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# A Second Look at Japanese Product Development

by Rajan R. Kamath and Jeffrey K. Liker



Harvard Business Review

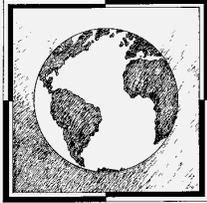
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*Partnerships, targets, and prototypes are only part of the picture. Discipline is another.*

## A Second Look at Japanese Product Development

by Rajan R. Kamath and Jeffrey K. Liker

Many companies in the United States and elsewhere, seeking ways to develop products more quickly and efficiently or to improve existing products, are recasting their relationships with suppliers—very often modeling their efforts on approaches adopted by world-class Japanese manufacturers, such as Toyota and Nissan. The favored Japanese practices include using fewer suppliers and forging longer-term relationships with them, prodding suppliers to improve continually, and involving suppliers in the design and development of products. Those practices are being eyed, too, by suppliers throughout the world that hope to win or increase business with large Japanese industrial organizations.

But many managers who adopt Japanese-style supplier-management practices have an incomplete understanding of them and, as a result, may be unable to gain all the benefits Japanese manufacturers enjoy. Worse, managers who don't fully understand the Japanese models may do their companies more harm than good. While most managers

outside Japan understand the general concepts of Japanese supplier-management strategies, they understand less well the details and nuances of those strategies—and that gap breeds misconceptions. For instance, it is widely believed that Japanese manufacturers treat virtually all their primary, or first-tier, suppliers—those that deal directly with the auto assembler—as close partners. In fact,

*Rajan R. Kamath is an assistant professor of strategy and international business at the University of Cincinnati's College of Business Administration in Cincinnati, Ohio. His recent work has focused on fast-cycle product development in Japan, South Korea, and Thailand. Jeffrey K. Liker is an associate professor of industrial and operations engineering at the University of Michigan in Ann Arbor and director of its Japan Technology Management Program. He is lead editor of *Engineered in Japan: Japanese Technology Management Practices*, to be published by Oxford University Press in 1995.*





they typically regard only a handful as partners and assign more limited roles to the rest. Nor do companies and suppliers work together in free-flowing teams to develop new products, as some would believe. Rather, Japanese companies structure their development programs tightly and use targets and prototypes to keep suppliers in line.

Managers in both customer and supplier organizations need to understand fully how Japanese manufacturers work with suppliers. Otherwise, they risk making the wrong kinds of investments and giving partners the wrong signals, jeopardizing the benefits that Japanese companies enjoy and potentially impairing these important relationships. Managed correctly, suppliers can help their customers reduce lead times and manufacturing costs, and can aid the design process – as Toyota's and Nissan's suppliers do. But if manufacturing managers copy the Japanese models inappropriately, they may involve too many suppliers who add too little value to the design process, or they may encoun-

ter project delays because of ill-equipped suppliers.

Those conclusions arise from an in-depth study of best-practice supplier-management techniques used in product development. In 1992 and 1993, we visited three large Japanese automakers – Toyota, Nissan, and Mazda – and more than a dozen of their suppliers in Japan. We also surveyed 143 Japanese suppliers of parts, components, and subassemblies to Toyota and other Japanese automakers, and 189 U.S. suppliers to General Motors, Ford, and Chrysler. (We have also observed supplier relations in industries as diverse as shipbuilding, telecommunications, defense electronics, and home appliances, and have found similar processes at work.)

Automobiles are mature, extremely complex products, an assemblage of numerous parts and subsystems. Although most vehicle models are variations on basic themes, with parts that are incrementally modified for succeeding models, integration – fitting all the different parts together properly –

is crucial. Our findings thus hold lessons for any company that manufactures products of similar complexity, including home appliances, toys, sporting goods, and office equipment. But they are probably less relevant for high-tech industries whose products are evolving rapidly and for companies that make simple products or highly customized products in small batches.

