What Happens When You Outsource Too Much?

By Francesco Zirpoli and Markus C. Becker
WE LIVE IN AN ERA in which business disaggregation is the norm. In industry after industry, managers have taken deliberate steps to separate their value chains and shift important activities and functions to outside suppliers. The outsourcing trend became increasingly visible during the 1990s, when companies such as IBM began to outsource not just manufacturing but also design activities. The trend reached its peak within the past decade, when even companies such as Boeing started outsourcing innovation activities. But what happens when companies become too dependent on outside suppliers and cede them too much control if they lack the same degree of understanding and awareness about how important product or service elements fit together and what's necessary? Once management lets go of critical internal levers, how does it go about reestablishing them?

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With complex products such as automobiles, integration is a key element of performance. That means managers must understand which activities and competencies they can safely outsource and which they need to keep.

BY FRANCESCO ZIRPOLI AND MARKUS C. BECKER

THE LEADING QUESTION
How can companies make the right decisions about outsourcing?

FINDINGS
- Keep activities in-house that have direct impacts on product performance.
- Maintain control over activities that are highly interdependent with the technologies that impact on the performance of the overall product.

THE ANATOMY OF AN AUTO:
A complex product such as a car can be decomposed at different levels of granularity, from large chunks (e.g., the front end, including bumpers, lights, radiator, etc.) to small components (e.g., a brake disc) up to little metal parts.
These questions arose during a multiyear research project examining supply strategy relating to new product development at a major European automotive company (see “About the Research”). In the late 1980s, the company — which we call Alpha — had direct supply relationships with more than 3,000 suppliers, most of them small companies. The suppliers were mostly involved in the production of components, and only to a limited extent in the design of components. In the early 1990s, however, management began shifting increasing amounts of design and engineering work to suppliers. That trend was hastened by the proliferation of electronics in cars, which was beyond the traditional competence base of automotive manufacturers. Although all companies shift activities to outside suppliers, Alpha pushed outsourcing even further. By the mid-1990s, Alpha began to outsource the design of complete systems, such as dashboards, seats and safety systems, to suppliers that had the ability to provide entire systems. (See “The Anatomy of an Auto,” p. 59.)

To senior management, outsourcing entire systems — including the design of those systems — seemed like the right direction. Similar supply arrangements were already common in other industries such as computers. By becoming less integrated, Alpha management hoped to increase flexibility (by being able to switch suppliers and technologies), reduce lead times (by taking advantage of concurrent engineering) and cut development costs while improving product quality (by utilizing suppliers’ specialized expertise). With its new networked innovation strategy, Alpha expected to build close relationships with 350 first-tier suppliers, mostly suppliers of systems, thereby significantly reducing the number of direct supply chain relationships. With independent suppliers, outsourcing coordination would become easier.

Between 1996 and 2001, Alpha underwent structural changes to support the new strategy. As it outsourced design work, experienced engineers who had worked inside Alpha’s functional units designing suspensions, dashboards and electric systems went to work for suppliers. Alpha was still involved with establishing overall targets, specifications and overseeing costs; it set the technical performance targets of the components, provided the physical constraints and benchmarked the technology and cost in order to get state-of-the-art technology at the right price. But as the internal engineering teams got smaller and less up to date on the specific design and technical issues, more and more responsibility shifted to outsiders.

Although internal engineers still managed key functions (development schedules, technical coordination, performance and costs), increasingly suppliers were the ones putting together the “black box” components that defined the overall product. The most influential suppliers went so far as to integrate entire chunks of the car.

Consider how a vehicle’s safety system was designed, managed and integrated. In the 1980s, Alpha designed safety systems in-house and outsourced components such as the seat belts and brakes to suppliers, providing them with the technical specifications. During this period, it continued to maintain responsibility for integrating all of the purchased components. But in the 1990s the company’s responsibilities and those of its suppliers changed (see “How Alpha’s Supply Chain Changed”). Rather than dealing directly with dozens of smaller suppliers providing components for the system, Alpha asked larger suppliers to provide entire systems, thereby shifting responsibility for managing and integrating the safety system from the inside to the outside.

