# LOW-TECH TOOLS SPEED PLASTIC PARTS

In having a mold built and getting initial parts quickly, engineers often ignore some powerful management aids. One is to select the suppliers first.

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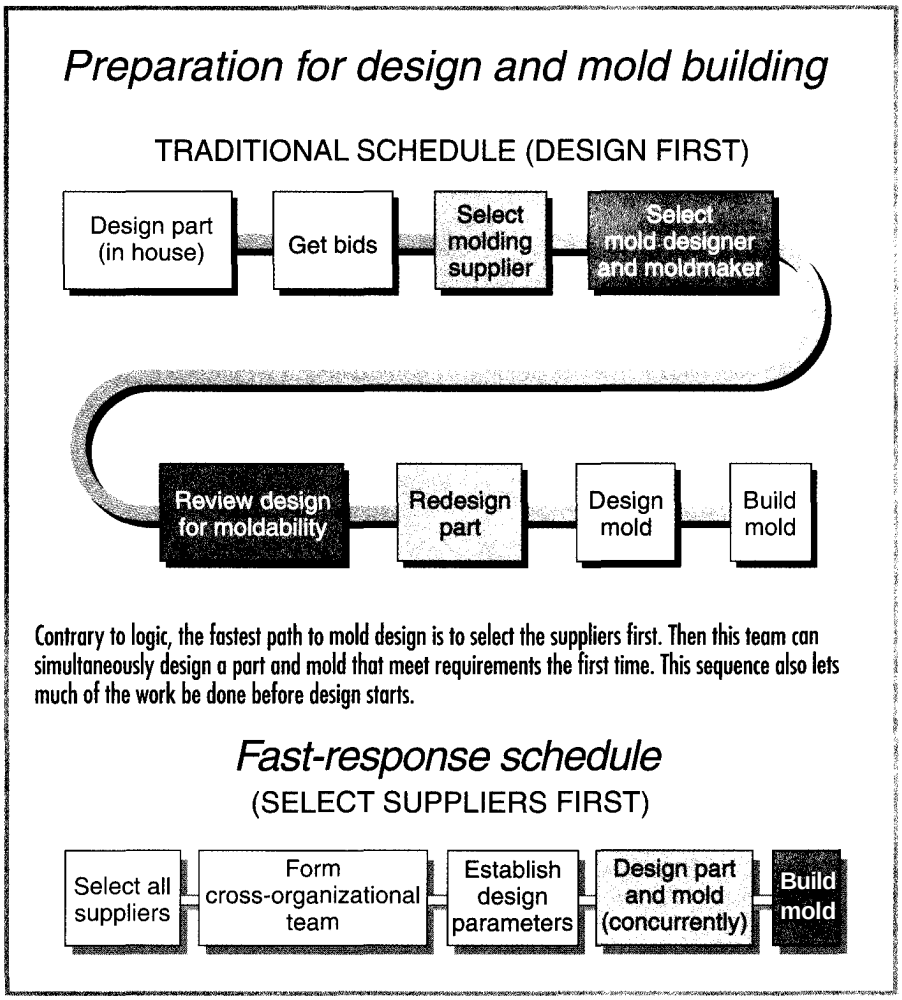



Delays in getting injection-molded plastic parts are a major reason why products don't get to market quickly enough. Not too many years ago, suppliers routinely quoted 26 weeks to design a mold, build it, and shoot the first parts. If the part design changed or the first shots were unacceptable, the process took even longer.

Such schedules are seldom acceptble today, and design engineers now use such computerized tools as solid modeling, computer-aided design (CAD), electronic data interchange (EDI), and rapid prototyping (for example, stereolithography) to dramatically reduce time and risk. Amazingly, however, they frequently overlook an equally powerful set of fast-cycle tools that do not depend on computers. These low-tech tools can be used independently of, or ideally in conjunction with, high-tech advances.

Injection molds take so long to build because usually several organizations hand off the work serially, not because it takes an enormous amount of time to cut steel. First, the product-development unit is involved. Then comes mold design which, even if done within the company, is usually performed by a separate department. Next comes the moldmaker, followed by texturing in still another organization. Finally, the molding house shoots the initial parts.

Although high-tech solutions can shorten certain segments of this sequence radically, there are also great opportunities to cut cycle time simply by overlapping segments and applying basic management tools. Following are eight keys to managing an interorganizational project to turn out new plastic parts rapidly.

