Rapid-Response Capability
in Value-Chain Design

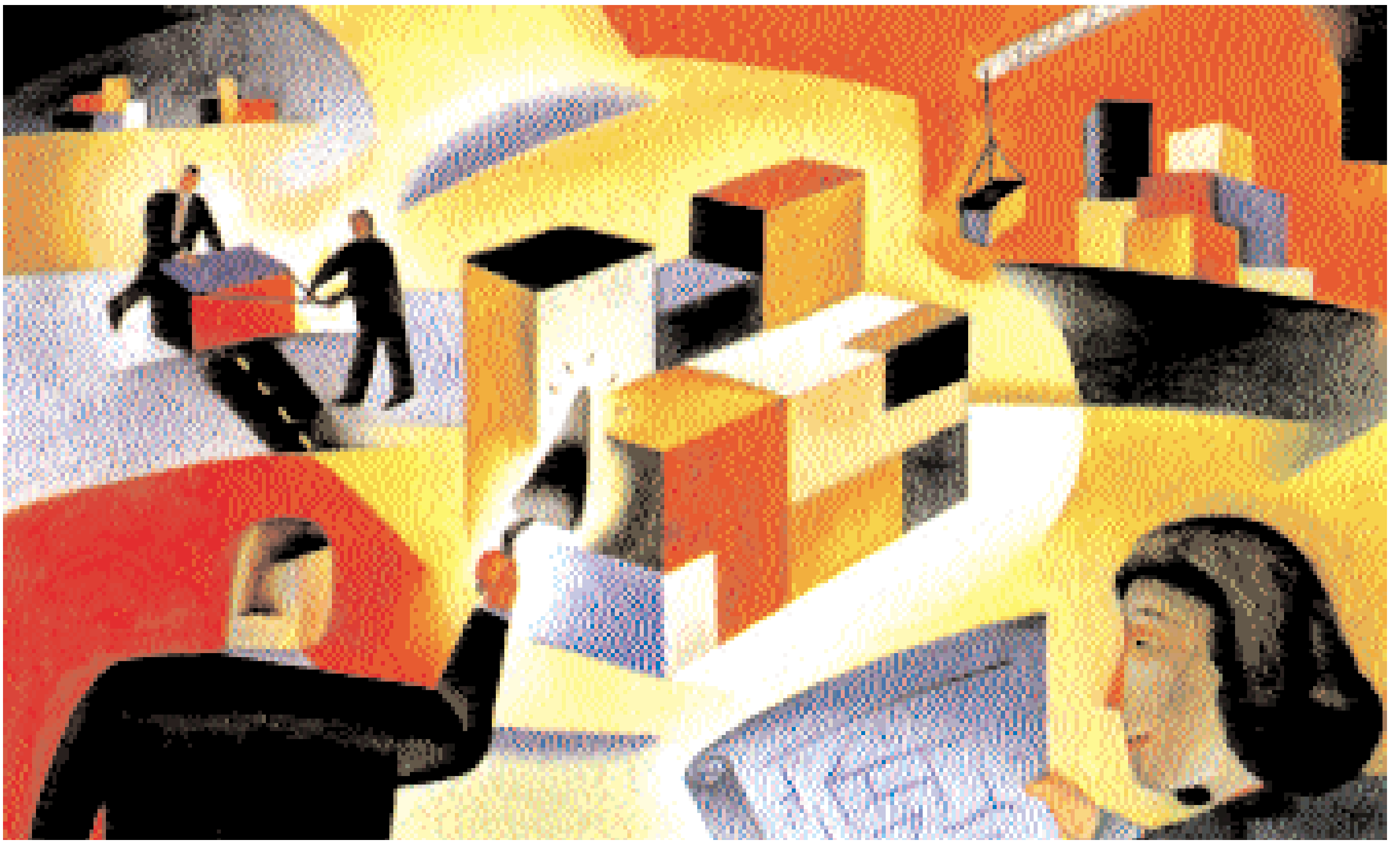


Illustration: ©Robert Pastrana/SIS

Organizations today must quickly and continually assess which parts of their value chain are vulnerable, which parts are defensible, which alliances make strategic sense, and which threats are deadly.

