# Six Steps To Smoother Product Design

A close study of how engineers and managers turn ideas into finished products reveals new rules that speed the process of writing specifications, forming project teams, and testing prototypes.

Vilma Barr
Contributing Editor
New York, N.Y.

The drive to push products out the door faster by shortening development cycles is approaching near-evangelical fervor. As management responds to a more competitive marketplace, the need for engineers to cut months— even years—off the development cycle has become a top priority.

"In the 1980s, the issue was quality. In the 1990s, the issue is going to be time," says Preston G. Smith, a mechanical engineer and head of the consulting firm New Product Dynamics (West Hartford, Conn.). "Quality is no less important, but now companies will have to emphasize both quality and time."

Fine-tuning companies to compress development times while improving product quality is a formidable challenge. As new products incorporate a growing number of diverse technologies, engineers from a multitude of disciplines must work to meld their expertise. In addition to mechanical engineers, the modern project team often includes electrical, optical, and software engineers, as
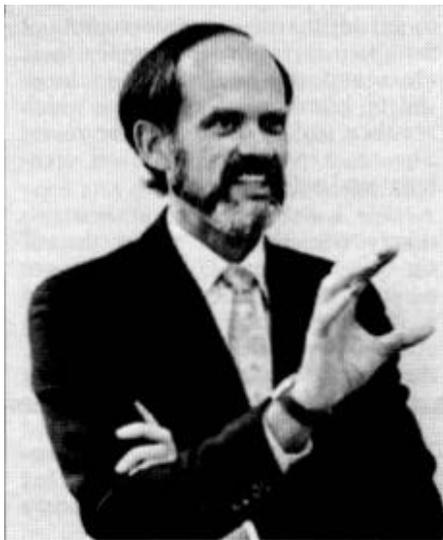
New perspective. Preston G. Smith has developed rules that he believes can cut time to market by eliminating roadblocks in the product development process.

well as specialists in manufacturing, industrial engineering, marketing, and purchasing.

Consultants who specialize in changing the way a firm approaches new product development deal with both the organizational structure and the technical product development process. The information Smith has gathered through stints at Emhart Corp., General Motors, the Institute

for Defense Analyses, and IBM, as well as his consulting firm's efforts, has shed light on many of the roadblocks that prevent products from getting out the door faster.

Indeed, many companies and managers have misconceptions about the actual length of their product development cycle. "People have different perceptions about when a project starts," Smith says. "The front end burns up a lot more time than anybody ever realizes. Did the project start at a trade show when management saw that the competition introduced a new line? Or was it, for example, when the federal government changed its regulations on carbon monoxide emissions and created a whole new market for CO measuring devices?"

Often, cycles stretch out as potential products languish. "It is not unusual that a company will sit on an idea for two, three, or five years before much of anything happens," says Smith. A worst case example is the consumer products company that initiated a project in January 1988 and wanted to bring it to market in two years. According to Smith, "they first thought of the idea in 1973, 15 years before they really did anything. It was not a matter of the technology not being available, it

was just always on the back burner." At the same time, many companies are not aware of the high cost of a lengthy product development cycle. "Although there is a general recognition that delay in product development is harmful to profits, most manufacturers do not know how much even one week's delay costs,"

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Smith says.

Once a project is under way, Smith believes that the application of several rules is crucial to its success. Although group dynamics and situations vary, these measures are basic to slashing product development time and smoothing the development cycle:
• Select a strong project leader.
• Make the writing of the new product specification a team effort.
• Emphasize that a strong team attitude is as important as individual expertise.
• Remember that quality need not be compromised when development time is compressed.
• Recognize that in an accelerated product development program, less testing may not be time efficient. (Cutting the development time in half often results in higher quality and lower overall product cost.)
• Avoid technological leaps.
In Charge. A competent, strong project leader is the most important element in getting a new product to market quickly, according to Smith. "It's difficult to find a good team leader—you basically want a person who walks on water. A team leader has to be pretty selective in the way he or she communicates with management, and must be extremely open with the people on the team to facilitate the kind of communication you want," he says.

The first criterion in filling this key slot is to disregard the name of the department from which he or she comes. Since project teams typically include members drawn from engineering, marketing, manufacturing, and purchasing, representatives of all of these departments should have a shot at the top job, based on ability.

