The Supply Side of Design and Development

Not all products are created equal, so supplier integration schemes must be flexible.

by Tim Laseter, Kamalini Ramdas, and Dorian Swerdlow

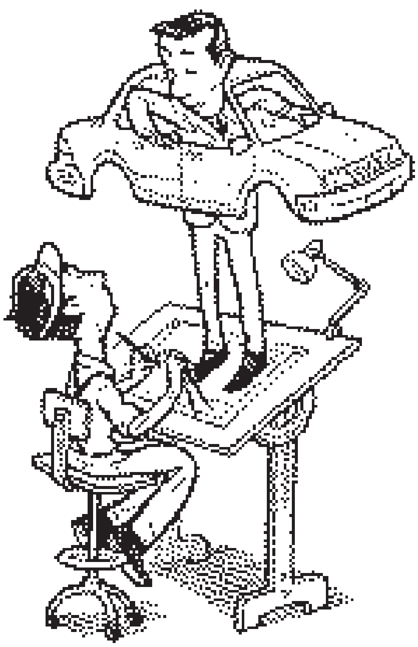

Illustration by Lars Leetaru

Everyone knows the virtues of collaboration between manufacturers and suppliers in new product development. The mantra of "early supplier involvement" has become common in engineering-intensive industries. But that simple prescription, although helpful in the 1990s, will not remedy today's product development challenges. Leading companies need more specific guidance in defining the optimal timing and integration of suppliers.

Consider the case of a frustrated executive from an automotive exhaust systems supplier, who told us his company was engaged in the customer's design process too early. As he explained it, the exhaust system faces two major design constraints. First, its tuning must be based on the design of the engine, and second, it must weave a path along the undercarriage that avoids conflict with other major protrusions beneath the car. Although he was glad to have been brought in to understand the basic product concept and the likely problems along the undercarriage, the executive argued that retuning the exhaust system with every evolution of the engine design was a waste of time and money. The manufacturer's engineers had ignored the fact that any excess cost incurred by the supplier would ultimately be borne by the car manufacturer. Instead, the executive argued that the exhaust system designers should have been brought in later — once the engine design was stabilized.

Is there a simple solution to the "too late/too early" problem? Our research suggests that determining the appropriate role and level of involvement for the individual supplier depends on the type of component part the supplier makes and its relationship to the manufacturer's end product. We have developed a basic framework to use in making judgments about the role of the supplier and the timing of its involvement in product development. Although our research draws on automotive industry examples, we believe the framework can also apply to many other industries.

Our research began with a survey of midlevel managers and engineers at vehicle manufacturers and suppliers in the automotive industry, selected randomly from a mailing list published by the Society of Automotive Engineers. Through this survey, we identified three characteristics of component parts that are significant from a new product development standpoint:

- the degree to which consumer perceptions of the end product are influenced by the part;
- the complexity of the part's interface with the rest of the product; and
- the part's cost relative to the total cost of manufacturing the end product.

A Classification Framework

Different combinations of these characteristics led us to identify four different categories of component products: critical systems, invisible subassemblies, simple differentiators, and hidden components. *Critical systems* have highly complex interfaces with the rest of the end product, are relatively expensive, and strongly influence consumer perceptions. By contrast, a *hidden component* has little influence on consumer perception, has a simple interface with the rest of the end product, and is relatively inexpensive. In between these extremes are *invisible subassemblies* and *simple differentiators*. Although each can range in cost from inexpensive to expensive, invisible subassemblies have less influence on consumer perception and far more complex interfaces with the rest of the end product than do simple differentiators.

Each of these four categories requires a distinct approach to supplier–manufacturer collaboration in product development. For example, a supplier's role in the development of a critical system would be different from what would be optimal in the case of a simple differentiator.

A vehicle's braking system is a good example of a critical system. Consumers care not only about how effectively their brakes stop the vehicle, but also about the feel of the pedal when they apply the brakes, the smell emitted by the pads from long braking, and any squeaks that may indicate a problem.

Brakes don't work in isolation. Since the first automobile, the brake system has stretched from the passenger compartment to all four corners of the vehicle. The advent of disc brakes changed the fundamental design of the wheels. More recently, the antilock brake system (ABS) has become a critical element in a broader system for traction control. To create an effective braking system, the brake designer must work closely with the designers of a host of other systems and components. If any details get lost in the fast-paced process of product development, passenger safety requirements, the ultimate concern of any automotive engineer, could be compromised.

In the past, vehicle manufacturers often procured brake system components from multiple sources: calipers from one supplier, brake pads from another, and so forth. To optimize the design as a system rather than a set of components, vehicle manufacturers now tend to purchase the entire system from a single supplier, or at least make one lead supplier responsible for ensuring that all of the components work together. The aggregation of parts into a single system that also features improved functionality like ABS has made the braking system one of the most expensive sourced systems in today's automobiles.