Charles H. Fine, Roger Vardan, Robert Pethick and Jamal El-Hout

The design of a company's value chain has traditionally been viewed as a static enterprise, the assembling of a fixed set of suppliers and distribution channels to get and keep competitive advantage. But the pace of change in today's technologies and markets has made that approach obsolete. Competitive advantage is, at best, a fleeting commodity that must be won again and again. And that requires continual disintegration and reintegration of organizations, with frequent reshuffling of structural, technological, financial and human assets, as every player in the value chain seeks some sort of temporary competitive advantage. No matter what business or industry one looks at — from

Charles H. Fine *is a professor of management at the MIT Sloan School of Management.* ***Roger Vardan*** *is manager of the Strategy Development Group at General Motors Powertrain, Pontiac, Michigan.* ***Robert Pethick*** *is director of Pittiglio, Rabin, Todd & McGrath, Inc., Detroit, Michigan.* ***Jamal El-Hout*** *is vice president, planning, General Motors Europe, Zurich, Switzerland. Contact them at charley@mit.edu, roger.vardan@gm.com, bpethick@prtm.com and jamal.el-hout@ch.gm.com.*

telecommunications to computers, automobiles to health care — ongoing value-chain assessment and design at the corporate level has become a necessity.

The best examples of such innovative value-chain adjustment can often be found in the dynamic evolution of upstart ventures and aggressive high-technology giants. With their constantly shifting technologies, processes and organizational structures, these companies provide useful lessons in how value chains can be managed to respond rapidly to ever changing strategic challenges. These New Economy players, however, are not the only ones facing dramatic and sweeping changes throughout their value chains. All companies in all industries are operating on ever faster evolutionary tracks and at ever greater risk.

Every industry has its own *clockspeed*[1] — or rate of evolution — depending on its products, processes and customer requirements. Individual capabilities can lose value overnight, hastened by rapidly changing technologies, abrupt shifts in the larger economy or by the new tactics of competitors. The faster the industry clockspeed, the shorter the half-life of any given competitive advantage. A company's real core capability — perhaps its only sustainable one — is its ability to design and redesign its value chain in order to continually find sources of maximum, albeit temporary, advantage.

Understanding and redesigning a company's value chain begins with a map, one that identifies the organizations involved, the subsystems they create, the capabilities they bring to the value proposition, and the technological contribution each makes to the company's products and services. In this context, we have developed a framework that seeks to answer questions in four key areas of value-chain strategy:

- *Architecture*: Where is value being created, and which activities are not adding to overall enterprise value?
- *Sourcing*: What areas of the business should remain in-house versus being outsourced?
- *Investments*: Where should investments be made, and how should they be leveraged?
- *Alliances*: How can the value chain be organized to optimize existing and emerging alliances?