### Not All Suppliers Are Equal

Conventional wisdom suggests that Japanese companies consider all their first-tier suppliers as exclusive partners and that they provide them with early information about new products or product changeovers. Our study of best practices, however, reveals that Japanese automakers assign suppliers different roles and give even first-tier suppliers varying levels of responsibility for product development. Only an elite corps of about a dozen first-tier suppliers enjoy full-blown partnership with their customers. (Typically, a Japanese automaker has about 100 to 200 first-tier suppliers.) Interestingly, this elite group includes all the big suppliers, such as Nippondenso, Aisin Seiki, and Calsonic – companies that managers who tour Japanese parts suppliers would likely visit. Visitors may generalize from what they see, concluding that this handful of companies represents all suppliers.

Few suppliers can make the investments in personnel, computer-aided-design (CAD) systems, prototyping facilities, and research-and-development capabilities that a true partnership with their customers requires. Small suppliers are often too “lean” to station engineers full-time in their customers' offices or to pledge major resources to the development of products they will not make and sell for three more years. Nor do automakers want to deal with all first-tier suppliers as partners. As most managers know, the Japanese tier structure simplifies communication between customers and suppliers: first-tier suppliers coordinate the activities of the second tier and so on down the hierarchy, allowing customers to focus scarce



communication resources on the top tier. Still, with 100 to 200 first-tier suppliers, an automaker cannot easily work with all of them as partners in product development.

Smart companies reserve partnerships for suppliers that have outstanding technology, sophisticated management, and global reach. As one Toyota executive puts it, "One more supplier on the list is more work. Unless the supplier has value, why do it? It is the integration of the technology of the supplier that is the basis of the long-term relationship."

Superlative technology is the most important bait suppliers use to hook new customers. However, suppliers must be selective too. Smart suppliers scan their major customers constantly to determine which are worthy of being partners. Since partnership requires suppliers to invest in capabilities for testing and making prototypes, and to appoint dedicated employees to work with the customer, those investments may make sense if the relationship has long-term strategic value. But in some cases, it may be more lucrative to let your customer call the product-development shots and to become very good at making parts to order. (See the insert, "Guidelines for Customers and Suppliers.")

Successful partnerships, then, depend on the right balance among a supplier's technological capabilities, a customer's willingness to share information, and both companies' strategic requirements. There is a range of postures that customers and

## Four Supplier Roles

Role	Description	Responsibilities During Product Development
Partner (Full-Service Provider)	Relationship between equals; supplier has technology, size, and global reach.	Entire subsystem. Supplier acts as an arm of the customer and participates from the preconcept stage onward.
Mature (Full-System Supplier)	Customer has superior position; supplier takes major responsibility with close customer guidance.	Complex assembly. Customer provides specifications, then supplier develops system on its own. Supplier may suggest alternatives to customer.
Child	Customer calls the shots, and supplier responds to meet demands.	Simple assembly. Customer specifies design requirements, and supplier executes them.
Contractual	Supplier is used as an extension of customer's manufacturing capability.	Commodity or standard part. Customer gives detailed blueprints or orders from a catalog, and supplier builds.

roles for different customers. Each posture carries fundamentally different responsibilities during product development, and the customer-supplier relationships vary considerably in closeness and intensity. The result of a mistaken choice of posture may be a long-term cooperative relationship that yields *no* competitive advantage.

Partners top the hierarchy. These select few among first-tier suppliers can also be thought of as full-service providers. Partners are responsible for entire subsystems such as heating, ventilating, and air-conditioning, and exhaust, alternator, and seating systems. They often participate in planning a new model even before the concept stage. Their understanding of their products and processes – and their technological capabilities and know-how – are superior to those of their customers, and they suggest solutions to meet their customers' price and performance objectives. They

do their own testing and may even be responsible for testing other suppliers' parts. In essence, they act as an arm of the customer. In the preconcept stage, the partner and the customer jointly determine the specifications of the subsystem. Because of the complexity of the subsystem, the partner must communicate intensively with the customer throughout the cycle.