It wasn’t long before management identified problems with this approach. By moving so much new-product design work to outside companies (in the space of 10 years, the percentage of design work being performed externally rose from between 25% and 35% to 85% of the value of a car, more than most com-

ABOUT THE RESEARCH
We systematically observed the consequences of a lean product development approach on a company’s competencies and knowledge domains and the extent that implementation of design outsourcing affected the sustainability of an outsourcing strategy. We chose the context of the automotive industry, one of the most complex in terms of technologies and players involved in innovation processes. We selected a major automotive manufacturer, “Alpha,” with products in all major market segments. The company had maintained a fully integrated design function internally before adopting an extreme outsourcing strategy. We studied the manufacturer’s two research centers and its first-tier suppliers. We observed changes over a 10-year period, during which we collected archival data and company documents and conducted interviews with its employees, its research centers and eight first-tier suppliers. We interviewed 34 managers, including most of Alpha’s top managers in charge of the product development process: the chief technology officer, the senior vice president of human resources, the vice president of product portfolio management, the director of vehicle concept and integration (the manager responsible for systems integration for chassis and vehicle), four of the five vehicle-line executives and key executives in the design and engineering division. Within supply companies, we interviewed account managers, project managers and in some cases the CEOs.
petitors), the company lost its grip on many of the elements that shaped design decisions and outcomes. The pre-development phase was when the concept of the vehicle was worked out and when decisions on performance trade-offs were made. But without any direct involvement in the component design and engineering process, key decisions — for example, how the suspension felt or where the ventilation control knobs were located — were now in the hands of suppliers that didn’t know the customers or what customers expected as well as Alpha did.

In the new design regime, Alpha didn’t become involved in integrating the main components until many of the most important decisions impacting performance were baked into the product (and at which point, undoing them was difficult and costly). However, making changes late in the process was not only complicated; redesigns also were expensive and led to delays in product launches. Moreover, it meant that products could not be fully tested, which often led to assembly problems or product recalls.

By 2005, top management realized that pushing outsourcing deep into the product development process had seriously altered the technical heart of the company. As Alpha’s director of vehicle concept and integration explained, there was a “substantial lack of technological competence in key areas and in the way [we] interpreted system integration.” With this realization, management began to rethink its approach to outsourcing and to decrease the amount of design work it moved outside.

**Defining the Problem**

How did management define the problem? Did managers see an inherent problem in the way lean development undermined the company’s competencies and knowledge base? Or did they see it more as a case of poor implementation of the company’s product design strategy? As we interviewed managers, we learned of several key issues they saw impinging on Alpha’s ability to manage new product development effectively.

Managers noted that it was difficult to integrate systems without having in-depth knowledge about the technologies underlying each system.

### HOW ALPHA’S SUPPLY CHAIN CHANGED

From the mid-1980s to early 1990s, Alpha designed the passenger safety system and had many direct links to suppliers that made components (such as seat belts and airbags) to its specifications. But starting in the mid-1990s, that changed. Alpha set the performance targets but a system supplier designed the passenger safety system, bought the components and integrated them into the car.

- **Navigating and balancing the various technical, cost and performance objectives presented major trade-offs that were hard to sort out simultaneously. Engineers realized that these trade-offs were difficult to resolve without in-depth knowledge about the technologies underlying the systems that make up a car.**

- **Because of internal staff reductions and engineers’ weakened abilities to remain up to speed on specific technical issues, managers said Alpha had no choice but to lean more heavily on outside suppliers during the pre-development phase. This sowed the seeds for problems during later phases of the product development process.**

There is an important difference between integrating physical systems and integrating the performance of such systems. Moreover, component-specific knowledge is crucial to the ability to integrate systems and performance; and learning by doing holds the key to maintaining component-specific knowledge.

To understand how to build effective network innovation strategies, we explored the balance between having sufficient architectural and component-specific knowledge internally to design new models, and outsourcing such knowledge by leveraging external sources of innovation. The ability to strike this balance — knowing what kinds of activities and competencies companies can delegate to suppliers and what they need to keep — has significant strategic implications for companies that design and manufacture complex products.
Physical Systems Versus Systems Performance

Cars are designed to deliver certain levels of performance in areas such as safety, handling, fuel consumption and noise. Different systems are made up of multiple parts and components, but assessments about performance are focused on how the systems interact with one another. For example, the vehicle safety system includes brakes, seat belts and air bags. However, in the event of a collision, many other elements, including the design and position of the engine or the configuration of the chassis, can influence what happens. Another problem with decomposing performance is that many factors such as speed, noise and vibration are interdependent. As a result, there are limits to how fully one can specify how much an individual component or system contributes to vehicle-level performance.