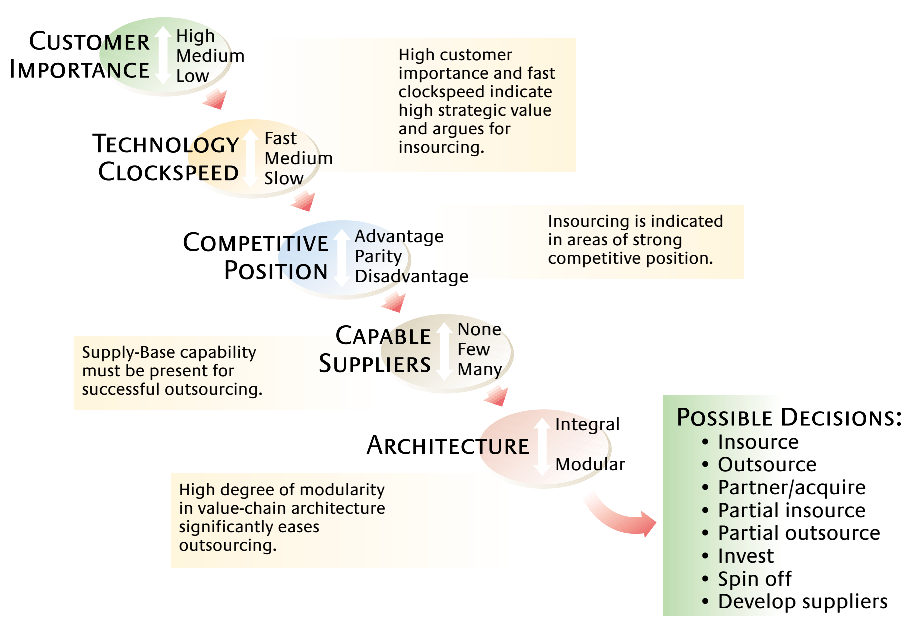
The Value-Chain Strategy Framework

The first step in any analysis is to identify the elements of the value chain — its products, processes and subsystems — and assign each a useful asset value. To complement the traditional tool of economic value added (EVA) analysis,[2] which provides a quantitative financial value, we developed a strategic value assessment (SVA) model that adds a qualitative component to the evaluation and decision-making process. (See "Strategic Value Assessment: Evaluating Five Key Criteria.") This model was developed during a yearlong strategic value-chain assessment at the General Motors (GM) Powertrain organization, which is responsible for the sourcing, engineering and manufacturing of all engines and transmissions for GM vehicles and those of numerous other manufacturers.

The model we developed at GM Powertrain identifies two broad categories of assets: knowledge assets and supply assets. Think of knowledge assets as those related to the design and engineering of products, processes and services. Supply assets relate primarily to manufacturing and delivery capabilities. This is an important distinction for an organization to make when assessing whether to outsource. At a strategic level, every sourcing decision through-

Strategic Value Assessment: Evaluating Five Key Criteria

To build qualitative factors into their value-chain strategy framework, the authors developed a strategic value assessment model. It takes into account how each sourcing decision affects customer preferences (*customer importance*), how rapidly the underlying technology is changing (*technology clockspeed*), how the company compares to its competition in cost, quality, and other dimensions (*competitive position*), how deep and capable is the outside supply base (*supply-base capability*), and how integral or modular is the value-chain element to the architecture of the overall product, service or system (*architecture*).



out the value chain is a choice between dependence and independence for supply and knowledge.[3] Deciding to outsource production, for example, is a decision to be *dependent* upon others for a supply asset. A decision to "insource" the associated engineering work, on the other hand, is a choice to remain *independent* for a knowledge asset.

Our SVA model considers how each sourcing decision affects customer preferences (*customer importance*); how rapidly the underlying technology is changing (*technology clockspeed*); how the company compares to its competition in cost, quality and other dimensions (*competitive position*); how deep and capable is the outside supply base (*supply base capability*); and how integral or modular is the value-chain element in the architecture of the overall product, service or system (*architecture*).

As we discuss below, the model assumes that the greater the importance to the customer, the more important the sourcing decision; the faster the technology clockspeed, the riskier it is to be fully dependent on an outside supplier; the stronger one's own competitive position in designing or making the value-chain element, the more desirable it is to insource it; the more capable the supply base (in number of competent, viable suppliers) the safer to outsource; and the more integral the value-chain element to the overall system, the riskier it is to be fully dependent on an outside supplier.