## SELECT YOUR SUPPLIER FIRST

Most design engineers start with the logical first step designing the part. This is really a misstep because it sets in motion the sluggish traditional sequence of making injection-molded plastic parts. Purchasing begins this sequence by using the part design, usually captured in detail drawings, to negotiate with plastics molders. Once it has selected a molder, the latter lines up mold designers and builders. After

this considerable delay, the suppliers look seriously at the part design, and usually suggest design changes to reduce cost and improve moldability. When they have redesigned the part—and renegotiated the contract—mold design can finally start.

Contrary to logic, the fastest way to mold design is not to start with part design but rather to initially select the suppliers, including the molder, mold designer, and moldmaker. Then this team, after agreeing on the basic factors influencing the design, can simultaneously design a part and mold that meet requirements the first time. With close teamwork, mold building can be done largely concurrently, too.

Beyond the time saved by avoiding redesign and working concurrently, the supplier-first sequence is much faster because much of the work can be done before design starts. This is an example of keeping the work—in this case, the supplier authorization work—off the critical path by getting it done early.

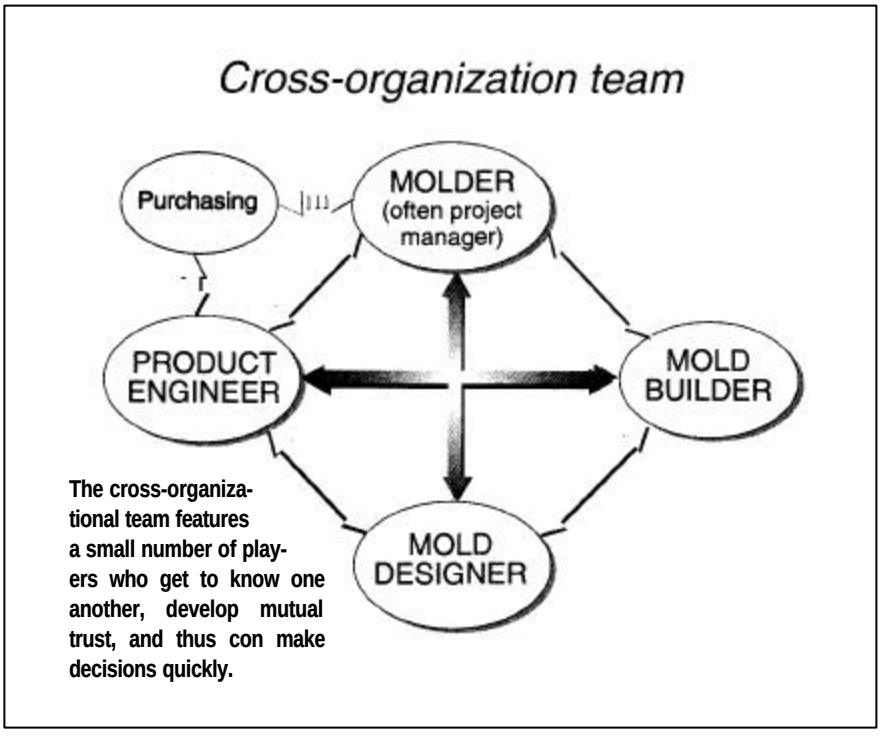
You may have two questions about this "idealistic" approach: One, do companies with the usual purchasing controls really use this sequence? Yes, some prefer to operate in this more efficient and much faster way. Two, do many companies use this approach? No, actually few are doing it today be cause either the engineers believe part design should come first, or purchasing takes false comfort in establishing a contract and price early, even though it winds up renegotiating without much leverage later, when the part must be redesigned to satisfy requirements.

In the design-first sequence, the initial contract estimate is really only a wild guess, because the final cost depends on many factors beyond what is defined on the part drawings. Many of these are trade-offs that require information from the other partners to obtain a viable, balanced solution. Such questions include:

- Should there be a prototype mold?
- What are realistic production levels?
- What class production mold is required?
- How many cavities are needed?
- Should space be left for additional cavities?
- Which uncertain portions of the part should be left with extra metal (or be metal-safe)?
- Where should gating be positioned?
- Where is venting needed?
- Will certain areas need extra cooling?
- Is mold-flow analysis needed?
- What molding machines will be used, and what are their bolt hole or clamping geometries?
- Where should cooling lines and connectors be located to be accessible on the mounted mold?

