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Strategic use of the Internet and e-commerce: Cisco Systems

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Abstract

Information systems are strategic to the extent that they support a firm's business strategy. Cisco Systems has used the Internet and its own information systems to support its strategy in several ways: (1) to create a business ecology around its technology standards; (2) to coordinate a virtual organization that allows it to concentrate on product innovation while outsourcing other functions; (3) to showcase its own use of the Internet as a marketing tool. Cisco's strategy and execution enabled it to dominate key networking standards and sustain high growth rates throughout the 1990s. In late 2000, however, Cisco's market collapsed and the company was left with billions of dollars in unsold inventory, calling into question the ability of its information systems to help it anticipate and respond effectively to a decline in demand.

Keywords: Internet; e-commerce; Cisco Systems; Virtual Organization; Business Ecology

1. Introduction

Information systems are strategic to the extent that they are used to support or enable different elements of a firm's business strategy (Porter and Millar, 1985). Cisco Systems, the world's largest networking equipment company, has used the Internet, electronic commerce (e-commerce), and information systems as part of its broad strategy of establishing a dominant technology standard in the Internet era. It has used these technologies to support its strategy in several ways: (1) to create a business ecology to reinforce its control of key technology standards in the networking market; (2) to create a virtual organization, outsourcing many operational and customer service functions and focusing its own

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resources on its core product innovation strategy; and (3) to showcase its own use of the Internet as a marketing tool. The Internet and e-commerce are used to tie together Cisco's own personnel with its customers, suppliers, and business partners in a virtual organization that has been pointed to as a quintessential network-era company.

Focusing on product innovation and consciously following the model of other standards leaders such as Microsoft, Cisco succeeded in establishing its proprietary Internet Operating System (IOS) as the leading standard for controlling routers and switches, the devices that direct packets of information across the Internet. Cisco also was a leader in adopting the virtual organization model, with heavy reliance on business partners to support its rapid growth rate. Cisco's own use of the Internet and information systems has been vital in coordinating the virtual model. It has touted its own success as a model for how Cisco's customers can transform their own businesses around the use of networking technologies.

Cisco's success in establishing a dominant standard enabled it to achieve extraordinary growth rates during the 1990s. The market for networking equipment grew very rapidly throughout the decade, driven first by local area networks linking personal computers (PCs) within organizations, and then by the Internet, which linked these networks globally. Not only did Cisco capture a large share of the growing market, it also enjoyed the high profit margins associated with standards dominance.

For a brief period in early 2000, Cisco had the largest market capitalization of any company in the world. However, starting in mid-2000, Cisco's business was hit hard by the collapse of many Internet companies, and by a broader decline in demand for information technology (IT) equipment. Cisco failed to anticipate the slowdown and was caught with over $2 billion in excess inventory that it had to write off in early 2001, when the company reported its first quarterly loss since it became a public company.

This swift reversal of fortune led many to reconsider whether Cisco was the innovative, well-run company portrayed by analysts, the press, and its own public relations machine. Cisco's management argues that the company was caught by market forces beyond its control, and that the fall in demand was more sudden and deep than anyone could have anticipated. However, its inability to avoid being caught with such a huge build-up of inventory may suggest the limits of its own business model, and of the Internet and IT in signalling such market shifts. Or it may show that Cisco's leaders failed to recognize the warning signals that the market was sending as they pursued their goals of continued high growth and expansion of Cisco's Internet standards into new market sectors.

2. Literature review and conceptual framework

A substantial literature has developed in the past 20 years on the subject of technology standards, particularly in the electronics and IT industries (Katz and Shapiro, 1985; Morris and Ferguson, 1993; Garud and Kumaraswamy, 1993; Besen and Farrell, 1994; Bresnahan and Greenstein, 1999). Much of this research has focused on the emergence of dominant technology standards, supported by a virtuous cycle in which their larger market share attracts a larger supply of complementary assets, which in turn encourages more users to adopt the dominant standard. A closely related literature argues that this cycle can lead to

increasing returns and supernormal profits for the dominant firm as competitors are driven to the margins or the exits (Arthur, 1996).