Managing the technical interdependencies between individual components presents challenges for overall product performance. Engineers need to make trade-offs (for instance, between a component’s technical performance and its cost), but the exact nature of the interdependencies is not always known or predictable. To be able to make such performance-based trade-offs competently, it’s not enough for engineers to have systems-level knowledge. They also need to have an understanding of components, something that many Alpha engineers lost as the number of opportunities for learning by doing diminished. That raised important questions about the prerequisites for making performance trade-offs and how companies should be organized. We found that there are several contributing factors to success.

Developing Component-Specific Knowledge

In making performance trade-offs, it’s not enough to be informed in a general way about the key technological trade-offs involved in designing components and subsystems. Managers need to have detailed knowledge and understanding of how subsystems interact within the products to achieve different outcomes. Such knowledge is sometimes called “architectural knowledge.” One of the main issues Alpha encountered was the difficulty of setting the cross-system functional requirements, which stemmed from its insufficient knowledge of the underlying components. Prior research has shown that knowledge of underlying components is essential for identifying the consequences of different trade-offs and making the best decisions regarding overall product performance.

Component-specific knowledge is key to architectural knowledge, and it plays an essential role in determining the performance of complex products. Researchers have studied the extent to which organizations can achieve a necessary level of understanding of the components that make up systems by using indirect means such as listening posts, shadow engineering, co-location or careful monitoring of technological advances (through scientific conferences, journals, industry meetings, etc.). Although such methods may be informative, they are not sufficient for providing the elevated level of understanding that allows managers to make detailed performance trade-offs.

Our research supports the view that component-specific knowledge is an essential building block that complements and strengthens a company’s architectural knowledge. Without it, Alpha failed to develop systems integration capabilities that allowed it to work successfully with outside suppliers. When all is said and done, this knowledge is best acquired by being immersed in the details of component development work, providing opportunities for learning by doing.

Practicing “Learning by Doing”

The problems with performance integration do not always manifest themselves right away. At the point when Alpha began implementing its outsourcing strategy, engineers still had deep and extensive knowledge of the underlying systems, and they were able to guide suppliers’ engineering work. However, without new learning opportunities, their competencies related to systems and components design eroded sharply over the next few years. The company tried to compensate for the loss of learning opportunities, primarily through co-location. For example, during the pre-development phase, suppliers of key systems such as safety systems, dashboards and seating systems were invited to co-locate their engineers in Alpha’s design and engineering facilities. The goal was to encourage communication and collaboration and to promote as much knowledge transfer as possible early in the development cycle. Despite these efforts, the engineers’ ability to remain on top of the design process deteriorated.
Rather than working “hands-on” alongside suppliers on design and engineering problems, they acted more as supervisors — detailing the specifications and managing the schedules. Separating Alpha’s engineers from both the underlying design of components and new opportunities to learn by doing weakened their ability to make sound decisions that ultimately affected vehicle performance.

This experience supports the argument that operational details and strategy are tightly integrated. In particular, it underlines the importance of learning by doing as a key lever for acquiring and maintaining the detailed knowledge that’s needed for determining performance trade-offs. Other approaches such as co-location are not a substitute.

**Adopting Mechanisms for Technological Renewal**

To the extent that component-specific knowledge is essential and that the best way to acquire this knowledge and remain up to date is through learning by doing, companies need to find ways to identify which knowledge and development work should remain in-house. Our automotive industry research indicated two criteria companies should apply in determining what they need to keep: (1) things that have a direct impact on key product performance and (2) things that have a high degree of reciprocal interdependency with technologies that help determine overall product performance. The first criterion refers to how relevant a component or subsystem is to a key performance of the product. For example, a critical performance element for a sports car is “handling.” Given the first criterion, an auto company will want to develop and maintain deep in-house knowledge about the components and systems that significantly influence handling. Without this knowledge, developing an attractive product would be difficult, if not impossible. This suggests that the automaker should focus on all subsystems that have a significant impact on handling (the steering system, suspension and so on).

The second criterion suggests paying attention to a different matter: whether the component-specific knowledge that’s key to achieving a given performance is associated with a component or subsystem that is highly interdependent with the rest of the vehicle. Consider our earlier example of the safety system. In a frontal collision, the performance of the safety system in protecting the passengers depends on the design of the different subsystems of the safety system (including seat belts, brake systems and the anti-lock brake system), and how they interact. Other factors include how the engine absorbs the shock, the layout of the front end of the car, and the material and design of the dashboard — elements that are not part of the safety system per se. In cases where interdependency is high and where performance affected by the component or system is key for customers (i.e., the first criterion is respected), the company may want to reacquire as much knowledge as possible from suppliers quickly; in cases where it’s low, components can be easily outsourced and later integrated.