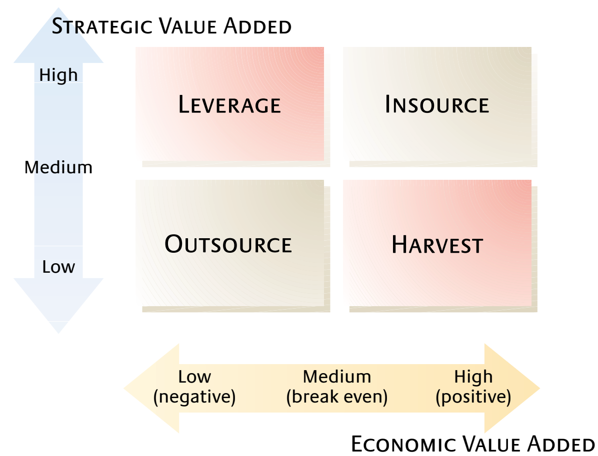
Combining the economic and strategic value analyses enables us to classify key elements of the value chain as having both high economic and strategic value (likely insourcing candidates); both low economic and strategic value (likely outsourcing candidates); high economic and low strategic value (potential to harvest assets); or high strategic, but low economic value (potential for future leverage). (See "Synthesizing Strategic and Economic Elements.")

Once the value-chain assets are categorized, our model compares the existing sourcing posture for each element with the desired position. When elements do not align, the model generates alternatives. The objective is to define a target value-chain configuration on the basis of both the strategic and economic analyses. "The systems approach to partitioning our knowledge assets and supply capabilities, and the application of consistent criteria to each partition enabled us to formulate the ideal value-chain configuration — a target toward which GM Powertrain could migrate," says Arvin Mueller, GM Powertrain vice president from 1997 to 2001.

The model is, of course, an analysis tool and part of a coherent value-chain strategy decision-making framework that includes the development and assessment of strategic sourcing options and the selection (and implementation) of a chosen option. (See "The Value-Chain Strategic Decision-Making Framework.") "With our ideal value-chain configuration in hand," says Mueller, "partnership or supply synergies can now be pursued with value creation as a crafted intent — not a hope."

Synthesizing Strategic and Economic Elements

Combining strategic value assessment with traditional economic value added analysis enables the classification of key elements of the value chain as having both high economic and strategic value (likely insourcing candidates), both low economic and strategic value (likely outsourcing candidates), high economic and low strategic value (potential to harvest assets), or high strategic, but low economic value (potential for future leverage).



Developing the Framework: GM Powertrain Group

Our analysis of the GM Powertrain business group provided the setting to develop and apply our model of how a value chain can be strategically structured to respond to changing market dynamics.

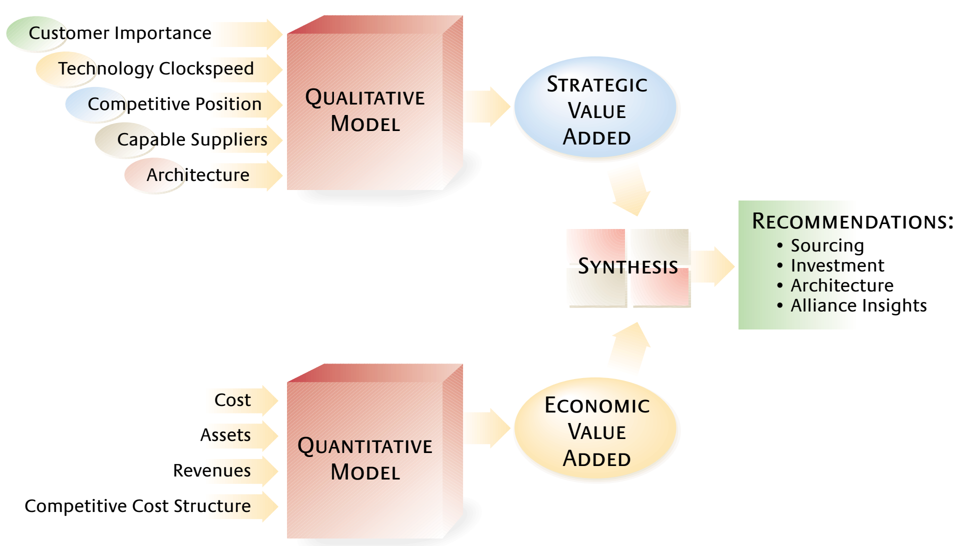
GM Powertrain is the world's largest manufacturer of automotive engines and transmissions with more than 35 engineering and manufacturing facilities and 76,000 employees spread across the globe. When we began our project, GM Powertrain faced a complex array of challenges that included cost reduction and performance improvement, as well as navigation of the first real threat of technological disruption in the century-long dominance of the internal combustion engine.