Well-known examples of dominant technology standards in the IT industry include the IBM mainframe, the IBM/Wintel PC architecture, and the Microsoft Office application suite. In each case, the standards leader or leaders have enjoyed large market shares and high profit margins without attracting any serious competition once the standard was established.

The literature on standards competition emphasizes the importance of strategy in determining outcomes in markets such as VCRs (Cusumano et al., 1992) and PCs (Langlois 1992; Morris and Ferguson, 1993; West and Dedrick, 2000). The images of Apple stubbornly pursuing a proprietary architecture strategy while being routed in the market by IBM-compatible PCs, or of mighty IBM inadvertently giving away control of its PC standard to upstart Microsoft, have shaped existing views of standards competition. In each case, the competition is cast as a contest of grand strategy more than one of execution. For instance, Arthur (1996) compares companies in increasing returns markets to casino gamblers, who must make billion dollar bets on new technologies whose market potential cannot be known ahead of time.

This vision of high-tech gamblers calculating the odds before making large bets in a winner-take-all game has an element of truth, as strategy is clearly vital to success in standards competition and in dynamic technology markets. However, standards leadership involves more than developing or supporting innovative technologies. It also involves creating a business ecology around the technology standard to increase the overall value of adopting that standard. Business ecology is a broad community of firms and individuals that add value to a technology standard by supplying complementary assets to the core product (Moore, 1993).[1] The presence of such assets makes the standard more attractive to potential customers (Teece, 1986; Besen and Farrell, 1994; Dedrick and Kraemer, 1998).

A business ecology should be distinguished from the concept of a virtual organization, which is a form of business organization adopted by Cisco Systems and a growing number of firms today. A business ecology is a larger community of firms and individuals supporting a particular standard, only some of which have any formal relationship to the sponsor of the standard. A virtual organization consists of the core firm and a number of other firms with whom the core firm contracts to carry out its business functions, such as contract manufacturers (CMs), customer service providers, and other specialists. So for instance, a firm that develops software to run on the Windows operating system is part of the Windows business ecology, but is not part of Microsoft's virtual organization. On the other hand, a Brazilian software firm that has a subcontracting relationship with Microsoft for product localization would be part of Microsoft's virtual organization.[2]

Cisco Systems has been the premier technology and standards leader in the Internet infrastructure market. It has achieved this position in part through the creation of a proprietary technology, the IOS, which has become the dominant standard for Internet routers, and by expanding its leadership beyond routers into other networking equipment markets through acquisition of new technologies. It has established its standards in the

[1] For example, add-on cards, peripherals, application softwares, and technical support services are complementary assets to a PC.

Table 1
Conceptual framework (Sources: adapted from Treacy and Wiersema, 1995; Hagel and Singer, 1999)

Strategic focus	Competitive environment	Competitive success factors	Structure and management
Product innovation	First mover advantages	Innovation, new product introduction	Focus resources on R&D and acquisition
	Increasing returns	Strong brand	Support outside suppliers of complementary assets
		Creation of business ecology	Reward innovation
		Battle for talent and ideas	Organize value network
Operational excellence	Decreasing or constant returns	Execution is key	Focus resources on capital investment
		Cost, quality and speed	Increase scale and geographic scope
		Battle for scale	Reward execution
			Participate in multiple value networks
Customer relationships	High customer acquisition cost	Keys are to attract and retain customers	Focus resources on marketing, sales and customer service
	Possible increasing returns from loyal customers	Clear customer segmentation	Maximize reach
		Battle for customer loyalty	Reward customer satisfaction
			Organize or participate in value networks

market by creating a business ecology that includes network engineers trained in Cisco technologies, hardware companies building products based on the Cisco standard, and software developers building complementary applications.

Cisco carries out its business functions via a virtual organization, which includes itself and a variety of business partners. These include resellers that sell and support Cisco products, service specialists providing network integration and operations, and CMs that provide most of Cisco's manufacturing capacity. It uses the Internet and IT to tie this virtual organization together, leveraging the capabilities of external partners to support rapid expansion while maintaining high levels of customer service and operational responsiveness. Cisco refers to this Internet-supported virtual organization as the global networked business model.