**Organizing for Learning**

So how can a company organize itself to maintain component-specific knowledge and learning opportunities to deliver innovative products that perform the way customers expect? Our research at Alpha indicated some important organizational guidelines. First, companies need to organize so they can develop, maintain and reestablish the competencies identified above. Second, it is not enough to reestablish component-specific knowledge and to invest resources in pulling together physical systems and components. In order to meet high performance standards for the overall product, companies also need to have the ability to experiment, test and use trial and error across the entire product. Without this ability, there are no guarantees that reciprocal interdependencies between the individual performance of systems and components will be adequately addressed. However, experimentation and testing can’t be conducted casually — it needs to be well organized. One of Alpha’s responses was to increase the number of inside people with skills such as virtual simulation that were considered important for pre-development. These skills enhanced efficiency by allowing engineers to represent performance without having to build expensive prototypes.

Performance integration has to be recognized as a critical organizational task that’s built into the structure of the company. As other researchers have noted, it requires resources and holding someone responsible for making it happen. But there is still another important strategic element that has to do with timing: when the design interventions occur. For example, in
the automotive industry, the number of interdependencies increased as the design process moved along and specifications were frozen. The earlier that interventions can be made, the less disruptive and costly design changes will be. The ideal, of course, is to design products that are right the first time. However, to the extent that this is not realistic, having the ability to manage experimentation will permit better and more efficient performance integration.

Interestingly, Alpha’s experience also shows that managing outsourcing by relying on the modularization of the product can have fundamental flaws. Modular product architecture may make good sense for dealing with physical integration, but it is not adequate for resolving issues of performance.

Focusing on product-level performance pushes companies to build and maintain enough competence to resolve the important performance trade-offs. That means organizations need to manage and maintain the right component-specific knowledge. The economic argument — that design and engineering outsourcing provides cost savings and increased efficiencies — can be offset by taking into account other strategic considerations. Decisions about which design tasks to outsource to suppliers and which ones to keep need to be made by looking at the whole picture rather than only short-term cost and efficiency. Once the critical competencies are identified, an essential task of managing innovation is developing and maintaining them properly.

**Francesco Zipoli** is an associate professor of management at Università Ca’ Foscari, in Venice, Italy. **Markus C. Becker** is a professor of organization theory at the Strategic Organization Design Unit, University of Southern Denmark, in Odense, Denmark. Comment on this article at http://sloanreview.mit.edu/x/52208, or contact the authors at smrfeedback@mit.edu.

**REFERENCES**


2. The insight into the essential role of component-specific knowledge to design larger systems has been a central finding of research in the automotive industry. Interestingly, the same conclusion was also reached by research on innovation in the comic book industry. In this industry, Taylor and Greve found that combining knowledge requires a deep understanding of knowledge, rather than just information scanning or exposure. Their research hints at a reason why shadow engineering, listening posts and the monitoring of technological advances might not be sufficient to maintain component-specific knowledge at the cutting edge. See A. Takeishi, “Knowledge Partitioning in the Interfirm Division of Labor: The Case of Automotive Product Development,” Organization Science 13, no. 3 (2002): 321–338; Takeishi, “Bridging Inter- and Intra-Firm Boundaries”; and A. Taylor and H. Greve, “Superman or the Fantastic Four? Knowledge Combination and Experience in Innovative Teams,” Academy of Management Journal 49, no. 4 (2006): 723–740.

3. Takeishi, “Knowledge Partitioning.”


5. Prior research has identified a further criterion that companies should consider in making decisions about what to keep. It has to do with technological “newness,” and it is especially important in technologically advanced areas where product performance integration is complex and where product architecture and company boundaries influence each other. In these situations (for example, products using new powertrains), having a higher level of component-specific knowledge can be strategically vital. Toyota Motor Corp.’s success at leveraging its hybrid electric and gas engines in its Prius and other models offers a good example. See Takeishi, “Knowledge Partitioning”; and S.K. Fixson, Y. Ro and J.K. Liker, “Modularization and Outsourcing: Who Drives Whom? A Study of Generational Sequences in the U.S. Automotive Cockpit Industry,” International Journal of Automotive Technology and Management 5, no. 2 (2005): 166-183.


7. In response to the challenges, Alpha managers began to seek out ways to back away from their black-box sourcing strategy. They did this in part by increasing the number of inside people with skills such as virtual simulation that were considered important for pre-development. These skills were seen to enhance efficiency in pre-development activities by allowing engineers to represent performance without having to build expensive prototypes.


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