Performers are 34% more likely to value more automation to reduce programming time.



# 6. Support Quality Verification Processes

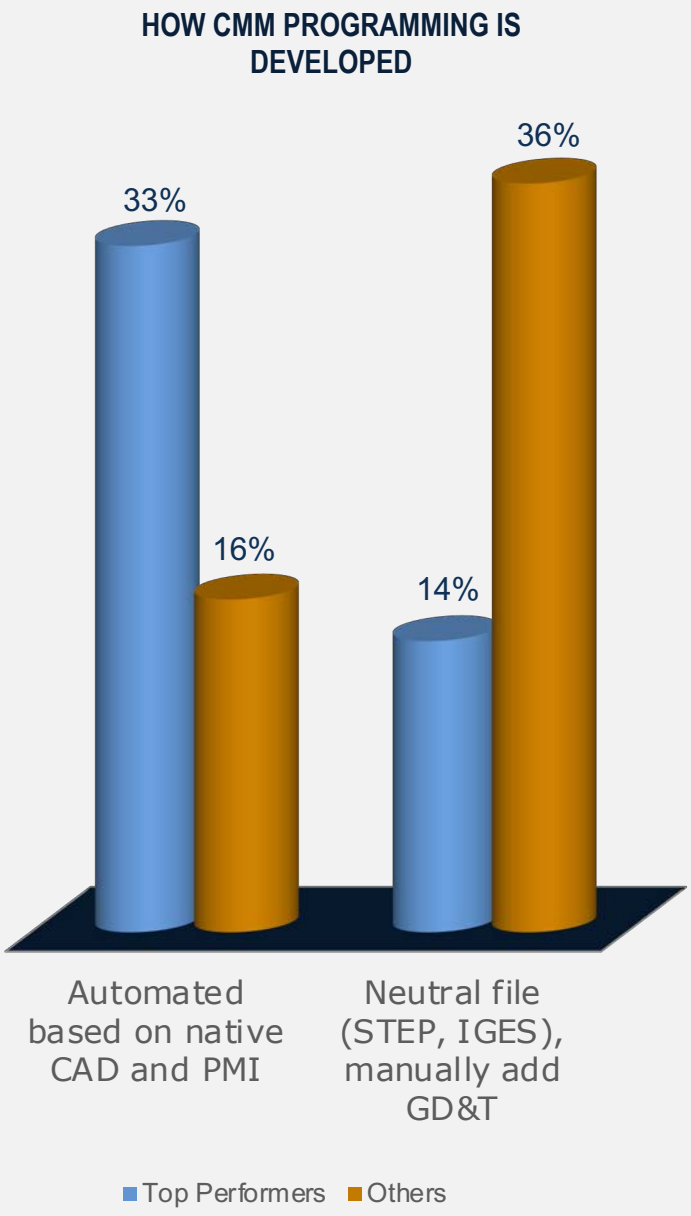
## Save Time While Preparing for Inspection

Continuing with recommendations to support quality, continue to leverage the digital model to support inspections. This will save time and also make sure you are validating the part based on as-designed.

## Use PMI

Top Performers are 2.1 times more likely to automate CMM programming based on the native CAD model and Product Manufacturing Information (PMI). PMI can be embedded during the design stage and can add much value to downstream processes because everyone can refer to the model as the single source of truth. This automates CMM programming, saving time, ensuring accuracy, and avoiding duplicating efforts.

On the other hand, Others are much more likely to import a neutral CAD file such as STEP or IGES and then manually add GD&T information. This is a far more tedious process, replicates work already completed by engineering, and has higher risks for human error.




Top Performers are 2.1 times more likely to automate CMM programing based on the native CAD model and PMI.