The quintessential partner is Nippondenso. Started as a unit within Toyota, it has grown to become an independent supplier of a broad range of components that approaches Toyota in size. Nippondenso engages in advanced research and development for a subsystem that is not directly related to its customers' product-development cycles, because the company intends to remain the leader in select components of the global parts industry for the next ten years.

To use alternators as an example, Nippondenso's basic research for this product took years and began with intensive discussion between Nippondenso engineers and their

## Contrary to popular belief, Japanese automobile manufacturers regard only a handful of first-tier suppliers as partners.

suppliers can adopt within a long-term cooperative relationship. (See the table "Four Supplier Roles.") The nomenclature is ours – these are not the formally designated roles used by Japanese automobile companies. Suppliers may play different

## Guidelines for Customers and Suppliers

The nuances of Japanese customer-supplier relationships during product development have implications for the way customers and suppliers conduct themselves.

*If you are a customer:*

1. Scrutinize each supplier relationship to determine (a) the status of the relationship, (b) whether you are handling components of a specific complexity consistently, and (c) the most desirable posture to adopt, given the complexity of components and the supplier's capability.

2. Assess the technological capabilities of each supplier, and assign the supplier an appropriate role. More important, monitor each supplier's capabilities routinely, both to benefit from them and to manage the supplier's transition from one role to another. You may have to increase the depth of technical knowledge among people in the purchasing department. Also, purchasing must be willing to work closely with design engineers and give them considerable latitude in selecting suppliers.

3. Manage a supplier's involvement in product development, as well as the content and intensity of exchanged information, in a manner that is consistent with the supplier's role. For example, a contractual supplier may not need to attend the concept-stage meeting. A supplier in the child role may require explicit and detailed specifications, whereas a partner may actually suggest specifications.

4. Develop a simple, stable product-development process, and communicate it clearly to key suppliers. Be receptive to new technology during the early stages of the development cycle so that suppliers know when to present their suggestions for radi-

cal changes. At some Japanese companies, one or two top-level managers routinely attend new-technology presentations made by suppliers.

5. Use carefully considered targets to coordinate and manage your suppliers' development efforts. Make sure your suppliers know the limits of their latitude, because late changes in the targets for one component will reverberate throughout the entire system, affecting the design work of many other suppliers. For instance, providing suppliers with a layout of mating components will communicate the reality of constraints and the opportunities for flexibility.

*If you are a supplier:*

1. Moving up the ladder from one role to another will require you to take on greater product-development responsibilities. This is a strategic decision, made in a deliberate, conscious fashion. If you are not ready, willing, and able to make the appropriate investments, you may be better off staying where you are. On the other hand, you may have no choice if you wish to do business with U.S. companies that are increasingly requiring suppliers to take on greater product-development responsibilities.

2. Make the effort to understand and internalize your customer's product-development cycle. Often this will require assigning your people to work in the customer's organization. Learn to synchronize your new-technology presentations with the customer's development cycle. You may have to study a particular customer's behavior across one or two cycles to learn the right cues. Even within the same industry, customers vary considerably. For example, Toyota allows suppliers more lati-

tude to participate in setting targets than does Mazda.

3. Whether you are trying to build a new partnership or maintain an existing relationship, think through the contents of your new-technology presentations. Do your homework. You should understand what your customer wants and its strategic direction (for example, emphasizing weight reduction for fuel economy), and know the advantages of your parts compared with those of competitors. Be prepared to add value to your customer's development process. What technological strengths can you provide above and beyond minimum expectations?

4. Technological competence makes it possible to meet tight deadlines. Some Japanese suppliers have separate manufacturing facilities dedicated to manufacturing prototypes. In-house testing and prototyping capabilities are critical for quick turnarounds during the prototype-testing-and-evaluation stage. If you must subcontract design, analysis, prototyping, or testing services, a world-class customer will question your ability to accomplish the quick turnaround that is the cornerstone of a partnership.