Our team's charter was to start with a focus on the subsystem value chain, assuming that the basic product line would remain stable.[4] Automotive engine value-chain subsystems include the traditional casting and machining of metal parts, electronic hardware and software for control systems, as well as subsystems for fuel, exhaust, ignition, sensing, etc. It is at this level that many customer preferences — with respect to fuel economy, emissions and horsepower, for example — are addressed.

Customer Importance Corporate success, at GM and elsewhere, begins and ends with customer satisfaction. For engines and transmissions, customer preferences can be estimated in part by observing buying behaviors. That is, one can tabulate how frequently customers choose a gasoline engine over a diesel or a manual transmission over an automatic. However, to uncover subsystem level preferences and biases, surrogate measures are often needed, in part because consumers do not have direct preferences on subsystems such as engine blocks, valve trains or exhaust systems. Instead, one must elicit customers' tastes on performance characteristics such as fuel economy, acceleration, emissions and quietness (noise, vibration and harshness), and then relate those to powertrain subsystems and value-chain process elements.

The Value-Chain Strategic Decision-Making Framework

The synthesis of quantitative and qualitative inputs provides the basis for any strategic sourcing decision.



As an example, consider two different classes of consumers (pickup truck buyers and minivan buyers) and two different engine subsystems (the starter motor and the engine controls logic algorithms). In the pickup truck segment, there are loyal GMC and Chevrolet customers who buy GM products for the superior acceleration and smoothness of their engines. For such buyers, knowing that the control systems are designed by GM engineers, generation after generation, can be important to continued customer loyalty and to the vehicle-purchase decision. Those buyers may not care, however, whether GM designs or builds the starter motors, which have little, if any effect, on driving characteristics. Minivan buyers, on the other hand, expect reliability from their engines, but typically pay much more attention to the layout of the vehicle's interior space than to any engine characteristics and may not care which parts of the engine are designed by GM.

To implement the customer-importance component of the model, GM Powertrain's value-chain team conducted workshops with engineering and manufacturing staffers, relating engine and transmission subsystems to various performance characteristics perceivable by customers. GM Powertrain also conducted clinics with customers to build a statistical model, capturing their preferences about powertrains. The resulting model aids in understanding what product characteristics the customer will trade off or pay for at a premium. For an organization whose annual investments in products, processes, capacity and technology are typically measured in billions of dollars, the model provides a critical new source of data to help direct these investments and related sourcing decisions.

Technology Clockspeed The second criterion in our SVA model assesses the rate at which underlying technologies of a product or system are changing. Value-chain elements with fast clockspeeds are more prone to experience rapid innovations and are thus more likely to require higher ongoing knowledge investments to maintain technological competency. Compare an engine's cylinder block, which has relatively stable underlying process technologies (aluminum casting, for example), with the microchip controller, which is the computerized "brain" of the engine and has underlying technologies (e.g., semiconductors, algorithms) that change quite rapidly. Although the cylinder block is a crucial element of the engine, the relatively slow pace of underlying technological change makes it less likely that a loss of competitive advantage would result if its manufacture were to be outsourced. On the other hand, once dependent on a supplier for a fast clockspeed technology like controllers, it can be difficult and/or costly to regain capability.

For an organization whose annual investments in products, processes, capacity and technology are typically measured in billions of dollars, the model provides a critical new source of data to help direct these investments and related sourcing decisions.