# 7. Use an Integrated Solution

## Integration Can Enable the End-to-End Process

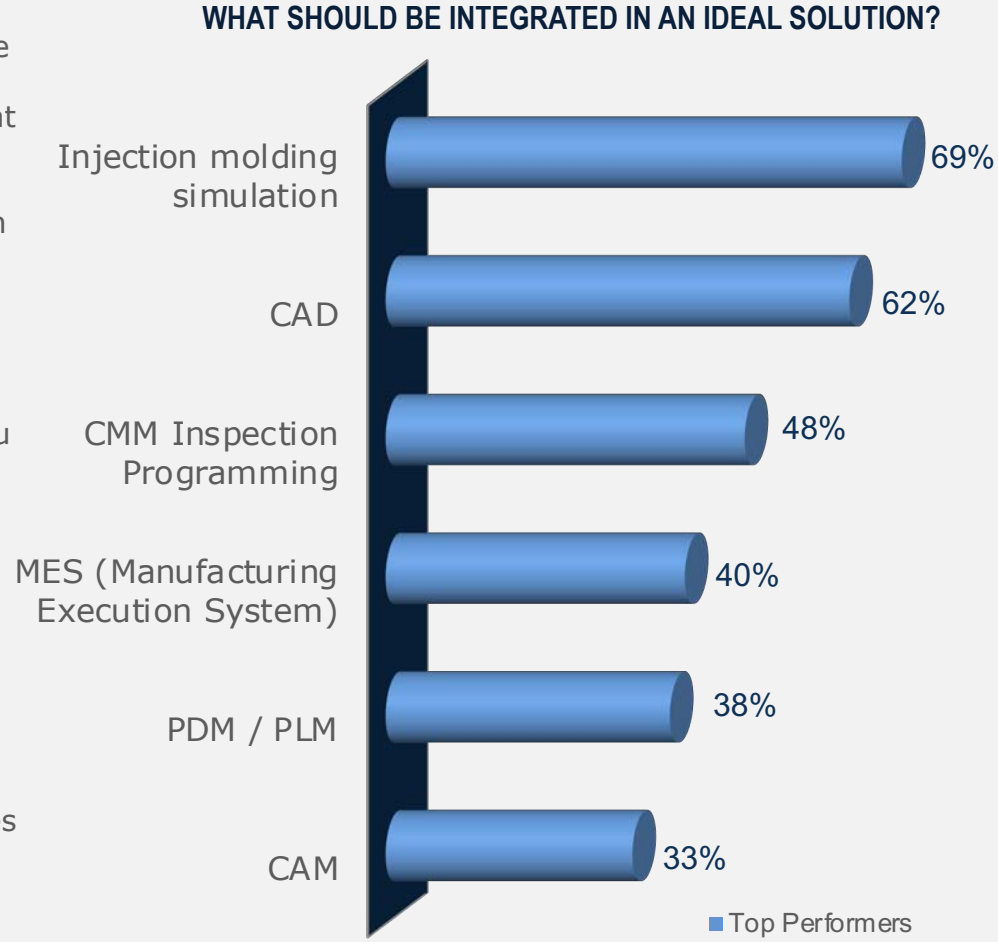
As a final step to support the end-to-end process, use an integrated solution. With an integrated platform, you can create a digital thread across all phases of the process. Since the model doesn't leave the platform, you do not break the thread, so you have traceability across the entire lifecycle. The technology will support changes and automatically update everything on the platform, so you do not have to worry about making manual updates, overlooking something, or forgetting to notify everyone who is impacted.

The graph shows the most common applications that Top Performers recommend should be integrated in an ideal solution.

## The Ideal Solution

Integrating injection molding simulation with CAD makes it easier to assess the design for manufacturability during the design process so you can catch problems sooner. It also makes it easier to iterate different options, so you end up with a more optimal solution. Integrating the CAD model with CMM inspection programming makes it easier to leverage the model during programming, saving time, and improving accuracy. Integrating MES provides a mechanism for more easily sharing data with manufacturing and ensures that manufacturing has access to the latest designs, avoiding working with the wrong version or outdated information. Product Data Management (PDM) centralizes the data. Hence, no one has to waste time hunting for it. It also manages access control, so you manage who can view or edit the data and when. In addition to data management, Product Lifecycle Management (PLM) also manages the workflows and processes to support the phases across the lifecycle. Finally, an integrated CAM solution allows you to work directly with the CAD model and ensures any model changes are automatically reflected in the tool paths.