The change in sequence also revises the criteria for selecting a supplier. Traditionally this is based on price and delivery date. However, until all the parties agree on just what the job is, time and price estimates are fiction. Thus, a new set of supplier selection criteria is needed, including:

- How well do you trust you partners? What is their reputation? How much have all of you worked together before?
- What is their experience with the type of part involved?
- How well can you communicate with them (distance and cultural differences make this harder)?
- Will they make time to talk with you?
- Do you all use the same CAD system?




**The cross-organizational team features a small number of players who get to know one another, develop mutual trust, and thus con make decisions quickly.**

## BUILD A CROSS-ORGANIZATION TEAM

All too often, even within an organization, a team is just a way to assign more tasks to individuals or to justify having more meetings. Our definition of a team is much more demanding and effective: A team is a group with a common goal and a working approach for reaching that goal; all members contribute (between meetings) to achieve the goal, and the output is a shared product. For example, plastic part design isn't the individual responsibility of the product engineer, but the joint output of the entire team, because all have contributed to it in essential ways and share responsibility for its success. Should the first shots reveal a design flaw, finger-pointing becomes meaningless.

Many companies strive to put such teams in place to carry out product development cross-functionally within their organizations, but few have applied the same principles to knitting together effective teams with customers and suppliers. Companies should go far beyond normal North American industrial practice, in which there is occasional communication between the product-development firm and the molding house, the tool design, or moldmaking shop. Instead, use a small group of actual players who get to know one another, develop mutual trust, and thus can make decisions quickly. Although this type of relationship can occur over a long

distance, proximity to other participants is a great asset; think about this when selecting suppliers.

The cross-organization team must establish alternate means for conducting business. This includes methods for recording, approving, and transmitting part and mold-design changes, a system for billing labor charges equitably, and a common understanding of who needs to know about various types of changes. Often, modern technology facilitates these systems, and sometimes it can obstruct progress. For example, electronically transmitting design changes generally saves time. But in critical cases the rationale is more important than the change itself, so it is actually faster to take the time for a conversation than to just pass the file.

## ESTABLISH LINES OF COMMUNICATION

Excellent communication is the key to keeping projects moving ahead, and perhaps the most important job of the project manager is to make sure the lines of communication remain open.

The product engineer and mold designer should be in close contact on design trade-off issues, as should the mold designer and moldmaker on design-build issues. Even more important, the product engineer and mold-maker should be in direct contact with each other, because the moldmaker will have unanticipated questions as he or she gets into the work. If the engineer isn't available to resolve these questions quickly, this job gets shunted to the side, and valuable time is wasted. The engineer can help build lines of communication by encouraging the moldmaker to call whenever a question arises, by showing interest in and respect for the skill that goes into mold making, and by giving positive feedback at the end of the project.