5. Expenditures on development or on prototyping and testing capabilities are investments in a relationship. If top management uses quarterly returns, annual returns, or even three-year returns on investment to evaluate these projects, the expenditures may seem unjustified. The key questions are, Is this customer worthy of a long-term relationship? Can we have a profitable relationship over the long term? Have we developed capabilities and credibility that are valuable to the customer and to potential new customers?

customers—primarily Toyota—to determine the complete range of sizes and performance levels that potential customers worldwide might require within the next ten years. (The supplier assumes that other customers will be satisfied if it can satisfy the very demanding Toyota.) Nippondenso then designed a family of alternators built around a single concept that could be made on the same production line. The options

## Mutual entanglement—not blind trust—is what binds important suppliers to their customers.

include 3 different housing types, 9 different wire specifications, 4 different regulators, and 30 different terminals, all mutually compatible. In all, Nippondenso offers customers more than 700 different alternators, and it has tooled its automated production lines to mix and match sets of alternative designs.

*Standardized variety* is the term Nippondenso uses for its philosophy of providing customers with a wide variety of products based on a standardized set of parts. When the supplier's engineers develop an alternator for a particular vehicle program, they show the customer—in the pre-concept stage—the advantages of their technology and the cost advantages of selecting from the 700 different types. (The customer may select an alternator outside this set but must pay a premium for it.) If the customer chooses from the menu of standardized parts, the development process then consists of tailoring certain aspects of the alternator for the customer—the location of mounts, for instance. In essence, Nippondenso's technology heavily influences the customer's design specifications. No other supplier we interviewed uses this approach, although other partners, including Aisin Seiki (a Toyota supplier) and Calsonic (a Nissan supplier), clearly influence the customer's choice of target specifications.

The distinction between the *mature* role and the partner role is subtle. Like partners, suppliers in the mature role (sometimes referred to as full-system suppliers) design and manufacture complex assemblies. But because they lack the technological capabilities of partners, they have less influence on design. The customer gives mature suppliers critical specifications for performance, interface requirements, and space constraints. The suppliers then develop the systems on their own. In fact, a mature supplier can sometimes influence, through negotiation, how a customer sets critical specifications. For example, the supplier may say, "If you give me more

space here, I can add this functionality." Moreover, mature suppliers take on major testing responsibilities: a customer might not even verify the test data a mature supplier submits along with its prototype. Intensive communications begin at the concept stage and continue through to production. Unlike partners, however, mature suppliers have their advanced development goals driven largely by the customer's goals.

An example of a Japanese supplier in a mature role is Hirotec, a supplier of stamped door panels to Mazda. In a typical case, Mazda designs the outer surface of the door for a new car model as part of its styling process and provides CAD data for that surface to Hirotec. Hirotec designs the door's internal supporting beams, manufactures the door, and sends completed doors, in sequence, to the assembly line. A door is a complex system, and all its openings must be coordinated with the work of other suppliers so that all the mechanisms and wiring fit. Hirotec does not have a partner's broad ability to influence the customer's specifications. Mazda calls the shots yet entrusts Hirotec with the design of a critical part.

Suppliers in the *child* role have even less influence on design specifications. They may participate as consultants in a meeting or two with

the customer during the concept stage, but the customer determines in explicit detail the specifications for the part. The responsibilities of suppliers in the child role include working out the details of the design and building and testing prototypes. But the customer often conducts critical tests internally to assess the performance of the supplier's parts. Communications are not very intensive in the concept stage but intensify during prototyping, though not to the same degree as with partners or mature suppliers.

For instance, a gearshift-lever maker for Toyota does not engage in intensive development efforts for each new vehicle model. There is no need to, because the technology for this part changes very little, there is limited interaction with other components, and the design of the part is relatively simple. So development efforts begin with a critique of the existing design from the last car model (based on internal evaluations and feedback from Toyota) and with new ideas for improving the gearshift lever. Toyota specifies the lever's height, and the supplier makes all other dimensions the same as those of the current model. Some of Toyota's specifications, like those for the mounting bolt's position and size, have not changed in 12 years.