**With an integrated platform, you can create a digital thread across all phases of the process.**



# Looking to the Future

## Impact of Technology

Beyond the recommendations to improve your processes, it is also valuable to look at future trends to anticipate how they may impact you. There have been several technological advances that will impact injection molding. Top Performers are often on the cutting edge of technology adoption, so it can be instructive to understand what they are doing.

## 3D Printing and Conformal Cooling

While injection molding simulation is the top way Top Performers currently optimize cycle time, some new methods are starting to emerge. Thirty-six percent of Top Performers are using inserts with conformal cooling channels. Currently, 37% of Top Performers use 3D printing to produce inserts, and another 33% plan to implement it. Of those 33% planning to adopt it, 55% plan to implement it in less than a year, so expect to see wider adoption soon.

## Automation Systems

Automation should increase. In fact, 47% of Top Performers say they will invest in more factory automation and robots over the next five years to improve their competitiveness. This is on top of the 88% of Top Performers who are already using some automation. The most common automation systems in use are:

- Robots for assembly (51%)
- Vision systems (47%)
- Conveyor systems (42%)
- Robots for material handling (40%)

## Cloud

The adoption of cloud solutions will also likely increase. Currently, 53% of Top Performers say they use at least one cloud solution to support mold design or production. On average, 58% of the applications they use are on the cloud. Of Top Performers using the cloud, they find cloud to be most useful in these areas:

- Tool design / CAD (67%)
- Data management (48%)
- Tool path simulation (37%)
- Injection molding simulation (37%)

Expect to see these emerging technologies to play a bigger role in mold design and production over the next few years.

36% of Top Performers are using inserts with conformal cooling channels.

# Conclusions and Recommendations

Top Performing mold makers support an end-to-end process with better collaboration and improved hand-offs between the different phases of the group.

## The Opportunity for Mold Makers

Mold makers need to keep customers happy to stay competitive. They need to ensure the quality of the mold, the parts it produces, manage costs, and meet delivery dates. Unfortunately, several challenges make meeting their objectives difficult. Global competition is fierce, skilled workers are hard to find, and margins continue to thin. To overcome this, Top Performing mold makers support an end-to-end process with better collaboration and improved hand-offs between the different phases of the group.

When looking at the end-to-end process, most mold makers struggle with process bottlenecks and managing changes. By creating a digital thread across the entire process, there is traceability across the complete lifecycle. Design details can be reused from one phase to the next, saving time by avoiding duplication of efforts, improving quality by reducing risks for introducing human error, and saving costs by catching problems sooner.

## Recommendations and Next Steps

Based on this research and our experience, we recommend that Automotive companies:

- Streamline bidding
- Support collaboration during tool design
- Ensure quality by verifying manufacturability
- Optimize cycle time
- Automate production planning
- Support quality verification processes
- An integrated platform can help

# About the Research

## Data Gathering

Tech-Clarity gathered and analyzed responses to a web-based survey from over 370 mold makers. Survey responses were collected by direct e-mail, social media, and online postings by Tech-Clarity.

## Industries

The respondents represent a broad cross-section of industries. 37% were from Automotive, 26% Industrial Equipment, 25% High-Tech, 24% Consumer Products, 17% Aerospace & Defense, 15% Life Sciences, and others.*

## Company Size

The respondents represent a mix of company sizes, including 20% from Less than $10 million, 20% between $10 million and less than $50 million, 12% $50 million to $100 million, and 22% greater than $100 million. 26% did not disclose their company size. Company sizes were reported in US dollar equivalent.