Competitive Position Strategic advantage can often be gained when companies insource those elements of their value chain in which they have relative competitive advantage. This is especially true when those areas are also characterized by high customer importance and relatively fast technology clockspeeds. By contrast, areas of relative competitive weakness could be candidates for outsourcing, since a company may not be able to overcome a weakness internally without significant investment, if at all. Imagine, for example, that benchmarking studies were to show that the total manufacturing cost for a given component at GM was about equal to the industry average. GM might then decide to outsource that component at a lower cost. For the same component, however, if a company such as Toyota were to find that its internal manufacturing costs were the lowest in the industry, it might decide to keep the manufacturing in-house. Same component, same customer importance, same technology clockspeed, but different sourcing decisions based on competitive position.

Capable Suppliers The relative strength of the supply base for any given value-chain element is also an important consideration in the strategic value framework. The fewer suppliers that exist for any outsourced element, the more considerable the leverage those suppliers have over the OEM. On the other hand, when an extensive supply base exists, the key capabilities are more likely to be judged as commodities and not necessarily a source of strategic value.

Consider the sourcing strategy that GM Powertrain might consider for the casting of engine blocks. As mentioned, the engine-block casting process is not a value-chain component that is prominent in the customer's consciousness. Also, the clockspeed is relatively slow, so we might consider this process as not particularly strategic. Yet, GM, like most of the world's large automotive OEMs, is largely vertically integrated in engine-block casting. For one thing, the supply-base capability is low for the volumes needed by the large OEMs. If one of the major auto companies chose to spin off its casting plant as an independent entity, that would create a large independent supplier. But having only one such supplier might leave the OEM in the type of situation IBM found itself in with Intel: dependent on a single supplier with little leverage on price. As a result, developing a capable supply base when none exists can be a difficult task. A first step to solving this problem is to create an internal marketplace. For firms, such as GM, that have many international affiliates and alliance partners, forming multiple suppliers from the capabilities of these affiliates may provide a viable path to developing a robust supply base.

Architecture Following Ulrich,[5] we think of product architecture as the scheme by which the function of a product is allocated to its constituent components. Ulrich distinguishes between integral and modular product architectures, where integral architectures exhibit close coupling among the elements of the product. In contrast, a modular architecture features separation among a system's constituent parts, where standard interfaces make the exchange of parts relatively simple. An automobile engine is a fairly integral system. One certainly cannot build one from off-the-shelf parts as can be done with a stereo system or a bicycle, for example. On the other hand, although the design of the many subsystems is fairly integrated, once the design is complete, the manufacture of those subsystems can be quite modular. In many such cases, the best course of action is to retain independence for knowledge in the engineering and manufacturing domains, but to allow significant dependence for supply in manufacturing capacity.

Applying the Framework: GM Powertrain's Exhaust-System Engineering

As an example of the SVA approach, consider an analysis of the Powertrain exhaust subsystem, which includes the catalytic converter, air-injection reaction system, oxygen sensors, etc. The performance of this subsystem affects vehicle emissions and acceleration, and it is quite important to many customers. Its key driver is sensor technology, which is evolving rapidly partly in response to stringent government regulations. GM Powertrain's competitive position in the marketplace is strong. Athough there are suppliers capable of component design, currently no suppliers are capable of developing the entire subsystem, which is essentially modular and can be used in many different vehicles.

These characteristics — high customer value, rapid technology clockspeed, neutral competitive advantage, weak supply base and modular architecture — add up to a value-chain component of high strategic value that is a likely candidate for insourcing. Recommendations might include outsourcing the fabrication of components, but maintaining in-house ownership of knowledge assets such as the design, process and architecture functions.