In order to analyse Cisco's business strategy and organization, and the role of the Internet, IT, and e-commerce, we employ a conceptual framework adapted from Hagel and Singer (1999), who drew on earlier work by Treacy and Wiersema (1995). This framework (Table 1) identifies three areas of strategic focus for firms — product innovation, operations, and customer relations. It defines the features of each in terms of economics of competition, competitive success factors, and the types of management strategies required for each.

Vertically integrated firms have historically carried out all three functions internally, but much of the management literature of the 1990s has argued that successful firms need to concentrate internal resources on one area of strategic focus (or core competency) and to work with external partners to provide necessary capabilities in the other areas. A good example of this division of labour can be seen in the PC industry, where Microsoft, Intel, and various component suppliers focus on product development, PC vendors such as Gateway and Dell focus on customer relationships and final product assembly, and CMs such as SCI, Solectron, and Quanta specialize in manufacturing operations (Curry and Kenney, 1999).

Within this framework, we would argue that Cisco's strategic focus is on product innovation, which is critical for any company attempting to establish technology standards in a highly dynamic technological environment. As such, it directs a large share of its financial resources and top management attention to R&D and to acquisition of other companies with key technologies.

Meanwhile, Cisco has chosen external partners to provide much of the necessary competence in operations and customer service, coordinating a virtual organization that extends well beyond its own corporate boundaries. For instance, it outsources much of its manufacturing, and relies on resellers, consultants, and other outside specialists to provide network integration services and customer support. Thus, Cisco was able to sustain rapid

[2] Other terms are sometimes used for the same concepts. Some writers refer to technology platforms or architectures to describe a set of design elements and interfaces that make up a technology (Bresnahan and Greenstein, 1999; Morris and Ferguson, 1993). Some speak of business ecosystems (Moore, 1993) networks (Garud and Kumaraswamy, 1993) or technological ecologies (Arthur, 1996) in the sense that we use business ecology. Virtual organizations are also referred to as network organizations, or as the Silicon Valley model (Morris and Ferguson, 1993). The overlap of terms such as virtual and network can make for some confusion, especially in the case of Cisco, which is also in the network equipment business. We use the terms business ecology and virtual organization specifically as described here.

growth by leveraging the resources and capabilities of others. It also could theoretically respond to market downturns by spreading the costs to its business partners, although recent experience has shown that this is not necessarily the case.

Having achieved dominance in its core markets by the mid-1990s, Cisco had limited potential for growth through increasing its share of those markets. Instead, its growth depended on the continued expansion of Cisco's traditional corporate and Internet Service Provider (ISP) markets, and on establishing Internet Protocol (IP)-based networking as a substitute for traditional circuit-switched telecommunications networks. To stimulate corporate demand for data networking, Cisco has publicized its own use of the Internet to illustrate the benefits of investments in network technologies. It developed an internal business unit and works with outside consultants to help corporate clients implement their own Internet and e-commerce strategies. Cisco also has aggressively targeted telecommunications services providers and has developed or acquired technologies aimed at that market.

3. Company background[3]

Cisco was founded in late 1984 by two computer specialists at Stanford University, Sandy Lerner and Len Bosack, who commercialised the router — a device developed at Stanford which determines the optimal path along which traffic on a computer network should be forwarded. Lerner and Bosack married and led Cisco until its public stock offering in 1990. They were then driven out by the management team hired by their financial backers, led by CEO John Morgridge.

Cisco was a one-product company making nothing but routers until 1993, when Boeing decided to develop a network using switches from Crescendo Systems instead of Cisco routers. So Cisco acquired Crescendo for $95 million in stock, thus keeping Boeing as a customer and transforming itself from a router company to a networking equipment company.

Cisco enjoyed an extraordinary rate of growth, with annual revenues increasing from $70 million in 1990 to more than $18.9 billion in 2000. It continued to expand its computer networking products and services to the point where it is a one-stop shopping source for most network components.

Cisco achieved its remarkable growth largely by setting standards for networking equipment through its proprietary IOS, which runs on all of its networking products. It has become an end-to-end solution provider for computer networking, by developing products internally and through a string of acquisitions.

Cisco steadily expanded the scope of its business into new markets and technologies. Initially focused on corporate networking, it has since targeted Internet service providers (ISPs), telecommunications companies, and the home market. In 1997, it formed an alliance with telecommunications equipment vendor Alcatel and made several acquisitions to develop products for the telecommunications and ISP markets. In 2000, Cisco

[3] This historical review has drawn material from several earlier case studies: Rankin and Parent, 1997; Cotteleer et al., 1998; Nolan et al., 1998; O'Reilly, 1998.