Suppliers in the child, mature, or partner role commonly face competition with other suppliers during the design and production stages. In fact, despite the impression of many managers that Japanese customers and suppliers forge relationships based on trust, even first-tier suppliers that send engineers to work at a customer's site may encounter fierce competition: automakers often invite two sets of guest engineers to compete side by side to see who can come up with the better design. However, once suppliers at any level have a contract for a part, they own it for the life of the model.

Suppliers in the *contractual* role simply manufacture parts designed by the customer—usually standard parts or commodities. Essentially, this role is appropriate when a customer chooses to supplement its

own internal ability to design those parts with a contractual supplier's manufacturing capacity. If the supplier has unique manufacturing capabilities, such as large-scale flexible automation, the customer will sometimes involve the supplier in the development effort. In this role, there is little need for communication in the preconcept or concept stage. Contractual suppliers and their customers may communicate frequently during the late-prototype and production-preparation stages, though communication is less intensive than it is in the other roles. These suppliers may have long-term relationships with their customers if the suppliers' unique manufacturing capabilities make them necessary or if the customers' just-in-time manufacturing schedules are so tight that they require them.

Some U.S. and European companies, adopting the Japanese tier structure, believe they should treat all their suppliers as partners. But suppliers that make simple, routine products don't always need to be treated as partners. Customers should manage those suppliers in the child or contractual role. By choosing inappropriate levels of responsibility for suppliers, a customer might waste resources (for instance, by involving suppliers too early in concept sessions), compel suppliers to design custom parts when off-the-shelf parts might

work, and require suppliers to add new-product-development capabilities that will not be fully utilized.

Many suppliers, in both the United States and Japan, make it a goal to "move up the ladder" from a simple parts-supplying role to one that provides more value to the customer. (See the table "Supplier Roles in Product Development.") But the move is expensive, and suppliers cannot be partners with all customers. If a supplier wants to move up the ladder, it must broaden its technological base. For instance, a precision-metal-cutting supplier might acquire electronics capabilities in order to supply electromechanical systems. An upwardly mobile supplier must also have a good track record at its current level, build a relationship carefully with its targeted partner-customer, and develop an ability to innovate.

Suppliers and their customers become increasingly interdependent as they work together and their business relationship grows. The customer depends on the supplier's know-how and relies on the supplier to deliver on time and on target. Committed ever more heavily to the customer, the supplier depends on it for its future revenue stream. The two sink or swim together. This mu-

tual entanglement—not blind trust—is what binds important suppliers to customers.

### Structure and Discipline

World-class Japanese automakers manage product development tightly. They set clear, understandable goals and communicate them consistently to suppliers, and they use

**Once Toyota's top-level managers approve a concept, there is little latitude for major changes in the specifications.**

targets and prototypes to enforce those goals. It is a simple, rigid process, much like an assembly line. Suppliers must "keep the line moving"—a highly regimented role.

All the Japanese customers and suppliers we studied showed us surprisingly similar charts describing their product-development cycles—a single sheet of paper capturing a high-level view of the process and including clearly tagged milestones that begin several years before the start of production. In contrast, the "structured design processes" adopted by some U.S. companies are extended, complex descriptions of the stages and gates, or milestones, of

## Supplier Roles in Product Development

	Partner	Mature	Child	Contractual
Design responsibility	Supplier	Supplier	Joint	Customer
Product complexity	Entire subsystem	Complex assembly	Simple assembly	Simple parts
Specifications provided	Concept	Critical specifications	Detailed specifications	Complete design
Supplier's influence on specifications	Collaborate	Negotiate	Present capabilities	None
Stage of supplier's involvement	Preconcept	Concept	Postconcept	Prototyping
Component-testing responsibility	Complete	Major	Moderate	Minor
Supplier's technological capabilities	Autonomous	High	Medium	Low

product-development endeavors, broken down into detailed steps. The Japanese process – which is essentially a management and not an engineering approach to product development – is easier to administer.