Applying the Framework: IBM's Fateful Outsourcing Decision

We believe the SVA model is applicable to many industries. Take, for instance, IBM's decision in the early 1980s to outsource to Intel the manufacture of the microprocessor for its first personal computer — one of the most significant sourcing decisions of all time. At the time, IBM was the world's largest semiconductor manufacturer, but it did not have a microprocessor that could serve as the brains for its new product. The company reasoned correctly that the customers would not care whether the computer's microprocessor was made by IBM. On this dimension alone, outsourcing the microprocessor was a reasonable choice. However, since semiconductor technology clockspeeds are so fast, a supplier that achieves a lead would prove tough to dislodge. Combine this with the small supply base — Intel and AMD were the only qualified suppliers — and the risk increases. Add to this the failure to recognize that modular architecture combined with an independent Wintel supply base would create extremely low barriers to entry for clone makers such and Compaq and Dell, and we gain some insight into why IBM's outsourcing decision was ill-advised from an SVA perspective. More specifically, note that although the microprocessor is modular when considered as an isolated subsystem of the PC, it is integral to the operating system, and this integral nature made retaining control of the value chain much more difficult for IBM.

Applying the Framework: Outsourcing Consumer-Product Manufacturing

Consider a hypothetical example of a consumer-products company, such as Proctor & Gamble or Unilever, assessing whether it should insource or outsource the manufacture of a branded product, say, shampoo. Investment in brand image is important, but few, if any, shampoo customers are likely to know or care which company actually mixes the ingredients and bottles the shampoo. Mixing and bottling are relatively mature and well-known processes, competitive differences among manufacturers are likely to be small, and the technology clockspeed for shampoo mixing and bottling is slow. Furthermore, many companies are capable of serving as suppliers for mixing and bottling, and the production of shampoo is quite modular, easily matched with the core functions of product design and brand-image development. Therefore, our model finds no strong strategic case to be made for consumer-products companies to own and operate their shampoo factories. Yet many of them do, probably as a result of company history and organizational inertia. For companies that wish to take a fresh look at these kinds of issues, we believe the model described here provides a practical, yet comprehensive approach.

Applying the Framework: Napster's Unrecognized Supply-Chain Value

The brief history of Napster is illustrative in the context of the SVA model. Started by a 19-year-old hobbyist as a venue for sharing MP3 music files among friends, Napster became embroiled in a seminal copyright infringement debate when its subscriber count reached into the tens of millions and a majority of its equity was purchased by venture capitalists. The Recording Industry Association of America (RIAA), which represents large music companies that hold the lion's share of rights for all commercially recorded music, challenged Napster's business model and successfully applied a legal strategy to have the courts shut it down. Despite the RIAA's legal success, its strategic vision may turn out to be quite myopic. Had the RIAA done a value-chain analysis, it may have concluded that Napster's huge market share represented its best chance to preserve any degree of control over the future of online music distribution.

About the Research

As we developed our framework at General Motors Powertrain, we continually collected data to quantify the concepts. For example, a major customer-preference assessment project was launched to collect data for the *customer importance* component of the model. For data on *technology clockspeed* and *architectural relationship*, dozens of engineers were interviewed and their assessments tabulated. For the *supply-base capability* and *competitive position* components, we interviewed experts in procurement, financial analysis, benchmarking, etc. In the first use of the model, we developed a database of each of the five criteria (and the underlying rationale behind each rating) for more than 20 engine subsystems and 20 transmission subsystems, as well as various supply-chain elements for both engineering and manufacturing.

In particular, Napster's identity as the central node of music file sharing was important to customers — the clockspeed on file sharing being very fast, Napster's competitive position as the preeminent online MP3 file-sharing coordinator was unsurpassed, and no other supplier could come close to providing the music file-sharing community that Napster had captured. As a result, acquisition of this irreplaceable asset (presumably by alliance) might have made far more sense than destroying it.

As widely predicted, Napster's demise has led to a multitude of Web sites devoted to free music file sharing.[6] Some of these Web sites are operated by what might be called "music industry anarchists," entrepreneurs who seem to be more interested in making music widely available for free than they are in financial remuneration. As a result, the upcoming battle between the RIAA and the anarchists is likely to be very different from the one with Napster. Anarchists are hard to find and harder to hit. By destroying Napster rather than finding a way to coopt or control it, the RIAA has made its value chain significantly more difficult to control.

