Organizing for Innovation: **When Is Virtual Virtuous?**

by Henry W. Chesbrough and David J. Teece

Advances in information technology have made it easier for companies to exchange data and coordinate activities. That has given rise to a radical new vision of corporate organization – one in which individual companies outsource many of their activities to an array of partners. Such virtual enterprises may be more efficient, but what are the broader strategic implications of rampant subcontracting?

Henry Chesbrough and David Teece sound a note of caution. When it comes to innovation, they argue, virtuality often does more harm than good. Loose partnerships of companies inevitably produce more conflicts of interest than do centrally managed corporations, and those conflicts can hamper the kind of complex, systematic innovation that creates valuable business breakthroughs. Innovation is a destabilizing force and will therefore be resisted by companies wary of upsetting a comfortable status quo.

Chesbrough and Teece acknowledge that some degree of outsourcing can further corporate creativity and that virtuality makes sense under certain conditions. But every company, they contend, needs to tailor its organization to its own operations and its unique sources of innovation. Blindly following fads is a recipe for disaster.

Outsourcing may make you more flexible. But it could also undermine your ability to innovate.

CHAMPIONS of virtual corporations are urging managers to subcontract anything and everything. All over the world, companies are jumping on the bandwagon – decentralizing, downsizing, and forging alliances to pursue innovation. Why is the idea of the virtual organization so tantalizing? Because we have come to believe that bureaucracy is bad and flexibility is good. And so it follows that a company that invests in as little as possible will be more responsive to a changing marketplace and more likely to attain global competitive advantage.

There is no question that many large and cumbersome organizations have been outperformed by smaller "networked" competitors. Consider, for instance, the eclipse of IBM in PCs and of DEC in workstations. But while there are many successful virtual companies, there are even more failures that don't make the headlines. After many years of studying the relationship between organization and innovation, we believe that the virtues of being virtual have been oversold. The new conventional wisdom ignores the distinctive

role that large integrated companies can play in the innovation process. Those rushing to form alliances instead of nurturing and guarding their own capabilities may be risking their future.

What's Special About Virtual?

What gives the virtual company its advantage? In essence, incentives and responsiveness. Virtual companies coordinate much of their business through the marketplace, where free agents come together to buy and sell one another's goods and services; thus virtual companies can harness the power of market forces to develop, manufacture, market, distribute, and support their offerings in ways that fully integrated companies can't duplicate. As William Joy, vice president of research and development at Sun Microsystems, puts it, "Not all the smart people [in the workstation industry] work for Sun." Because an outside developer of workstation software can obtain greater rewards by selling software to Sun customers than by developing the same software as a Sun employee, he or she will move faster, work harder, and take more risks. Using high-powered, market-based incentives such as stock options and attractive bonuses, a virtual company can quickly access the technical resources it needs, if those resources are available. In situations where technology is changing rapidly, large companies that attempt to do everything inside will flounder when competing against small companies with highly trained and motivated employees.

What gives the virtual company its advantage? In essence, incentives and responsiveness.

But the incentives that make a virtual company powerful also leave it vulnerable. As incentives become greater and risk taking increases, coordination among parties through the marketplace becomes more and more difficult, precisely because so much personal reward is at stake. Each party to joint development activity necessarily acts in its own self-interest. Over time, innovation can generate surprises that work to the advantage of some parties and to the disadvantage of others. The result: Once friendly partners may be unwilling or unable to align strategically, and coordinated development activity falters. In contrast, integrated, centralized companies do not generally reward people for taking risks, but they do have established processes for settling conflicts and coordinating all the activities that are necessary for innovation.

This trade-off between incentives and control lies at the heart of the decision that managers must make about how to organize for innovation. (See the exhibit "Finding the Right Degree of Centralization.") If virtual organizations and integrated companies are at opposite ends of the spectrum, alliances occupy a kind of organizational middle ground. An alliance can achieve some of the coordination of an integrated company but, like players in a virtual network, the members of an alliance will be driven to enhance their own positions, and over time their interests may diverge. The challenge for managers is to choose the organizational form that best matches the type of innovation they are pursuing.