In order to move a project along quickly, the project leader's authority over that project must exceed the authority of the functional heads; otherwise, the structure is design-by-committee, too slow a procedure in today's economy.

But if, somewhere in the middle of a project, the question arises as to who is really running the show, there may be a problem. To determine who is actually in charge, Smith will query team members on who they think is project leader. "If I get different answers and somebody tells me that the vice president is really the leader, because when meetings are held he's the one who makes all the critical decisions, then we may have a problem.

"This means that more time than is necessary will be spent on big meetings with a lot of input. If the vice president is in Europe for a week on other business, then decisions that affect the project team do not get made. Management has to understand that they have to turn these decisions over to someone at a lower level and stick with them, if they intend to meet their product development schedule," Smith says.

On Paper. Creating viable specifications for a new product should involve dialogue between members of a cross-functional team. Smith believes that the critical task of writing the specifications is done very poorly in most companies. His method is to get all the players into one room for about three days and to list their ideas and the key issues on large sheets, known as storyboards, which are then tacked up around the room. The team members can then comment and refine them.

"We will have accomplished two things," Smith says. "First, the basic specs get done faster than if one person was assigned the job and had to run drafts of the specs through the company's political process. Second, the team members learn a valuable

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lesson in communication. They have to be clear on the issues that are important to them and able to explain and defend their ideas to others."

When marketing and engineering do not sufficiently discuss the product specifications, the resulting product usually lacks the balance needed to make it salable. The marketing manager at a New Product Dynamics client firm specified that the product had to be an advanced, top-of-the-line model, but he provided a manufacturing cost target for an average product. The spec was forwarded to

engineering, which laughed at the contradictory information. Rather than discuss it with marketing, which they felt would lead to an argument they might lose, engineering decided to design the product they had always dreamed of developing. They "resolved" the contradiction by ignoring the specification.

The resulting design was beautiful; it even won some design awards. The problem with the product, however, was that its manufacturing cost was very high. Even by cutting the profit to zero, the company still could not lower the price enough to attract buyers. The award-winning product was a business failure.

In a second case, the marketing and engineering departments did not discuss beforehand the crucial factor of how well the product had to work.

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For this piece of food processing machinery, its processing effectiveness was directly related to its height, an attribute they discovered too late. Engineering and marketing had agreed in the specification that the machine should be as low as possible, with 11 feet as the maximum height. Marketing, however, provided a four-foot-high model of the product that influenced the engineers because the offsetting specification on processing effectiveness was vague.

Engineering finally got a seven-foot-high prototype to operate with fair effectiveness. They thought they were doing poorly because their prototype was higher than marketing's ideal. But the real problem, they found out, was that it did not process the food as completely as necessary. Marketing would have been quite happy with a 10-foot-high machine that processed the food more thoroughly, but the relative importance of the conflicting goals was not discussed at the outset.

This case illustrates that specifications do not always explicitly define all relevant requirements. "The important thing about specifications is that there is a whole lot written between the lines," says Smith. This is why the dialogue involved in developing and fleshing out the specification should draw upon all areas of expertise, both within engineering and outside it.

After the project is over, valuable lessons can be learned from studying the spec. "One of our diagnostics is to look at the specifications and see how they change. That tells you a lot. You get hold of the very first draft; then you get the last one after the product's gone to market and you see what's changed and why. You've got to get a feeling for how engineering and marketing interact and whether or not they stick to their strategy and get it done or they keep fiddling with it," according to Smith.

Many Voices. It is important to keep the project team lean and talking to each other. Fast-paced new product communication involves a great deal of partial information and the best way to transmit this quickly and reliably is face to face. If possible, team members should work within direct talking distance.

"It helps to have the team very close together physically. For example, if the mechanical engineer and the electrical engineer are talking to each other about something and they reach an agreement, the software person, who is sitting there, could say, 'Hey, wait a minute! You can't do that!' If he were 50 feet away, that never would happen. Months could go by, and a lot of decisions could be made and money spent before the glitch would have been caught.

"We normally think that in speeding up the process you have to give

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A compressed development schedule can actually be beneficial by spurring clearer, quicker, and more accurate thinking.