The simplicity of the Japanese charts reflects years of clear and consistent communication between suppliers and customers. The suppliers we interviewed could explain precisely the milestone events, their timing, and customers' expectations through their understanding of these charts. As a result, when a supplier gets word that the concept session for a specific vehicle model is being scheduled, there is no ambiguity about what the supplier must bring to the session; approximately when the first, second, and third prototypes will be due; and what the customer's expectations at each of those milestone events will be.

The supplier knows that there is a clear, though small, window of opportunity in the concept stage, before the release of specifications, when it can suggest new technology and try to introduce new methods. Outside that window, suppliers must focus their overall efforts on incremental cost-saving improvements that will not involve the redesign of mating parts and subsystems. If a technological breakthrough occurs at a time that does not coincide with one of these windows, therefore, the supplier must simply wait until the next window comes along—the next model change,

For example, every Toyota supplier we interviewed said it presents its latest relevant developments to the automaker about 36 months before the production of new models begins. The supplier may present up to three concepts and suggest which avenue seems most promising. At these presentations, the supplier will demonstrate working prototypes and furnish a great deal of test data on the parts, including comparisons with existing or alternative designs. Suppliers commented that Toyota engineers are knowledgeable enough to engage in meaningful discussions aimed at improving their particular products. In every case, these presentations precede any specific information or statements from Toyota about the new model.

The suppliers are able to offer meaningful new design ideas because of their long-term relationships with the automaker and their knowledge of current trends. For example, during the energy crisis of the 1970s, when fuel efficiency was a key factor, suppliers could count on weight reduction to be high on Toyota's list of priorities. In the declining Japanese market of the early 1990s, however, cost reduction displaced weight reduction as a priority. Once Toyota's top-level managers approve a concept (27 months before production begins), there is little latitude for any major changes in the specifications.

During the prototype stage, as well as during mass production, surprisingly little joint problem-solving occurs. The customer lays down clear targets, and the supplier has to figure out how to meet them. Milestone events usually represent delivery deadlines. Meeting those deadlines is crucial.

In general, as many managers know, Japanese automakers give marching orders to suppliers through carefully considered targets for price, delivery date, performance, and space constraints. Then the suppliers go off and design to those targets. There is usually little room for missing them: a deviation by one supplier will have implications for

designers of mating component systems. Thus, for a supplier, design is a "pull system," in some ways analogous to the renowned kanban system. It is "pulled" by explicit customer requirements in the form of targets and nonnegotiable deadlines. Suppliers are expected to work hard to meet targets on time. Although customers are generally understanding if, despite its best efforts, a supplier cannot meet a target, they are unsympathetic if the supplier shows signs that it has not worked very hard. The customer is responsible for avoiding arbitrary and capricious changes in targets, because they would reverberate throughout the system and could disrupt other suppliers' design work.

The nuances of targets are not as well understood by managers outside Japan. In fact, in Japan, targets play different roles in different supplier relationships. For instance, Toyota views the presentations that occur before the development of a new car model as more than just an opportunity to refine a predetermined design. They also seem to play a critical role in Toyota's ability to set reasonable targets for its suppliers. The company uses several approaches to setting targets, depending in part on the supplier's role.

Toyota gives partners and mature suppliers some flexibility. A full-blown partner such as Nippondenso can actually suggest alternative targets. Mature suppliers told us that Toyota sends them targets about four months after the initial supplier presentation. For most components, the targets for the previous design were sufficiently aggressive and Toyota merely asks suppliers for a modest improvement. These improvements, generally expressed relative to an existing product or to the prototype unveiled in the presentation, are approximate. For example, Toyota may ask for about a 4% reduction in cost or about a 5% improvement in power output, so all parties understand that there is some flexibility.