Types of Innovation

When should companies organize for innovation by using decentralized (or virtual) approaches, and when should they rely on internal organization? The answer depends on the innovation in question.

Some innovations are autonomous – that is, they can be pursued independently from other innovations. A new turbocharger to increase horsepower in an automobile engine, for example, can be developed without a complete redesign of the engine or the rest of the car. In contrast, some innovations are fundamentally systemic – that is, their benefits can be realized only in conjunction with related, complementary innovations. To profit from instant photography, Polaroid needed to develop both new film technology and new camera technology. Similarly, lean manufacturing is a systemic innovation because it requires interrelated changes in product design, supplier management, information technology, and so on.

The distinction between autonomous and systemic innovation is fundamental to the choice of organizational design. When innovation is autonomous, the decentralized virtual organization can manage the development and commercialization tasks quite well. When innovation is systemic, members of a virtual organization are dependent on the other members, over whom they have no control. In either case, the wrong organizational choice can be costly.

Consider what happened to General Motors when the automobile industry shifted from drum brakes to disc brakes, an autonomous innovation. GM was slow to adopt disc brakes because it had integrated vertically in the production of the old technology. GM's more decentralized competitors relied instead on market relationships with their suppliers–and the high-powered incentives inherent in those relationships. As a re-

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sult, they were able to beat GM to market with the new disc brakes, which car buyers wanted. When companies inappropriately use centralized approaches to manage autonomous innovations, as GM did in this case, small companies and more decentralized large companies will usually outperform them.

To understand why the two types of innovation call for different organizational strategies, consider the information flow essential to innovation. Information about new technologies and products often develops over time as managers absorb new research findings, the results of early product experiments, and initial customer feedback. To commercialize an innovation profitably, a tremendous amount of knowledge from industry players, from customers, and sometimes from scientists must be gathered and understood. This task is easier if the information is codified.

Codified information – for example, specifications that are captured in industry standards and design rules – can often be transferred almost as effectively from one company to another as it can within a single company. Because such information is easily duplicated, it has little natural protection. Sometimes, bits and pieces can be protected by intellectual property rights, but those pieces, especially trade secrets and patents, are small islands in a broad ocean of knowledge.

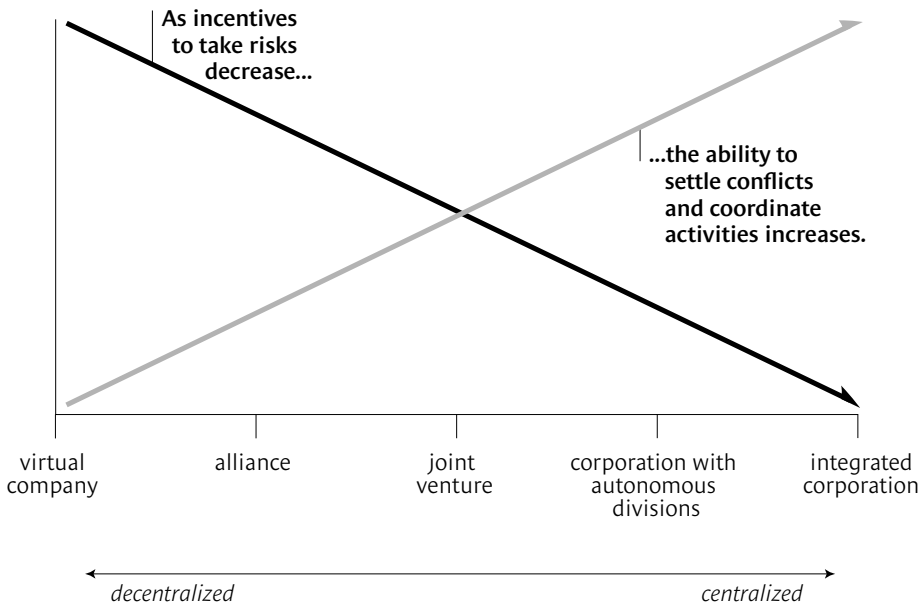
Other information does not travel as easily between companies. Tacit knowledge is knowledge that is implicitly grasped or used but has not been fully articulated, such as the know-how of a master craftsman or the ingrained perspectives of a specific company or work unit. Because such knowledge is deeply embedded in individuals or companies, it tends to diffuse slowly and only with effort and the transfer of people. Established companies can protect the tacit knowledge they hold, sharing only codified information. They can be quite strategic about what they disclose and when they disclose it.