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up something, that you're going to have a low-quality or a more expensive product. What I've seen is that these techniques of doing it with a small, closely knit, dedicated team; doing it through low-level decision making; and getting all the different technical specialties involved on the team frequently will give you the best of all possible worlds," says Smith. How closely and how well team members collaborate can often spell the difference between making the deadline or blowing it.

For example, New Product Dynamics was retained by a company in which the lead design engineer and the manufacturing engineer on the team seemed to Smith to be an odd match. He wondered whether the differing working styles of the two engineers would mesh.

The design engineer was from the old school, an outstanding designer who was very meticulous and proud of his work. By contrast, the manufacturing engineer spent his spare time racing cars at Daytona Beach. On the job, he was overloaded with mundane paperwork such as bills of material and operations sheets. Could the designer overcome his professional pride enough to discuss his preliminary concepts with his manu-

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facturing counterpart? Could the manufacturing engineer break loose enough mentally from his paperwork to even think about preliminary concepts?

They did manage to work out alternatives together on a chalkboard before the design had a chance to become frozen in anyone's head.

Quick Work. A longer development time does not guarantee the superior quality of a product. In fact, Smith believes that with the right project team, a compressed development schedule can actually be beneficial by forcing members to think more clearly and accurately as well as more quickly about what they are doing and its impact on the quality level of the finished product.

He points out that the well-managed and dedicated project team that produced the new model of Carrier Transicold's new Phoenix truck refrigeration unit *(ME,* Dec. 1988, pp. 42–43) not only slashed 12 months from the old product development cycle (from 18 to 6 months), they scored an esthetic breakthrough as well by completely redesigning the housing.

At Dynapert (Beverly, Mass.), a leading manufacturer of automatic assembly equipment for the electronics industry, a small cross-functional team developed the Intellisert V12000 axial inserter in 15 months, just half the time it normally takes this company to develop products of comparable complexity. The manufacturing cost of the V12000 was much closer to its goal than was typical for the company's products. Why? The cross-functional team was able to make more realistic decisions from the outset about the factors that would be important to the customer and about the most cost-effective manufacturing approaches to use. Product quality was higher than usual; relatively few problems arose as the product was subjected to field trials.

There had been special costs involved with setting up the team, such as special facilities and heavier use of personnel. But because the team finished in record time, it cost no more to develop this product than did products developed in the traditional manner.

Multiple Test. "Innovation is a cut-and-try business. Those who get products out quickly do it by building and testing models relentlessly, not by careful planning and analyzing," Smith says. The best way to do testing in an accelerated project schedule is to do lots of little tests, each building on its predecessor, rather than a colossal model that tests everything. Combine working models with computer analysis. To see how a product will work, build a functional model. To see how it will look, build a styling model. Don't try to put the two together, however, because a dual-role model takes more than twice as long to construct.

A New Product Dynamics client company was quite careful—and thus slow—in their development effort because the new designs had to be submitted to Underwriters' Laboratories for a brutal $20,000 test. Once the firm realized that their time was more valuable than money, they switched to a mode where they planned to do a second UL test in order to save development time. They designed a product that seemed pretty good, but they did not spend a lot of time refining the design.

Instead, they shipped their initial design to UL, along with their first $20,000, and UL told them where it had to be improved. On the next pass, they planned to improve just

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those areas that had to be strengthened, rather than fretting about the whole design. By using more testing, and using it wisely, they saved design time and got to market faster.