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Invisible subassemblies don't influence consumers as much. However, these components do have moderately complex interconnections with other elements of the end product. They can also be costly. Consider the automobile's wiring harnesses. These are collections of wires, fuses, and connectors that link all of the electrical elements in a car together, from such mundane items as the battery and taillights to the more sophisticated collision-detection sensors that trigger airbags. Although consumers interact with most of the devices connected to the harness, they never think about the harness itself. Yet with the increasing electronics content in a modern vehicle, wiring harnesses have grown to be a major cost component in the car.

Simple differentiators — such as cup holders, vanity mirrors, and storage consoles — are highly visible to the consumer, and their interface with other parts of the automobile is relatively simple. The cost of such products varies widely, but typically is less than the cost of critical systems and hidden subassemblies. Because these items influence consumer perceptions of the overall product, good product design of these components is crucial. When designed well, simple differentiators can dazzle the consumer. Executed poorly, however, they can produce a bad impression of the quality of the whole vehicle.

Manufacturers need to be constantly innovating new designs for simple differentiators. For example, automatic dimming rearview mirrors, first introduced in high-end brands like Cadillac, are now available in a broader range of the General Motors lineup because consumers have responded to them so positively. The use of these mirrors in more types of vehicles has lowered the cost of manufacture, but their ubiquity also diminishes the mirrors' value as a differentiator.

Hidden components, such as the anchor on a boat or a zipper on a jacket, may be visible to the consumer, but individually they add little to the cost, quality, or perceived performance of the end product. Nevertheless, the product as a whole can't work without them. The vast majority of parts in any product qualify as hidden components. Every automobile requires many hidden components. Some, such as the filler tube that connects the gas cap opening to the gas tank, are actually hidden from the driver. Others, such as the standard door lock, are visible but have no influence on consumer perceptions.

Many Dimensions

It would be easy to use this framework only to classify components and prescribe the suppliers' role in design. But that wouldn't be helpful. We also need to consider the many dimensions of the relationship between suppliers and their customers in new product design.

Should the manufacturing be outsourced or kept in-house? What about the design? Should the product be designed in-house but manufactured outside? These questions precede all others since they ultimately determine whether supplier integration is an issue at all.

The optimization of supplier involvement in product design and development also obliges a company to address the frequency of the interaction between the two parties. Some suppliers should be worked with continuously, whereas others don't require it. In the exhaust system example, the supplier ultimately was less concerned about being brought into the process too early than he was about the number of iterations that were involved. He would have preferred less frequent interaction until the engine design was stabilized.

Another issue is the degree to which design is delegated to the supplier. For example, a customer may provide performance specifications (i.e., the vehicle weight and desired stopping distances under certain road conditions) to a brake system supplier. Alternatively, the customer may provide detailed drawings of the physical part with material hardness characteristics and tightly defined dimensional tolerances.

Part standardization versus variety is an additional consideration. The manufacturer could request a single standardized part design from the supplier to reduce costs. Or the manufacturer might try to increase sales by offering wider product variety — which would allow consumers to choose components that customize the end product to their unique tastes. Managing this tradeoff can be a challenge. Prior to the 1980s, one General Motors executive told us, GM produced "20 cars that looked different on the outside but were the same underneath." But, after pursuing a decentralized product development approach throughout the 1980s, the automaker began producing "20 cars that looked the same on the outside but were different underneath." GM had lost both the advantages of standardization and the distinctive look that helped differentiate its cars to consumers.

Another concern is how suppliers should interact with different business functions. For example, some suppliers should work with the designers who define the aesthetic characteristics of the end product; others should collaborate more closely with the engineers who define the performance. Still others should interact tightly with the finance and purchasing staffs who manage the overall budget for the end product.

Taking this broader view of the many dimensions of the supplier–manufacturer relationship, we can now apply the four-category classification framework to define the appropriate roles for suppliers in new product development. Each category presents different challenges and, accordingly, demands that suppliers and manufacturers focus on different sets of priorities.

Black & Decker outsourced the entire design and production of its glue gun, effectively defining the product as a critical system.

Applying the Framework

As implied by the name, critical systems warrant the greatest attention from the original equipment manufacturer (OEM) designing a new product. In fact, these parts may be critical enough to justify internal design and manufacturing. A well-documented case that looks clear in retrospect was IBM's decision to outsource the operating system for the PC to the Microsoft Corporation. Clearly a critical system influencing consumer perceptions and interfacing with all of the application software and most of the hardware, the operating system should have been developed in-house, unless IBM lacked the capability to do so.

When a lack of capability mandates that a critical system be designed or manufactured by a supplier, then the OEM should tightly integrate the supplier in the development process. The supplier should be brought in early and consulted continually in order to ensure that the critical system reflects the desired consumer image and interacts appropriately with other subsystems and components.

The suppliers of outsourced critical systems should be the experts in their field. The customer should define performance specifications, including the cost, but not detailed physical specifications. The supplier, as the expert, should be allowed to make the trade-offs within the performance parameters provided by the customer. Rather than managing the design details, the customer should invest more time in understanding consumer desires.