Table 2
Worldwide data communications equipment market shares (%) (source: McKinsey, 1998; note: the IP-based datacom market was about 10% of the $12 billion datacom market in 1992 and 25% in 1997)

Company	Market share	
	1997	1992
Cisco	19.3	3.9
3Com	15.3	3.8
Bay networks	5.7	n.a.
Fujitsu	4.4	9.3
Cabletron	4.4	n.a.
IBM	3.9	12.0
Hewlett–Packard	3.8	n.a.
Toshiba	3.5	7.3
Ascend	3.2	n.a.
Motorola	3.0	5.2
Newbridge Networks	3.0	n.a.
Racal	n.a.	5.0
AT&T	n.a.	3.6
All others	30.9	49.9
Total market	$36 billion	$12 billion

teamed up with GTE, Whirlpool and Sun Microsystems to develop a home gateway device to tie together PCs and other appliances using phone lines in the home. Cisco also has invested in optical switching and wireless equipment companies to enter those markets (Hoover's Online, 2001).

4. Market environment

The global market for data networking equipment grew from $10.7 billion in 1992 to $49.6 billion in 1999 (from IDC). Data network traffic already exceeds voice network traffic and is expected to increase further due to the cost advantages of IP networks and the widespread diffusion of computing power.

In 1997, Cisco was the leading provider of hardware for the Internet, followed by 3Com and Bay Networks. This was a major change, because as recently as 1992, the market for data networking was led by major computer vendors such as IBM, Fujitsu and Toshiba who provided data communications for mainframe-based corporate computing networks (Table 2). Cisco, 3Com and Bay Networks moved past the established vendors by concentrating on IP products for the fast-growing PC LAN and Internet markets.

The key players in the industry may change just as dramatically in the next few years as telecommunications equipment companies such as Alcatel, Lucent Technologies, Nortel Networks, Siemens, Ericsson, and Nokia have entered the data networking market from their historic role as suppliers of voice networking equipment. Also, newcomers such as Juniper have captured a significant share of important markets such as high-end routers.

Demand for networking equipment took a dramatic decline in 2000, due to the demise

of many 'dot.com' firms[4] and a slowdown in corporate demand. Telecommunications companies also have been slow to switch from existing technologies to Internet technology to handle their traffic, and new carriers using Internet technology have struggled. The impact on the network equipment industry has been devastating, with firms such as Cisco, Nortel Networks, and Lucent losing hundreds of billions of dollars in market value.

5. Cisco's strategy and organization

In terms of the conceptual framework presented in Table 1, Cisco is fundamentally a product innovation company, but pays close attention to customer relations and operational excellence as well. Its product strategy is to provide an end-to-end single vendor networking solution, so it offers a broad range of network hardware products and the IOS software which provides network services and enables networked applications. Its goal is to be first or second in all of the markets in which it operates, thus sustaining its leadership in key technology standards. The following sections describe Cisco's strategies for product innovation, operations, and customer relations.

5.1. Product innovation

Cisco began life as an innovator in the emerging market for IP-based network equipment. It gained an advantage over other router vendors such as Wellfleet by offering a proprietary standard for routing messages across the network. This standard, called the Internet Gateway Routing Protocol (IGRP) was an alternative to the open standard Routing Information Protocol, and offered technological advantages, such as support for multipath routing, a load-balancing technique. Cisco could have turned the IGRP over to a standards group to create an open standard, but decided not to. "We decided if we gave up IGRP to standards groups, we would lose ownership and control," said Cisco IP product line manager, Martin McNealis, "If you want to look at that negatively, you can say that's a lock-in, but a lot of our users are using it for its unique value-add" (Berinato, 1998).