## BUILD A SCHEDULE THAT INTEGRATES THE TASKS OF ALL PARTNERS

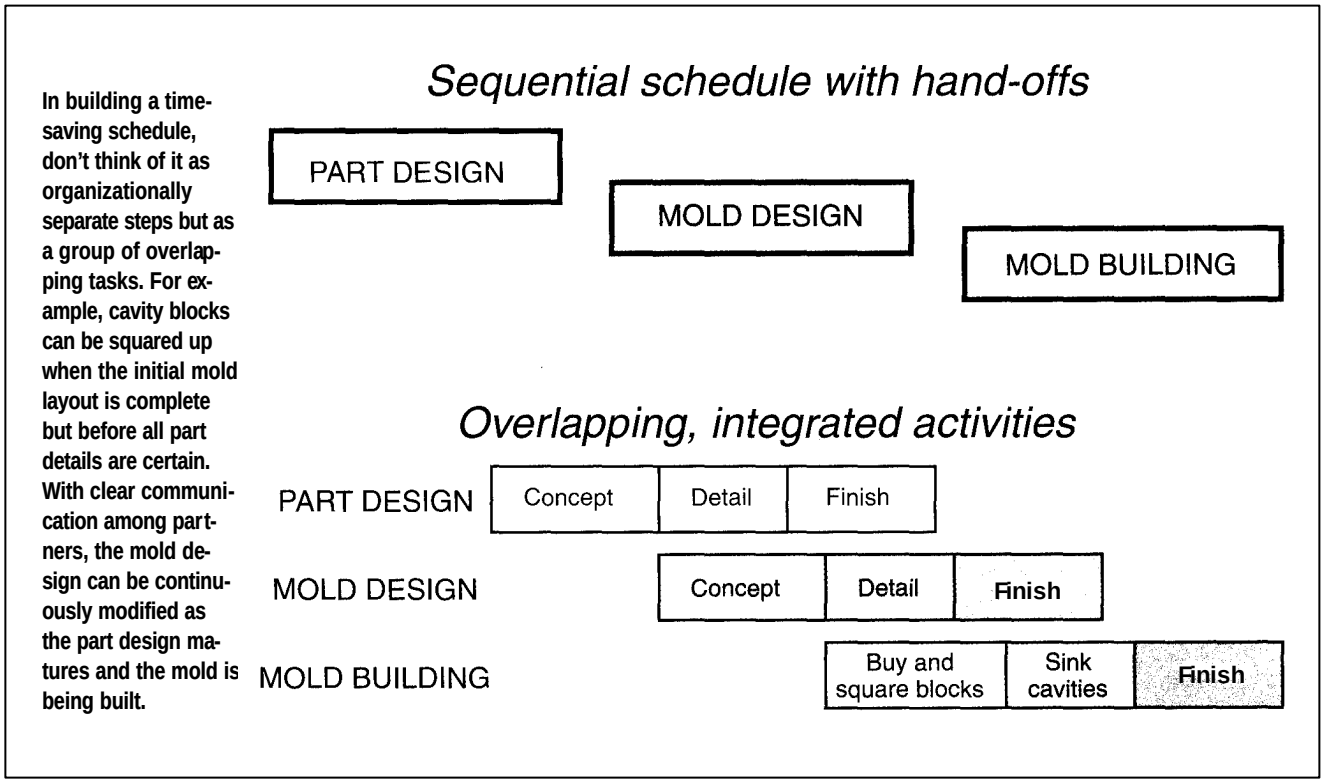
It is far too slow to allow each partner to determine its own schedule, assuming that each organization obtains all the information it needs at the beginning of its task and hands off a completed job at the end. Real time savings come from working together to build a heavily overlapped schedule that allows each partner access to bits of input information as needed. This requires a completely different scheduling approach. Instead of asking, "When will your piece be done so I can start mine?," we must ask proactive questions:

- What is the least information I need to get started?
- Can I use an approach that reduces the necessary information?
- Can I make some assumptions that are accurate enough to begin work?
- What are the consequences of being wrong?

Clearly, you will need the whole team to construct an overlapped schedule; do this early so all players will start off operating at maximum speed.

The trick is not to think of the schedule in terms of organizationally separate steps, but as a group of overlapping tasks. For example, cavity blocks can be squared up when the initial mold layout is complete but before all part details are certain. If the part engineer, mold designer, and mold builder are communicating effectively, mold building can start well before detailed design is complete. In this fast-moving process, mold design becomes a living document that is modified and changed as the part design matures and the mold is being built.

Once you have your schedule, establish measurable milestones. These should occur regularly to allow tracking at uniform intervals. A product-development manager can become anxious waiting for progress on a moldmaking schedule that




**In building a time-saving schedule, don't think of it as organizationally separate steps but as a group of overlapping tasks. For example, cavity blocks can be squared up when the initial mold layout is complete but before all part details are certain. With clear communication among partners, the mold design can be continuously modified as the part design matures and the mold is being built.**

## HOW FAST-RESPONSE TEAMS DIFFER FROM TYPICAL SUPPLIER 'TEAMS'

| Normal 'team' | Fast-response team |
|---|---|
| Only the design engineer can initiate design changes. | Any member who sees the need can initiate a change. |
| Communication flows through a point of contact, such as a buyer or manager in each organization. | There is worker-to-worker contact—for example, between the part engineer and moldmaker. |
| Only the point-of-contact's phone number is known outside the organization. | Every member has all other's numbers, including home, fax, and pager. |
| Decisions are made by the customer and transmitted to suppliers. | Decisions are made jointly by the affected members and transmitted to others to keep them informed. |

has a "black hole" of several weeks in it. Above all, make sure all partners "buy in" to the schedule.

### LINE UP RESOURCES EARLY

Much of the time lost in these projects is spent waiting for critical resources to become available in other organizations. This is why it's important to line up suppliers willing to work as a team and commit resources.

Our solution is to identify and preschedule these resources. Your aggressiveness will determine how far you're willing to go with this option. For example, some companies find that moldmaker availability is critical to the schedule, so they preschedule the moldmaker, agreeing to start paying for this individual on a certain date, even if the design isn't ready.