Within Limits. Using design time wisely also means eschewing over-design. How the product is viewed by prospective buyers is a crucial factor in determining the appropriate level of technology to put into a product. It is essential for engineers, who naturally take great pride in the quality of their work, not to incorporate too much technology or invention into the product if they
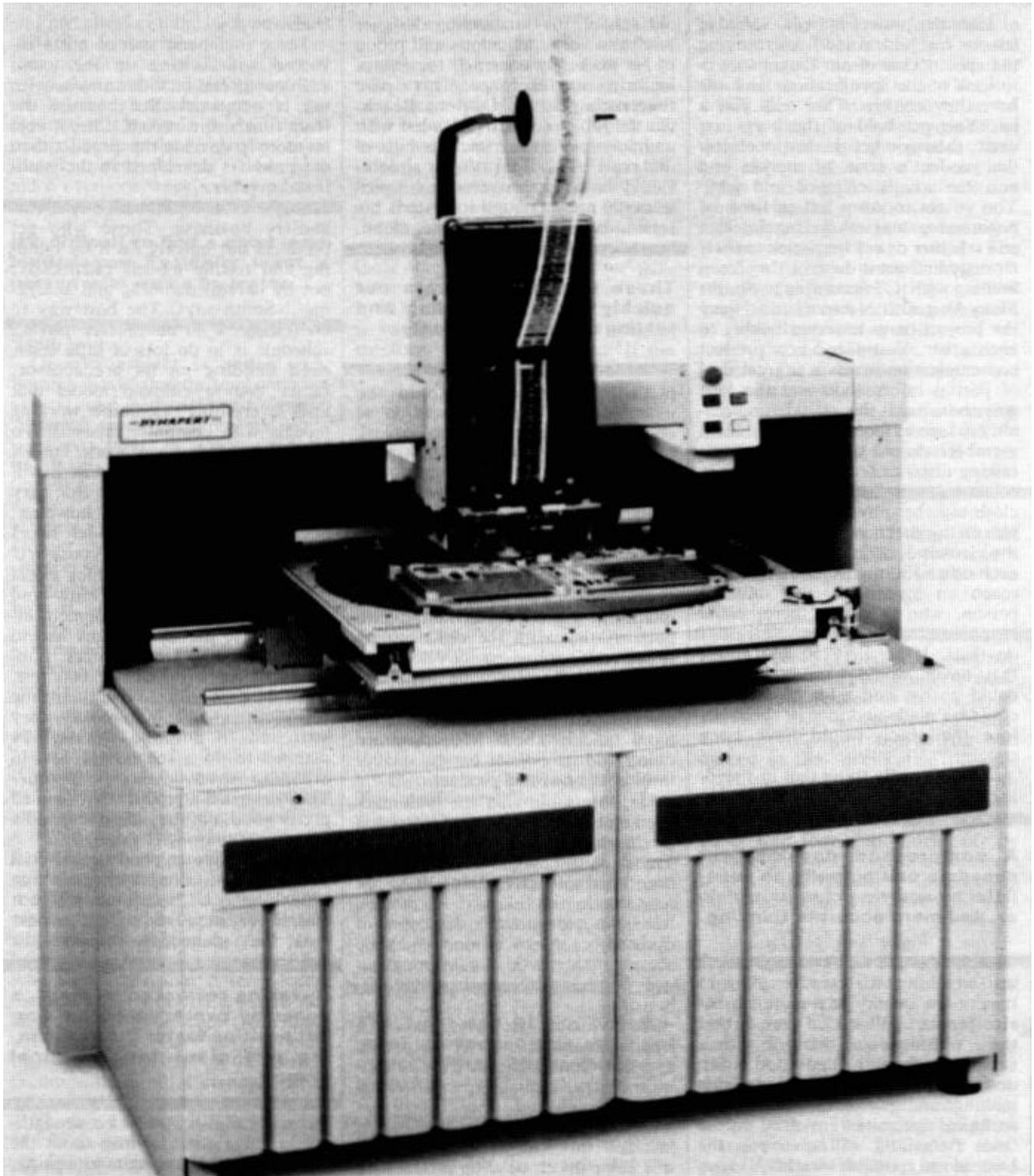
Quick assembly. At Dynapert, a small cross-functional product team was able to design the Intellisert V12000 axial inserter in just 15 months, half the company's normal development time.

want to get it to market quickly. By taking several small and quick steps, the company can usually advance its market position faster than by making a giant technological leap," Smith says.

For the engineer, the hardest part of the development process often comes after the product has gone out the door. After an exciting project winds down, the engineer may face a forced transition to a less glamorous design effort. "How can management keep the creative juices flowing after a successful team effort?" asks Smith. "People complain that it is difficult to understand and motivate engineers; they work by a completely different set of internal rules than most of the rest of the world."

In many companies, financial rewards are used as a motivator. Although money can be important, to many engineers financial rewards are not the prime motivator. "I think it is the satisfaction of doing a good technical job, finding the flawless product, or putting together some technical aspect that had never been put together before," says Smith. ∎