Cisco was focused on producing routers, but customers wanted hubs as well, as the combination of routers and hubs improved the performance of local area networks, which were growing in popularity. Cisco had developed its own operating system, the IOS that could run on both routers and hubs. To gain access to large corporate accounts, Cisco initially teamed up with hub vendors such as SynOptics and Cabletron. Cisco licensed the IOS to the hub vendors, ensuring compatibility across the network. By doing so, Cisco was encouraging adoption of the IOS, which was only available on Cisco routers. In time, customers began to replace hubs with Cisco routers, taking advantage of additional capabilities offered by routers (DiCarlo, 1999).

In 1993, Cisco started to move beyond routers and recognized that the networking industry was shifting to a more complex environment in which a number of technologies would need to co-exist. The company was concerned that if it became too strongly tied to

[4] According to one source, around 500 Internet companies shut down from January 2000 to June 2001. 'Dot-com death toll still rising', Reuters June 6, 2001, http://news.cnet.com/news/0-1007-200-6208359.html?tag = nbs.

Table 3
Key Cisco acquisitions, 1993–2000 (Source: Kraemer and Dedrick, 1999; based on company documents and various news reports.)

Technology	Company	Date acquired	Value of deal (million $)
Fiber-optic equipment			
	Cerent	1999	6900
	Qeyton systems	2000	800
	Pirelli (fiber optic operations)	2000	2000
Switching			
LAN switching products	Kalpana, Inc.	1994	240
ATM & LAN switching	LightStream Corp.	1994	120
Ethernet desktop switching	Grand Junction, Inc.	1995	400
Multi-layer ethernet switching	Granite Systems	1996	220
ATM & frame relay WAN switching	Stratacom	1996	4700
Token ring switching	Nashoba Networks	1996	100
SONET/SDH technology	Skystone Systems Corp.	1997	102
Intelligent Web switching	ArrowPoint Communications	2000	5700
Remote access			
Software routers for remote network sites	Newport Systems Solutions, Inc.	1994	93
ISDN remote networking	Combinet, Inc.	1995	132
Moden ISDN channel aggregation technology	Telebit Corp.'s MICA Technologies	1996	200
Internet			
Internet software to connect different computers over various networks	TVG Software, Inc.	1996	138
Software for IP-address management and Internet access	American Internet	1998	56
Networks			
Hi speed data transmission over existing copper phone lines	Dagaz	1996	126
Comm. support for compressed voice, LAN, data and video	Ardent Communications Corp.	1997	156
Internet access & data	Netspeed	1998	265
Wireless comm. technology	Clarity Wireless Corp.	1998	157
Voice protocol translation	LightSpeed International, Inc.	1997	160
Multimedia networking software	Precept Software, Inc.	1998	84

any one technology it would not be in tune with changing market needs. Cisco succeeded in becoming the first company to provide most of the hardware components to build an end-to-end network from a single vendor. Cisco claims that more than 80% of its large enterprise customers have committed to its single-vendor solution.

However, Cisco understood that one company cannot always meet all of its customers needs due to the expanding scope and complexity of networking. Thus, it relied increasingly on strategic alliances with hardware manufacturers, software developers, resellers,

systems integrators, and consulting companies to provide complete solutions to its customers. These relationships may involve technology exchange, product development, joint marketing and sales, product distribution, and service and support.

At the heart of Cisco's technology alliances was the IOS, which Cisco consciously positioned as the key to its strategy of establishing a dominant proprietary standard. "Cisco will do with IOS what Microsoft did with DOS," said Nadine Jajowka, program manager for Cisco's Business Development Group (in 1995), "IOS will become the standard software for interoperability for switched networks" (Roberts, 1995). Just as Microsoft created a vast business ecology around DOS/Windows, including PC and peripheral makers, independent software vendors, and various service providers, Cisco built a similar ecology around IOS. Most importantly, it licensed IOS to a number of companies that were developing networking products, servers, software, and components, including Compaq, Hewlett–Packard, Chipcom, DEC, Alcatel, Ericsson, Nortel Networks, Bay Networks, 3Com, Microsoft, Intel, and 12 Japanese companies. This simplified life for customers, who could manage products from all of these companies via IOS, but also locked them into the Cisco standard.