## Geographies

Responding companies report doing business in Asia (47%), North America (42%), Western Europe (39%), Eastern Europe (20%), Latin America (11%), Australia (10%), Middle East (9%), and Africa (5%).*

## Title

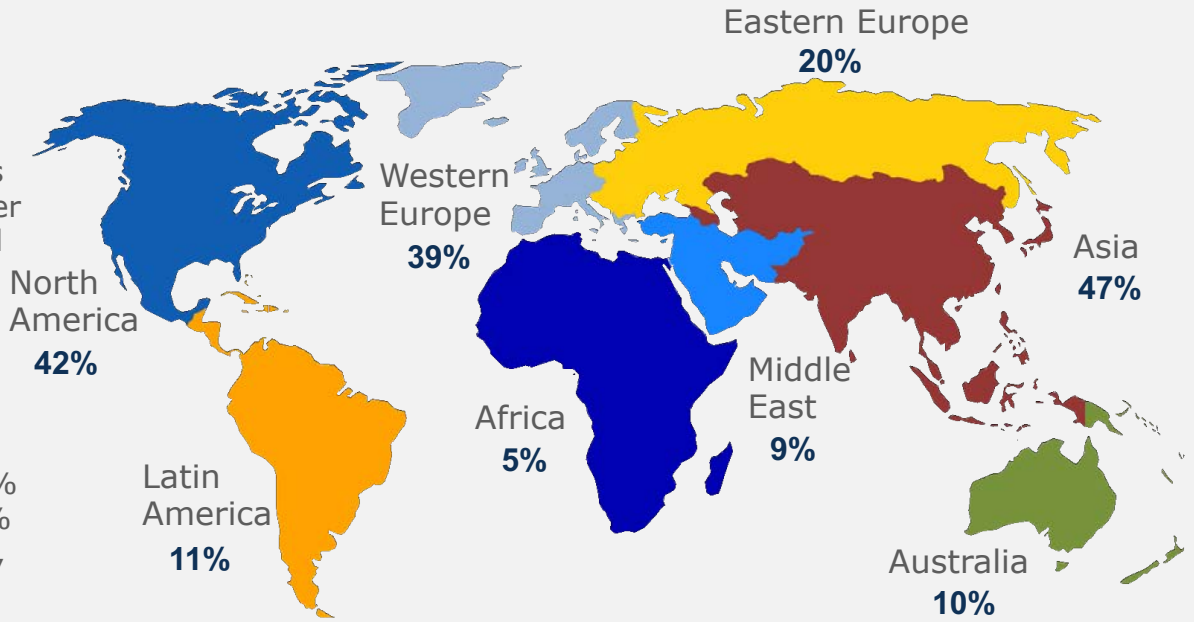
The respondents were comprised of 7% Executive, 11% Directors or VP Level, 34% Manager level, and 48% individual contributors.

## Organizational Function

Of the respondents, 20% were Tool Designers, 19% in Engineering roles, 16% Manufacturing Engineers, 13% Product / Project / Program Management, 9% General Administration, 5% Quality, and the remainder were from a variety of other roles including Machine Operator, NC Programmer, Electrode Designer, Other Manufacturing, and more.

* Note that the values may total greater than 100% because companies reported doing business in multiple industries and geographies.

The respondents represented a mix of industries, company sizes, and geographies.



# Acknowledgments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## About the Author

Michelle Boucher is the Vice President of Research for Engineering Software for research firm Tech-Clarity, an independent research and consulting firm that specializes in analyzing the business value of software technology and services. Michelle has spent over 20 years in various roles in engineering, marketing, management, and as an analyst.

Michelle graduated magna cum laude with an MBA from Babson College and earned a BS in Mechanical Engineering, with distinction, from Worcester Polytechnic Institute. She is an experienced researcher and author, having benchmarked over 7000 product development professionals and published over 90 reports on product development best practices.

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