The information needed to integrate an autonomous innovation with existing technologies is usually well understood and may even be codified in industry standards. Systemic innovations, on the other hand, pose a unique set of management challenges regarding information exchange. By their very nature, systemic innovations require information sharing and coordinated adjustment throughout an entire product system. Here is where a market-based, virtual approach to innovation poses serious strategic hazards. Unaffiliated companies linked through arm's-length contracts often cannot achieve sufficient coordination. Each company wants the other to do more, while each is also looking for ways to realize the most gain from the innovation. Information sharing can be reduced or biased, as each seeks to get the most at the other's expense. In most cases, the open exchange of information that fuels systemic innovation will be easier and safer within a company than across company boundaries. The inevitable conflicts and choices that arise as a systemic innovation develops can best be resolved by an integrated company's internal management processes.

The Case of Industry Standards

Coordinating a systemic innovation is particularly difficult when industry standards do not exist and must be pioneered. In such instances, virtual organizations are likely to run into strategic problems. Consider how technical standards emerge. Market participants weigh many competing technologies and eventually rally around one of them. There are winners and losers among the contestants, and potential losers can try to undermine the front-runner or to fragment the standard by promoting a rival. Until a clear winner emerges, customers may sit on the sidelines rather than risk making the wrong choice.

Finding the Right Degree of Centralization



By virtue of its size and scope, an integrated company may be able to advance a new standard simply by choosing to adopt a particular technology. If a large company commits itself to one of a host of competing technologies, consumers as well as companies promoting rival technologies will probably be persuaded to follow suit. Virtual companies, however, which may be struggling to resolve conflicts within their networks, won't be able to break a deadlock in a complicated standards battle. Players in a network won't be able to coordinate themselves to act like a large company.

The very reliance of virtual companies on partners, suppliers, and other outside companies exposes them to strategic hazards.

Once a standard has been established, virtual organizations can manage further innovation quite well. But when an industry begins to advance technology to a new level, the cycle can begin anew. Again, technically feasible choices present new strategic trade-offs. Suppliers, competitors, and customers may fail to agree on a common path. Unless a big player emerges to break the logjam among rival technologies, the existing standard will prevail long past its usefulness.

Today, computer floppy disks are frozen in an old standard because no single company has been able to establish a new one. IBM pioneered the 3.5-inch hard-case diskette in 1987 when it introduced its PS/2 personal computers. Within two years, the memory capacity of 3.5-inch diskettes roughly doubled from 720 kilobytes to 1.44 megabytes, where it has remained ever since.

Why? The technical capability to expand diskette capacity is available, but no company has the reputation and strength to set a new standard. Through the 1980s, IBM was large enough to coordinate standards among the key participants in the industry: personal computer manufacturers, diskette makers, and software publishers. If IBM told the industry it would use a particular capacity on its next generation of machines, others did the same. But in the 1990s, IBM's leadership of the PC market came to an end, perhaps permanently. Today, IBM is not strong enough to move the industry by itself, and it won't move ahead of the other industry players and risk being stranded if they don't follow.

A simple rule of thumb applies: When innovation depends on a series of interdependent innovations – that is, when innovation is systemic – independent companies will not usually be able to coordinate themselves to knit those innovations together. Scale, integration, and market leadership may be required to establish and then to advance standards in an industry.

The IBM PC: Virtual Success or Failure?