Cisco has kept up the pace of innovation in its core products through internal R&D, which accounted for 14.3% of revenues in the year 2000, while acquiring new technologies through a steady stream of acquisitions. Between 1993 and 2000, Cisco acquired over 60 companies (Table 3) to fill gaps in its networking hardware and software portfolio, and in telecommunications gear. It bought minority positions of 5–10% in another 40 companies as a means of staying close to technology developments.[5] As evidence of the importance of acquisitions in Cisco's technology strategy, from 1997 to 1999, Cisco's acquisitions included $1.5 billion in purchased research and development compared to $3.3 billion spent on internal R&D (Donlan, 2000). Cisco claims that 75–80% of its acquisitions have met or exceeded expectations and that the attrition rate of employees for acquired companies is only 6%, which is less than the level of the company as a whole.

Cisco used its own highly valued stock as currency for most transactions, a strategy that was questioned by some as diluting the value of the company. Questions also were raised about the high prices paid for some acquisitions. For instance, in late 1999, Cisco paid $6.9 billion for optical equipment maker Cerent, a company with annual sales of just $10 million (Donlan, 2000).

The acquisition binge came to a halt in 2001 after the collapse of Cisco's stock price. However, the company stated that it was no more than a temporary pause in a long-term plan that still included acquisitions as a key element of its product innovation strategy. According to current CEO John Chambers, Cisco will return to a more conservative approach used before the stock market run-up of 1999. "In our first 6 or 7 years, we waited for companies to come out with products. In the last 12-18 months (because of the market boom) that was not an option. We had to buy them before they had product working, and maybe just when they had a design. The risk went up and our hit rate dropped. Now we are back to the days where we wait until the products are out there before we acquire them" (Wong and Heskett, 2001).

[5] Notes taken by William Fletcher at talk by Mike Darby, Senior Manager, Business Development, Cisco Systems, at a Corporate Investment and Strategic Investment Conference, Newport Beach, CA, January, 1999.

5.2. Operations

Cisco has developed what it calls a 'global virtual manufacturing' system, a partial build-to-order production system that involves its own plants and those of CMs, who produce the majority of Cisco's equipment. CMs such as Flextronics, Solectron, Celestica, and Jabil Circuit, as well as over 20 Taiwanese suppliers, are tightly integrated into Cisco's order fulfilment systems. Orders taken by Cisco sales people, distributors, or online at Cisco's website are transmitted directly from Cisco's order management system to the CMs via Cisco's extranet. The CMs drop ship about half of Cisco's orders directly to the end customer or to a distributor without Cisco ever taking physical possession of the product.

Cisco's integration with CMs and component suppliers spans the production process, from product design through final assembly. For instance, according to Chambers, chip foundry TSMC works closely with Cisco's ASIC design teams in the chip design process (Chen, 1999). As CMs expand their design and new product introduction functions, Cisco can rely more heavily on their capabilities.

Cisco was one of the earliest and most aggressive users of outsourcing, giving it an advantage over many competitors. Such collaboration has allowed Cisco to grow rapidly without heavy investments in manufacturing capacity. Companies such as Flextronics and Solectron are extremely cost-efficient manufacturers, with global operations to serve Cisco's needs, so ultimately Cisco probably cuts its manufacturing costs by outsourcing as well.

However, while a virtual manufacturing system should in theory give Cisco greater flexibility to respond to market fluctuations quickly, this turned out not to be the case when Cisco faced a downturn in demand for the first time. In mid-2000, Cisco made large orders for components and subassemblies in anticipation of rapid demand growth for the rest of the year. When demand fell, Cisco was left with billions of dollars in inventory for products that weren't selling. This points to the fact that Cisco cannot force suppliers to take most of the risk of holding inventory, as many PC makers do, because of the complexity of Cisco's products and the need for custom components that cannot be sold to another manufacturer if Cisco's demand falls.

5.3. Customer relations and support

Cisco is a product-oriented company, but it places a heavy emphasis on customer relations as part of its strategy to expand market share and reach new markets. Its organizational alignment by customer lines of business is designed to maintain close ties with the customer. In addition, Cisco ties management bonuses to increased customer satisfaction. John Chambers has been quoted as saying, "If I find someone who looks at the customer as a burden or problem, I'll strangle him or her. That's unacceptable" (Schlender, 1997).