Toyota also provides partners and mature suppliers with a layout of the area surrounding the suppliers' component system. The suppliers' engi-

## In Japan, targets play different roles in different supplier relationships.

say – before suggesting the major design change. In other words, with a highly structured and routinized product-development process (almost like that in an assembly plant), Japanese suppliers know exactly where they fit in and when, and this arrangement allows them to be innovative within clearly determined boundaries – to be creative without being disruptive.



neers can then better understand how their parts fit with surrounding parts, and they may even suggest that the customer change the design of mating parts to improve its own components. For example, a Nippondenso engineer said, the suppli-

## Of the Big Three automakers, Chrysler is most like Japanese companies in its efforts to involve suppliers early on.

er, when reviewing a layout, might suggest that certain engine components be moved from the left to the right side for a model under development so that the radiator-hose assembly could stay on the left side—a more cost-effective approach.

On the other hand, Toyota does not often change the design, from model to model, of parts made by suppliers in the child role, nor does it change less critical aspects of the

product, such as the mounting holes for the gearshift lever. The targets might focus instead on incremental cost or weight reductions. If the supplier can suggest changes in the design that will reduce cost or weight, Toyota may modify the targets.

In short, Japanese automakers use targets as a major coordinating mechanism. In fact, we found that suppliers designing mating systems or components rarely share design information. As long as the targets and layouts were thought through by the automaker and did

not change, three different suppliers could design to their own specifications and the resulting parts would fit together.

Japanese automakers use prototypes as a way to structure the design process—in effect, as an organizational lever to measure the performance of suppliers and ensure that they meet delivery deadlines. While many U.S. and European managers believe that prototypes are

becoming obsolete, soon to be replaced in large part by sophisticated CAD technology, Japanese automakers disagree: in their estimation, prototype trials, which in every case were the basis of the development-process charts that Japanese suppliers and customers showed us, play an important management role. When a customer delegates a complex task such as design to a supplier, it is practically impossible to track the supplier's day-to-day design progress. Prototype testing and evaluation provide a way to manage the process because each prototype stage is an opportunity to appraise the supplier's performance.

Those appraisals can be demanding. According to a heating, ventilating, and air-conditioning (HVAC) system supplier, "Performance evaluation is based on the car data, not on our data. For example, if the HVAC, when fitted into a car, does not meet their requirements, it does not matter that it meets the specifications. They may ask us to change it. If the engine's heat characteristics are different from the estimates, they may ask us to change it."

Japanese car manufacturers emphasize that the first prototype should be fully functional and in some cases complete in appearance down to surface finishes, because the prototype is the ultimate test of how the entire system fits together. The automakers require prototypes that are designed for mass production, since if there is a significant difference between the early prototypes and the later mass-production parts, then the early tests and refinement of the design will have proved meaningless.

Suppliers who miss prototype delivery deadlines face severe penalties, such as a reduction in the size of subsequent orders. Performance problems with the prototype are not in themselves serious. But the failure of suppliers to work quickly and effectively to improve or change the performance based on the customer's suggestions is considered unacceptable.

In contrast, many U.S. companies think of the prototype as an opportunity to experiment with new ideas—

and to use crudely crafted versions of the final design – which defeats the ability to use prototypes as a pacesetter. U.S. customers and suppliers also treat prototype deadlines as flexible rather than hard targets, which may explain why Japanese customers express shock when U.S. suppliers deliver prototypes late. U.S. suppliers involved in developing Toyota's new Avalon model met prototype deadlines 47% of the time, while Japanese suppliers did not miss a single deadline.

### Transplanting Relationships

A handful of companies outside Japan *are* adopting product-development alliances that look very much like the Japanese model. In the United States, these include nonautomotive companies like Texas Instruments, whose Defense Systems and Electronics Group won a Malcolm Baldrige Quality Award, and Whirlpool Corporation. They also include U.S. auto companies like Chrysler and Ford, as well as parts suppliers like Eaton Corporation, United Technologies, and Johnson Controls. Johnson Controls has been designing and building complete seating systems for Nissan and Toyota for almost a decade. Companies such as these can point to sub-



brakes. Chrysler's top management sets broad targets (such as vehicle cost, performance features, and weight) for the platform teams, and the team leaders set operational targets for the subsystem groups. The lead engineer of a subsystem group has some flexibility in setting targets for outside suppliers. For example, he or she may need to meet a weight target for a set of components. The engineer could decide to save weight in one component to allow for looser constraints on other components. Similarly, lead engineers have a total target price, like a checkbook, and can decide how to allocate money among suppliers.