IBM's development of the personal computer is a fascinating example of both the advantages and disadvantages of using virtual approaches to pursue innovation. When IBM launched its first PC in 1981, the company elected to outsource all the major components from the marketplace. By tapping the capabilities of other companies, IBM was able to get its first product to market in only 15 months. The microprocessor (the 8088) was purchased from Intel, and the operating system (which became PC-DOS) was licensed from a then-fledgling software company, Microsoft. In effect, the IBM PC had an open architecture: It was based on standards and components that were widely available. The high-powered incentives of the marketplace could coordinate the roles of component manufacturers and software vendors. IBM successfully promoted its open architecture to hundreds of third-party developers of software applications and hardware accessory products, knowing that those products would add to the appeal of the PC.

IBM also relied on the market to distribute the product. Although IBM launched its own IBM Product Centers as retail storefronts and had its own direct sales force for large corporate customers, the majority of the company's systems were distributed through independent retailers, initially ComputerLand and Sears. Eventually, there were more than 2,000 retail outlets.

By using outside parties for hardware, software, and distribution, IBM greatly reduced its investment in bringing the PC to market. More important, those relationships allowed IBM to launch an attack against Apple Computer, which had pioneered the market and was growing quickly. The IBM PC was an early success, and it spawned what became the dominant architecture of the entire microcomputer industry. By 1984, three years after the introduction of the PC, IBM replaced Apple as the number one supplier of microcomputers, with 26% of the business. By 1985, IBM's share had grown to 41%. Many observers attributed the PC's success to IBM's creative use of outside relationships. More than a few business analysts hailed the IBM PC development as a model for doing business in the future.

Indeed, IBM's approach in its PC business is exactly the kind of decentralized strategy that commentators are urging large, slow-moving companies to adopt. The early years of the IBM PC illustrate many of the benefits of using markets and outside companies to coordinate innovation: fast development of

technology and tremendous technological improvements from a wide variety of sources.

With the passage of time, though, the downside of IBM's decentralized approach has become apparent. The company failed to anticipate that its virtual and open approach would prevent it from directing the PC architecture it had created. The open architecture and the autonomy of its vendors invited design mutinies and the entry of IBM-compatible PC manufacturers. At first, competitors struggled to achieve compatibility with IBM's architecture, but after several years, compatibility was widespread in the industry. And once that happened, manufacturers could purchase the same CPU from Intel and the same operating system from Microsoft, run the same application software (from Lotus, Microsoft, WordPerfect, and others), and sell through the same distribution channels (such as ComputerLand, BusinessLand, and MicroAge). IBM had little left on which to establish a competitive advantage.

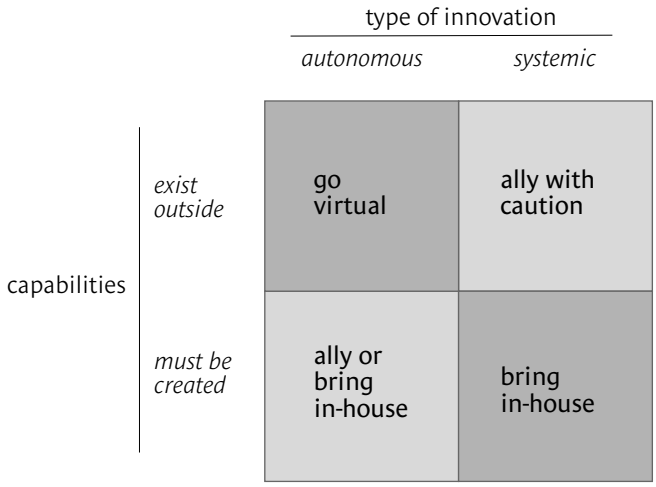
To maintain technological leadership, IBM decided to advance the PC architecture. To do that, IBM needed to coordinate the many interrelated pieces of the architecture – a systemic technology coordination task. However, the third-party hardware and software suppliers that had helped establish the original architecture did not follow IBM's lead. When IBM introduced its OS/2 operating system, the company could not stop Microsoft from introducing Windows, an application that works with the old DOS operating system, thereby greatly reducing the advantages of switching to OS/2. And third-party hardware and software companies made investments that extended the usefulness of the original PC architecture. Similarly, Intel helped Compaq steal a march on IBM in 1986, when Compaq introduced the first PC based on Intel's 80386 microprocessor, an enhancement over the earlier generations of microprocessors used in IBM and IBM-compatible machines. Even though IBM owned 12% of Intel at the time, it couldn't prevent Intel from working with Compaq to beat IBM to market. That was the beginning of the end of IBM's ability to direct the evolution of PC architecture.