While Cisco recognizes the importance of customer relations, it does not try to handle all of its marketing, distribution, and support functions internally. In 1996, when Cisco decided to expand its target market to include small and medium businesses, it shifted

Table 4
Cisco's sales by region (source: Cisco Systems Annual Report, 2000)

Region	Percentage of net sales
Americas	68.3
Europe/Middle East/Africa	25.2
Asia-Pacific	9.0
Japan	4.9
Sales adjustments	(7.4)
Total	100

from relying mainly on direct sales to develop a two-tier channel of distributors and resellers.[6] By 2001, over 80% of Cisco's sales were accounted for by the indirect channel.[7]

The rapid growth of the Internet resulted in a global shortage of networking technicians to build and support networks. Cisco created the Cisco Networking Academy to train customer staff and college and high school graduates in network design, implementation, and support. It provides global access to training materials through its website. These training and certification programs not only ameliorate the skills shortage, but more importantly develop a cadre of engineers and technicians trained specifically in Cisco technologies.

Cisco further has established an organizational unit whose function is to develop and maintain global business alliances aimed at meeting business demand for integrated business solutions for e-commerce. It works with service specialists such EDS, KPMG, PeopleSoft and USI to provide systems integration for customers.

5.4. Organization of business activities

Cisco is functionally organized and centralized on a global basis. Manufacturing, customer support, finance, human resources, IT and sales are centralized while product marketing is decentralized into its four customer segments: service providers, large enterprise customers, small- and medium-sized businesses, and the home. R&D is a centralized function but organized by lines of business. Geographically, country sales managers are responsible only to sell the market segment products within a country or region, but have no product development or production responsibilities, as those functions are handled globally within the customer segments.

In financial year (FY) 2000, Cisco's sales were broken down as seen in Table 4. While two-thirds of revenues come from the Americas, Cisco is counting heavily on international markets, particularly China to revive its flagging sales. Rick Justice, Cisco's senior vice president in charge of global sales said, "Our growth in China is very, very significant and we intend that to be the case going forward. It's well above 50%, and it's becoming a significant amount of our business."

[6] Cisco had actually started doing business through one-tier and two-tier partners earlier than 1996, mostly outside the USA. For instance, 98% of business of Europe, the Middle East and Africa was through channel partners (Interview with Steve Cunningham, Cisco Systems, June 1999).

[7] Interview with Steve Cunninghan, Cisco Systems, June 6, 2001.

6. The Internet and e-commerce at Cisco

Cisco's product innovation strategy and networked organizational model are supported by extensive use of the Internet and e-commerce. Cisco refers to its approach as the global networked business model, which it defines as "…any size company that strategically uses information and communications to build a network of strong, interactive relationships with all its key constituencies, opening the corporate information infrastructure and leveraging the network to achieve a competitive advantage."

As the definition makes clear, this model goes far beyond simply accepting orders online or using EDI to transmit orders to suppliers. Instead, Cisco integrates its customers, suppliers, channel partners, and service partners into its own information systems, blurring the boundaries between itself and those 'constituencies'. It uses a corporate intranet to carry out internal functions such as human resources, financial analysis, and sales force automation. It uses the Internet for online sales and uses extranets to coordinate with CMs and other partners. These IP-based systems are linked to Cisco's internal IT infrastructure and applications, and to those of its partners.

Cisco claims that its own use of the Internet has been critical to its rapid growth and profitability. "It has moved from an opportunistic look at the Internet to a core strategy," says Peter Solvik, Cisco's chief information officer and in-house Web evangelist, "It's one of the key reasons why we broke away from competitors 5 years ago" (Thurm, 2000).

To understand how this system has evolved and how it works today, we look first at the history of Internet use at Cisco, and then at the major systems and applications in use today. We then analyse how Cisco uses these technologies within the context of its overall strategy to expand the market for its technologies and to create a business ecology around its own technology standards. Finally, we consider what Cisco's inability to anticipate the drop-off in demand for its products in the late 2000 might say about the limitations of the Internet and IT.

6.1. Evolution of Internet strategy

While using the Internet is now considered a core element of Cisco's strategy, it evolved mostly through experimentation, rather than through any grand design. In the early 1990s, Cisco created a simple bulletin board for customer information requests. In 1993, it began using the Mosaic browser as an interface for customer information, but with the Web still not available for commercial use, it relied on dial-up connections. Online sales began in 1995, when promotional items such as coffee cups were made available. Seeing the cost advantage of selling online, Cisco began to offer its network products for sale on its website, and Web sales grew rapidly until they accounted for the majority of Cisco's sales.