The general manager of the large-car platform team, G. Glenn Gardner, explicitly rejects the complicated structured-development processes of his U.S. competitors in favor of simple milestones and aggressive target dates. His team developed the LH line and the new compact sedans: the Chrysler Cirrus

and Dodge Stratus lines. For the LH line, Chrysler outsources about 70% of its parts to a greatly reduced number of suppliers, and it invited key suppliers into the development cycle early. For the new sedans, Chrysler "presourced" 95% of the parts—effectively choosing suppliers even before the parts were designed and virtually eliminating supplier bidding. Some suppliers have full-service responsibilities and actually coordinate the development activities of other, "lower tier" suppliers. Like its Japanese competitors, Chrysler has been making complete prototypes much earlier, and those early prototypes are very similar to production models.

One supplier, Johnson Controls, designed the seating system for the Chrysler LH car and supplies 80% of the system's components. It hired a former Chrysler executive to head up the engineering effort. The supplier joined the development effort early, allowing engineers at Johnson Controls the time to develop foam specifically for the LH model. Since Johnson Controls was responsible

## Those suppliers that don't understand their changing role will find their opportunities shrinking.

stantial payoffs from adopting the Japanese approach. However, both suppliers and customers tend to implement it inconsistently.

Among the Big Three U.S. automakers, Chrysler most closely resembles Japanese companies in its efforts to involve suppliers early in the design process. Chrysler vehicle lines are now organized into four broad platform teams – large car, small car, minivan, and jeep/truck – and those teams are in turn divided into smaller groups responsible for specific vehicle subsystems, such as

for managing Chrysler's seating-component suppliers, many of whom had formerly been treated as first-tier suppliers, Chrysler dramatically reduced the total number of suppliers it dealt with directly – to 230, including the Accustar division. By contrast, 456 suppliers had worked with Chrysler on the New Yorker model. As a result of these approaches, Chrysler compressed development time by 25% or more and produced world-class vehicles incorporating state-of-the-art components at considerably lower cost than its competitors did.

Eaton Corporation is an example of how a U.S. supplier can benefit from a Japanese-style relationship with a customer. Traditionally, Eaton made large-volume valves and lifters. Ford was Eaton's largest auto-parts customer. In fact, Eaton made more than 90% of Ford's valves and

lifters worldwide. In 1986, Ford asked Eaton to participate in the development of its new modular V-8 engine. Ford wanted Eaton to take responsibility for the design and manufacture of the entire valve-train system, including components that Eaton did not produce, such as springs. More specifically, Ford wanted Eaton to coordinate the activities of lower-tier suppliers and to deliver a kit in a form that could be robotically loaded onto a conveyor and assembled by automation at Ford's plant. Additionally, Ford set an aggressive target price for the package. It didn't care how Eaton allocated the price among the components of the system – as long as it added up to the total target price.

Working with Ford on this project, Eaton developed new technologies and capabilities now in demand by other customers, such as Caterpillar.

While Eaton isn't certain that the Ford contract was profitable enough to justify the required up-front investments, the supplier is certain that those investments are paying off many times over in new contracts and customers.

Suppliers must follow Eaton's lead. Those interested in working with Japanese automakers—a growth segment of the auto industry—must understand their role in the customer's product-development cycle. If they don't, they could walk away from some of the world's most desirable industrial customers. And as companies like Ford and Chrysler—seeking more effective ways to design products—change their approach to managing suppliers, those suppliers that don't understand their changing role will find their opportunities shrinking. 

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