By the third quarter of 1995, IBM's share of the PC market had fallen to just 7.3%, trailing Compaq's 10.5% share. Today, its PC business is rumored to be modestly profitable at best. Most of the profits from the PC architecture have migrated upstream to the suppliers of the microprocessor (Intel) and the operating system (Microsoft) and to outside makers of application software. The combined market value of those suppliers and third parties today greatly exceeds IBM's.

IBM's experience in the PC market illustrates the strategic importance of organization in the pursuit of innovation. Virtual approaches encounter serious problems when companies seek to exploit systemic innovation. Key development activities that depend on one another must be conducted in-house to capture the rewards from long-term R&D investments. Without directed coordination, the complementary innovations required to leverage a new technology may not be forthcoming.

Matching Organization to Innovation

To organize a business for innovation, managers must first determine whether the innovation in question is autonomous (it can be pursued independently) or systemic (it requires complementary innovations). They must also assess whether the capabilities needed to produce the innovation can be easily obtained or must be created.



The Virtuous Virtuals

How have the most successful virtual companies accomplished the difficult task of coordination? The virtual companies that have demonstrated staying power are all at the center of a network that they use to leverage their own capabilities. Few virtual companies that have survived and prospered have outsourced everything. Rather, the virtuous virtuals have carefully nurtured and guarded the internal capabilities that provide the essential underpinnings of competitive advantage. And they invest considerable resources to maintain and extend their core competencies internally. Indeed, without these companies'

unique competencies and capabilities, their strategic position in the network would be short-lived.

Consider the well-known battle between MIPS Technologies and Sun Microsystems for control of workstation processors. MIPS was trying to promote its Advanced Computing Environment (ACE) against Sun's Scalable Processor Architecture (SPARC). Sun had strong internal capabilities, whereas MIPS tried to compete as a more virtual player, leveraging the competencies of partners such as Compaq, DEC, and Silicon Graphics. MIPS had a good technical design, but that was literally all it had, and this hollowness left the company at the mercy of its partners. As soon as DEC and Compaq reduced their commitment to the ACE initiative, the network fell apart and pulled MIPS down with it. The very reliance of virtual companies on partners, suppliers, and other outside companies exposes them to strategic hazards. Put another way, there are plenty of small, dynamic companies that have not been able to outperform larger competitors. In particular, a hollow company like MIPS is ill equipped to coordinate a network of companies. Although Sun also worked with alliance partners, it had strong internal capabilities in systems design, manufacturing, marketing, sales, service, and support. As a result, Sun can direct and advance the SPARC architecture, a dominant technology in the industry.

Many companies with superior capabilities have prospered as the dominant player in a network. Japanese *keiretsu* are structured that way. Consider Toyota, whose successful introduction of the lean production system – a truly systemic innovation – required tremendous coordination with its network of suppliers. Because Toyota was much larger than its suppliers, and because, until recently, it was the largest customer of practically all of them, it could compel those suppliers to make radical changes in their business practices. In a more egalitarian network, suppliers can demand a large share of the economic benefits of innovations, using what economists call holdup strategies. Strong central players like Toyota are rarely vulnerable to such tactics and thus are in a better position to drive and coordinate systemic innovation.

The most successful virtual companies sit at the center of networks that are far from egalitarian. Nike may rely on Asian partners for manufacturing, but its capabilities in design and marketing allow it to call all the shots. In the computer industry, Intel has effective control of the 80X86 microprocessor standard, Microsoft dominates PC operating systems, and Sun is driving the SPARC architecture. Those companies control and coordinate the advance of technologies in their areas, and in this regard they function more like integrated companies than like market-based virtuals.