Clearly, using such options is unwise unless you are comfortable with your schedule and have communicated your plans well. Too often it is easier for the project engineer to throw money at the project than to set up effective coordination with all the partners. These prescheduling options are not an alternative to building an effective team, because without teamwork, guaranteed payments are unlikely to yield the expected result.

Routinely arrange to schedule some mold-designer time in the planning stage to work out mold-architecture issues that will influence the rest of the project. For example, do you want to design the mold in separable modules to permit dividing the work among several moldmakers and compress this activity? Some quality time spent by the mold designer thinking through such alternatives before the parts are even designed saves time later. Also, be sure to preschedule production time for test shots.

### IDENTIFY AND MANAGE THE CRITICAL DETAILS

Few product-design changes come as complete surprises to the perceptive product engineer. Certain areas of the part, such as interface surfaces and assembly snaps, are more likely to change as the design is fine-tuned for manufacturability. In addition, there may be specific features—such as particular radii, surface textures, or cosmetic details—under discussion between engineering and marketing. A shrewd engineer examines these areas, talks about them, and manages them.

The mold designer is often able to allow for easy changes by employing inserts in the mold, leaving extra space for modifications and the like. A moldmaker aware of the soft spots in the design can leave extra metal (be metal-safe), put off machining certain portions of the mold until later, or know to call the product engineer before taking certain steps.

For example, a product engineer at Sentrol Inc., a Tualatin, Ore., manufacturer of building security electronics, anticipated that a plastic housing part would need major changes when the product was upgraded with a new printed-circuit board. He discussed this issue with the cross-organization team, which suggested preparing for this change by ordering spare core and cavity inserts machined to fit the mold frame but without the feature details sunk into them yet.

Often the product engineer assumes that some design decisions, which seem like tweaks, can be left until later. These may include selecting the specific resin, surface textures, or draft angles. Unfortunately, many of these "later" design choices are fundamental mold-design parameters that can create delays if changed later. For example, surface texture can affect draft-angle requirements, upsetting the whole design. Again, make sure these unresolved issues are known to all partners, so all are aware of the degree of uncertainty and the ramifications if they change.