As an extreme example, consider the Black & Decker Corporation's approach when it developed a glue gun to extend its line of handheld tools. Recognizing that the glue gun required no motor (typically the critical system in Black & Decker tools), the company chose to outsource the entire design and production to the leading glue gun manufacturer. Effectively defining the entire product as a critical system, Black & Decker then focused its effort on market research to determine the functions the company's consumers required.

Critical systems also present a real challenge for companies choosing between variety and standardization. Since consumer perceptions are heavily influenced by variety, the offering of a wide variety of critical system options should be beneficial in attracting customers. Conversely, critical systems have many interfaces and are costly, which suggests that standardization would be best from a cost and reliability standpoint. Ultimately, the answer typically lies between the extremes: Manufacturers usually benefit by offering a small range of options, addressing a good-better-best profile.

Suppliers of critical systems should also be linked to all business functions that participate in the development process. Product designers need input from suppliers to understand any limitations. That is because portions of the end product often must be designed around the critical system, rather than the other way around. Likewise, engineering integration with suppliers ensures that performance objectives are met, and that the system interfaces appropriately with the other parts of the end product. Finally, critical systems can account for much of the end product cost, so finance and purchasing must also be involved early in setting the cost target for the supplier.

Optimal supplier integration for invisible subassemblies looks quite different from that for critical systems. First, the only justification for in-house design and production of an invisible subassembly is a lack of capable suppliers. In-house production offers no strategic advantage and can, in fact, create a disadvantage when in-house operations are inferior to what a well-focused supplier can do.

As in the case of the exhaust supplier, suppliers of invisible subassemblies should be made aware of the broad strategic goals early. But the suppliers should not be brought into the detailed design process until the design parameters are set. A range of designs may also be necessary for invisible subassemblies in order to optimize the cost/performance trade-off, but it can be a tightly controlled range because consumer perceptions of the component aren't a big consideration. Finance and purchasing functions may be the only ones needed early in the design process because they are responsible for setting supplier cost targets to meet the end product cost goals.

Denso Does It

The Denso Corporation, a longtime member of Toyota's supplier *keiretsu* and now a global player in the automotive industry, offers a good example of how an invisible subassembly supplier should be integrated in new product development. Denso designs a family of alternators to support the Toyota vehicle product line. Toyota keeps Denso informed of the overall product line strategy, but then expects Denso to produce a range of parts that can meet the needs defined by the critical systems, at a previously agreed-upon cost target. Denso typically produces an evolving lineup of five or six different-sized alternators to support the dozens of models and hundreds of power-train configurations offered in Toyota's vehicles.

The most successful companies seek input from a variety of potential sources in the ongoing search for simple differentiators. In some cases the company develops its own design concepts; in others it integrates new ideas from innovative suppliers. Regardless of the source, however, manufacturing should be outsourced and the details of the design — such as material selection and manufacturing tolerances — can be left to the supplier. Cell phone designers, for example, need to understand what characteristics consumers seek in the keypad if they hope to differentiate their mobile device from the multitude of options on the market; they don't need to be experts at producing the actual keypads.

Accordingly, suppliers of simple differentiators need to be brought in during the early conceptual design process and linked closely with the designers up front to ensure that the products relate well to the targeted consumer. And because simple differentiators are low cost and have little interface complexity, they offer a great opportunity to create variety to reach a broad range of consumers. Once the general design concept becomes fixed, the supplier can be left to work out the details, since these components also have limited interactions with other elements of the end product.

Companies should seek to minimize product development integration with suppliers of hidden components. Since the component isn't a differentiator in the consumer's mind, does it matter that everyone offers the same windshield washer motor in a car? A manufacturer might even choose to design around a standard catalog part offered by a supplier. In fact, it's desirable to have a standard design for anything that is not a differentiator.

Such standard components, often produced in huge volumes for use in multiple end products, can benefit from economies of scale. The real challenge for most companies is developing systems that make it easy for the design engineer to use a standard part rather than design a new one. (In one company, engineers simply sketched out new custom washers for new product designs because it was easier to do than finding an existing washer in the catalog of a qualified supplier.)

Simplicity and Flexibility

Admittedly, we have attempted to reduce the complex problem of supplier integration in new product development into a rather basic framework. Some products may not align clearly in a single category. Critics also might argue that we have failed to capture some significant dimensions, such as the importance of development cost relative to the total product cost.

We accept such criticisms, but take heart in Albert Einstein's assertion, "A theory is the more impressive the greater the simplicity of its premises, the more different kinds of things it relates, and the more extended its area of applicability."

We do not believe in "solution templates" that give simple prescriptions or "best practices" that employ a one-size-fits-all mind-set. Instead, we prefer practical and flexible frameworks that can clarify the complexity of real business problems while also stimulating thinking about new applications for the same ideas. Our perspective on supplier roles in new product development does not have all the answers, but we hope its simplicity will allow business practitioners to apply it in many different ways. +

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