Choosing the Right Organizational Design

Today, few companies can afford to develop internally all the technologies that might provide an advantage in the future. In every company we studied, we found a mix of approaches: Some technologies were purchased from other companies; others were acquired through licenses, partnerships, and alliances; and still other critical technologies were developed internally. Getting the right balance is crucial, as IBM's disastrous experience in PCs illustrates. But what constitutes the right balance?

Consider how a successful innovator such as Motorola evaluates the trade-offs. Motorola, a leader in wireless communications technology, has declared its long-term goal to be the delivery of "untethered communication" – namely, communication anytime, anywhere, without the need for wires, power cords, or other constraints. In order to achieve that goal, Motorola must make important decisions about where and how to advance the required technologies. Those decisions turn on a handful of questions: Is the technology systemic or likely to become systemic in the future? What capabilities exist in-house and in the current supplier base? When will the necessary technologies become available?

For Motorola, battery technology is critical because it determines the functionality that can be built into a handheld communications device and the length of time that the device can be used before recharging. Batteries have been a pacing technology in this area for many years.

As Motorola scans the horizon for improved battery technology, it encounters a familiar trade-off between the degree of technological advancement and the number of reliable volume suppliers. Conventional battery technologies such as nickel cadmium (Ni-Cd) have become commodities, and there are many suppliers. But few if any suppliers can offer the more advanced technologies Motorola needs. And the most exotic technologies, such as fuel cells and solid-state energy sources, are not yet commercially viable from any supplier. How should Motorola organize to obtain each of the technologies it might need? Under what circumstances should the company buy the technology from a supplier, and when should it form alliances or joint ventures? When should Motorola commit to internal development of the technology? (See the exhibit "Matching Organization to Innovation.")

For Ni-Cd technology, the clear choice for Motorola is to buy the technology or to use the market to coordinate access to this technology, because Motorola can rely on competition among many qualified suppliers to deliver what it wants, when needed, for a competitive price. Motorola faces a more complex decision when it comes to fuel cells and solid-state battery technologies. Should Motorola wait until those technologies are more widely available, or should the company opt for a joint venture or internal development?

Before Motorola decides whether or not to wait for cutting-edge battery

technologies to be developed, it must consider three issues. The first is that Motorola could lose the ability to influence the direction of the technologies; the early commercial forms may be designed for applications that do not benefit Motorola, such as electric automobiles. The second problem is that Motorola might lose the ability to pace the technologies – in other words, to bring them to market at a competitively desirable time. The third issue is that if such technologies are – or become – systemic, and Motorola has no control over them, the company may not be able to advance related technologies and design features to achieve its ultimate goal of untethered communication.

Those issues suggest that Motorola cannot simply wait for the technologies to be provided by the market. Rather, Motorola needs to build strong ties to suppliers with the best capabilities, thus increasing its ability to direct the path of future systemic innovation. Where Motorola itself has strong capabilities, the company should pursue the technologies on its own.

To retain its leadership over the long term, Motorola must continue to develop the critical parts of its value chain internally and acquire less-critical technologies from the market or from alliances. Although networks – with their high-powered incentives – may be effective over the short term for an unchanging technology, they will not adapt well over the long term as technology develops and companies must depend on certain internal capabilities to keep up. The popularity of networked companies and decentralization arises, in part, from observations over a time horizon that is far too short. Remember the enthusiasm that greeted IBM's early success in PCs.

Scale and Scope

Business history presents us with a lesson of striking relevance to the organizational decisions managers face today. In the classic *Scale and Scope,* Alfred Chandler details how the modern corporation evolved in the United States, Germany, and Great Britain at the end of the nineteenth century. Managers who invested the capital to build large-scale enterprises blazed the trail for the leading industries of the second industrial revolution. Markets in railroads, steel, chemicals, and petroleum were developed and shaped by major companies, not the other way around. The most successful of those companies were the first in their industries to make the massive investments in manufacturing, management, and distribution that were needed to realize the gains from innovation.