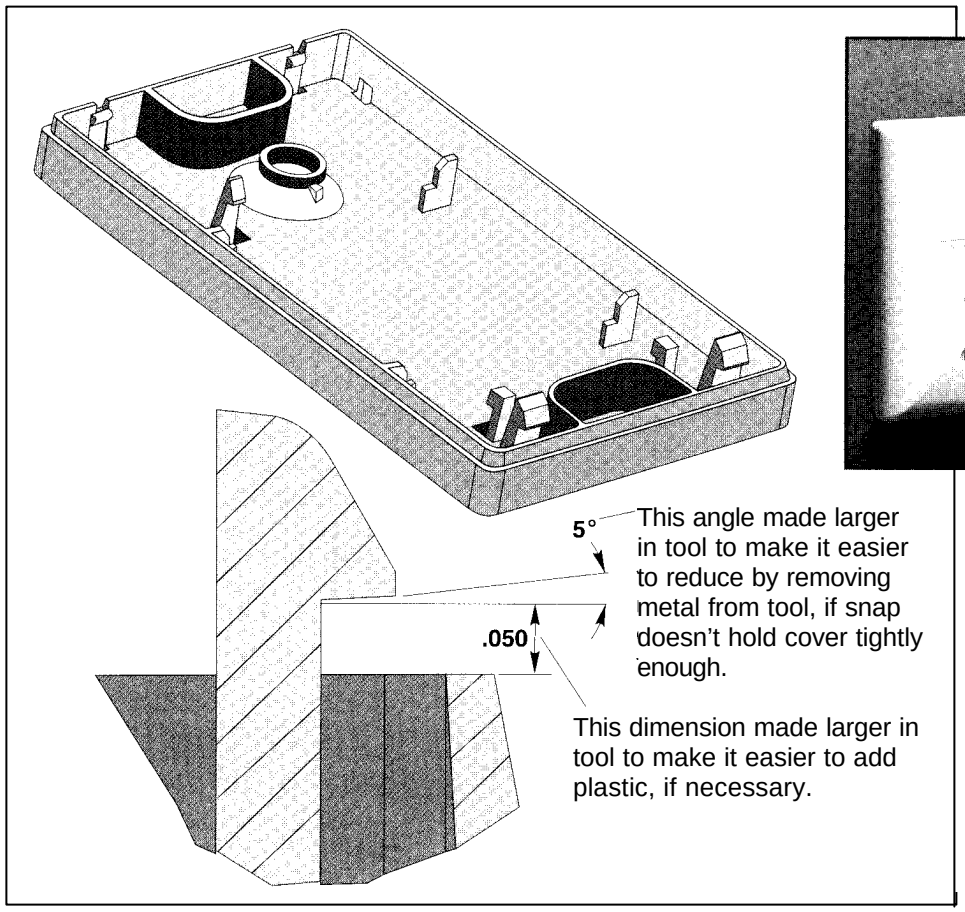
### USE ENGINEERING INSIGHT TO CUT TIME

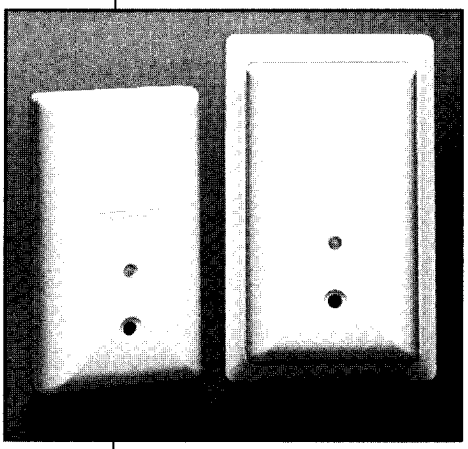
As the product engineer, there are several technical areas where you can take the lead. One is to keep the mold designer focused on a mold that can be fabricated quickly. For example, the mold might be made in pieces that can be worked on independently, so the mold-building house can put several moldmakers on the job or send portions out. At the same time, listen carefully to the mold designer's needs and be willing to adjust your part design quickly to meet them. Anticipate the need for outside resources, such as wire-EDM cutting, mold polishing, and mold texturing. A forgotten step can delay the project.

Since it is easier—and faster—to remove metal than to add it to a mold, think of creeping up to the proper dimension in uncertain areas by leaving extra metal. Better yet, resolve these uncertainties off of the critical path through modeling, testing, or analysis of the uncertain items.

Be sure your designs incorporate adequate draft angles from the beginning, because making room for draft later in a tight design can take considerable time.

Resolve as many problems early as possible by making liberal use of rapid prototyping. Mock-ups can be especially valuable in getting management



**Sentrol's glassbreak sensor comes with and without an optional trim ring. The base half of the case is illustrated, and the detail view shows one of the two snaps in the near corners of the base that secure the case's cover. The snaps had to be "tuned" so the cover is neither too easy nor difficult to remove.**

and marketing feedback early. Marketing often judges enclosures and similar parts on looks and feel, and it is much less disruptive to the schedule to get these concerns resolved while there is time to deal with them. Once you have concurrence on the prototype, be careful about blemishes, such as sink marks and parting lines, that do not show on the prototype.

## USE FAST-TRACK FINANCIAL PROCEDURES

To get a quick start while minimizing financial risk, consider funding the work in stages rather than as a massive requisition that requires full drawings, estimates, and so forth. Such staged funding allows for midcourse technical and financial corrections.

Designs seldom get simpler as they mature, so set up a means of quickly handling the almost certain cost increases that come with understanding the design's implications better. For example, you can make mold changes much faster if you provide an open purchase order just for them. This saves time in processing paperwork and getting approvals just when you are likely to be in a crisis anyway.

If you select a supplier and agree on key design factors first, such late changes will diminish. However, if you manage the project so that no late changes occur, this is a sure sign you are not managing aggressively enough. The sagacious engineer works to keep changes and mistakes from affecting the schedule by planning for them in advance.

Underlying these procedural opportunities is the theme that time is money, but saving money at the expense of time may be unwise. To avoid either underspending or overspending to "buy" time in making such trade-off decisions, you should calculate what one week's delay means in dollar terms. Then encourage each member of the team to constantly look for cost-effective ways to "buy" time. Possibilities include: building extra core and cavity inserts to accommodate change quickly, making additional prototypes of the part to check out and communicate part features and resolve uncertain issues, and budgeting for frequent travel to visit partners.

Finally, although many of the approaches advocated here are not widely followed in industry today, we have seen these techniques work to greatly speed up the plastic-parts cycle. The results from using all of these tools can be dramatic, but you do not have to apply the whole package at once. Start with a few steps in the right direction. The central breakthrough is finding suppliers willing to take this journey with you. ■