Building SWAT Capability in a Fast Clockspeed World

More than ever, as all companies — almost regardless of industry — must operate in fast-clockspeed environments, they need to continuously assess their supply and distribution chains. Strategic value-chain analysis can ultimately help create an organizational capability for fast response to rapidly evolving industry dynamics — what we call a "value-chain SWAT capability."[7] The case of Napster provides a prime example of how quickly value-chain dynamics can change and reshape industries. In a shockingly short period of time, Napster disrupted a significant portion of the entire distribution segment of the music industry's value chain, which happens to be the stage of the chain where most revenue is traditionally collected after large music companies have made significant investments in upstream value stages.

Even slower clockspeed industries like the auto industry must also be prepared for rapid value-chain transformations. When the first phase of our GM Powertrain project was almost complete, for example, GM announced a major alliance with Fiat, Italy's leading vehicle manufacturer. Building on the value-chain analyses that our project team had developed, we were able to make specific recommendations that influenced the alliance structure in the powertrain domain.[8]

When such disruptions occur, value-chain SWAT teams must rapidly assess which parts of the chain are vulnerable, which parts are defensible, which alliances are palatable, and which threats are deadly. The value-chain framework presented here can help organizations build this critical capability.

ACKNOWLEDGMENTS

The authors would like to thank Arvin Mueller for conceiving of the GM Powertrain value-chain project and, more importantly, for leading it with his active involvement and strategic insights. The authors also acknowledge the valuable contributions of Cuneyt Oge of Pittiglio, Rabin, Todd & McGrath; Gary Blair and Alan Kennedy of GM Powertrain; Daniel Whitney of MIT; as well as the members of the GM Powertrain Strategy Development Group and the Pittiglio, Rabin, Todd & McGrath team.

REFERENCES

1. See, for example, C.H. Fine, "Clockspeed" (Cambridge, Massachusetts: Perseus Books, 1999).

2. See, for example, A. Ehrbar, "EVA: The Real Key To Creating Wealth" (New York: John Wiley & Sons, 1998), or S.D. Young and S.F. O'Byrne, "EVA and Value-Based Management: A Practical Guide to Implementation" (New York: McGraw-Hill, 2000).

3. The starting point for this model was the material in Fine, "Clockspeed," Chapter 9. The work, in turn, builds on P.M. Gutwald, "A Strategic Sourcing Model for Concurrent Product, Process and Supply-Chain Design" (master's thesis, MIT Sloan School of Management, need year), and C.H. Fine and D. Whitney, "Is the Make-Buy Decision Process a Core Competence?" eds., M. Muffatto and K. Pawar, "Logistics in the Information Age" (Padova, Italy: Servizi Grafici Editoriali, 1999), pp. 31-63 (also available at http://web.mit.edu/ctpid/www/Whitney/papers.html).

4. Later and ongoing work addresses the product value chain, i.e., what products should be in the GM Powertrain portfolio. See, for example, S.S. Metcalf, "A System Dynamics Exploration of Future Automotive Propulsion Regimes" (master's thesis, MIT Sloan School of Management, June 2001).

5. Karl Ulrich, "The Role of Product Architecture in the Manufacturing Firm," Research Policy 24 (1995): 419-40.

6. S. Rosenberg, "Revenge of the File-Sharing Masses!" July 20, 2001, http://www.salon.com. Also see http://www.zeropaid.com.

7. In police work, SWAT stands for special weapons and tactics. SWAT teams are rapid-response teams that are trained to react to difficult and unanticipated urgent matters. We think the analogy fits well here.

8. J. Israely, "Looking More Savvy Than Sentimental: A Year After Rejecting Merger, Fiat's Silencing Critics," Boston Globe, June 23, 2001, p. C1.

Reprint 4327