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Companies that failed to make such coordinated, internal commitments during this period were soon thrust aside. The experience of British companies provides a cautionary tale for the champions of the virtual company. Many enjoyed early technological leads in their industries, but the reluctance of those family-run companies to relinquish control to outside investors prevented them from investing to build the capabilities they needed to commercialize their technologies. When German or U.S. competitors made the requisite investments, British companies lost their leadership position. In chemicals, for example, the British lead in the 1870s was completely lost by 1890. History even provided British chemical companies with a second chance when Germany's defeat in World War I temporarily cost German chemical manufacturers their plants and distribution networks. But by 1930, German chemical companies regained the lead because the British again failed to invest adequately. The lesson is that companies that develop their own capabilities can outperform those that rely too heavily on coordination through markets and alliances to build their businesses.

The leading industries of the late nineteenth and early twentieth centuries – chemicals, steel, and railroads – all experienced rapid systemic innovation. The winners were the companies that made major internal investments to shape the markets rather than those that relied on others to lead the way. While business conditions have certainly changed, many of the principles that worked a century ago still pertain.

Today, leading companies like Intel and Microsoft make extensive investments to enhance their current capabilities and spur the creation of new ones. Because so many important innovations are systemic, decentralization without strategic leverage and coordination is exactly the wrong organizational strategy. In most cases, only a large company will have the scale and scope to coordinate complementary innovations. For both the chemicals industry 100 years ago and the microcomputer industry today, long-term success requires considerable and sustained investment within a company. The lessons of the second industrial revolution apply to the third: Adept, well-managed companies that commit the right internal resources to innovation will shape the markets and build the new industries of the twenty-first century. ▽

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ARTICLES

"Unbundling the Corporation"

John Hagel III and Marc Singer

Harvard Business Review, March–April 1999
Product No. 4533

Hagel and Singer add another perspective on the advantages of virtual organization for innovation. Traditionally, large corporations have engaged in three very different businesses – attracting customers, developing products, and overseeing operations. The conflicting characteristics of these intertwined businesses force companies to make major trade-offs among scope, speed, and scale. But as electronic networks drive down the costs of communicating and exchanging data, big companies seeking to organize for product innovation can – and should – begin unbundling and then rebundling themselves. They must reorganize into large customer-relationship and operations businesses and small, nimble product-innovation companies. In the increasingly "frictionless" information economy, this agile rearranging will enable companies to speed new products and services to market.

"Lead from the Center: How to Manage Divisions Dynamically"

Michael E. Raynor and Joseph L. Bower

Harvard Business Review, May 2001
Product No. 1008

When new technologies, turbulent markets, and other profound changes bombard your corporate strategies, the ability to alter your company's organizational structure is critical. Just as Chesbrough and Teece advocate balancing competition and cooperation among partners and suppliers, Raynor and Bower suggest dynamically balancing competition and cooperation among your divisions to sustain your innovation momentum. Rather than taking an either-or approach to organization – that is, treating your divisions as either related (sharing resources and collaborating) or unrelated (competing for resources and operating independently) – you should encourage varying degrees of divisional relatedness, depending on your current circumstances.

"The Power of Virtual Integration: An Interview with Dell Computer's Michael Dell"

Joan Magretta

Harvard Business Review, March–April 1998
Product No. 7907

Dell Computer's story demonstrates the power of blending virtual and integrated approaches, achieving both the leanness of outsourcing and the control of centralized coordination. Dell focuses on mass customization, supplier relationships, and just-in-time manufacturing to sell built-to-order computers directly to customers. Its "virtual integration" is the invisible thread that stitches these strategic pieces together. How? Dell communicates regularly with customers to forecast needs and keep inventory down. And it treats its small number of suppliers as in-house partners. Dell keeps those partners as long as they remain technical and quality leaders, and it orders from them only when customers' demands are known.