Since 1995, Cisco has been developing corporate information systems to support its various business processes. This includes implementing applications such as the Oracle ERP suite, building a robust IT infrastructure, and creating architectural standards for the entire company.

Building on this IT infrastructure and an IP-based open standards architecture, Cisco began Web development in earnest. The aim was to move beyond using the network as an

Table 5
Cisco's web-based applications (source: various Cisco reports and interviews)

Intranet–CEC	Extranet–CSC	Internet–CCO
Employee self-service for travel, benefits, product information	Supply chain integration, sharing of forecast, order and inventory information	MarketPlace for net commerce by customers, resellers, partners
Communication and distance learning	New product development sharing of design, test, ramp-up, quality and product specification information	Technical Assistance, Software Library, and Open Forum for customers, resellers, partners
Collaboration and workflow management		Customer service for non-technical issues
Executive information systems and decision support systems		Internetworking Product Center online ordering by authorized customers and resellers

information-sharing tool to using the network as a foundation for applications linked to the core business systems.

Today a large percentage of external customer, partner, and supplier interaction with the company, as well as internal interaction among Cisco employees worldwide, is network based. About 95% of all applications at Cisco use a Web interface for the user, and about 200–250 applications are Web-based, having been created explicitly as tools for use only via the Web. Cisco's Internet and e-commerce applications can be divided among three categories: intranet, extranet, and Internet (Table 5).

6.2. Internet–Cisco connection online[8]

Cisco connection online (CCO) is Cisco's Internet website, which is a comprehensive resource for customers, suppliers, resellers, business partners, investors, and potential employees. CCO is a portal for informations stored in Cisco's ERP systems, databases, legacy systems, and client–server systems. It also has links to Cisco's extranets for suppliers and partners. CCO has five key components: MarketPlace, technical assistance and software library, Customer service, Internetworking Product Center, and Cisco supplier connection (CSC).

(1) *MarketPlace* is a virtual shopping center where customers can purchase items online including networking products, software, training materials and promotional items. It also has configuration, pricing and purchase requisition tools that customers can use to print out requisitions for submission with company purchase orders. Links to channel partners are provided, and most orders from resellers and distributors are placed online.

(2) *Technical assistance, software library, and open forum* enable customers and business partners to get online answers to technical questions and download software updates

[8] This section draws from Ernst and Young (1998).

and utilities for Cisco hardware. Technical assistance consists of tools to identify bugs and take needed preventative or repair measures for Cisco equipment. The software download library saves Cisco millions of dollars in burning and shipping CD-ROMs for software distribution. Open forum allows users to pose networking questions, search a database for answers to technical problems, and interact with networking experts from other customers who offer their own solutions to problems posted by users. Open forum has created a virtual community of technical experts that reduces Cisco's demand for help and enables its own experts to focus on complex or unusual problems.

(3) *Customer service* provides non-technical assistance on a self-help basis for customer requests such as product status, price lists, latest releases, and service order status. It uses intelligent agents and is available for 24 hours a day and 7 days a week.

(4) *Internetworking Product Center* is a suite of applications for order processing. They enable users to configure, price, route, and submit electronic orders directly to Cisco (or to Cisco distributors, in the case of resellers). When users are ordering online, it advises them if information is missing from a product configuration, thereby reducing the need for rework. Order processing links the company's order management system to its scheduling system, which looks at product availability to determine a first available time slot for each order. The component data are then translated into parts orders for Cisco's contractors and distributors, which in turn have direct links into Cisco's ERP systems. A series of commerce agents allow customers and partners to access information about the status of their orders.

The power of the Web-based tools in CCO is illustrated by its use to support the distribution channel. Rather than provide support to small- and medium-sized businesses itself, Cisco chose to rely on distributors and resellers to do so. Cisco provided capabilities in CCO expressly to support resellers in handling transactions and information requests.

6.3. Extranet–Cisco supplier connection

Cisco uses extranet and Web-based EDI technologies to coordinate with its suppliers and CMs via the CSC, which is accessible to registered users from the Cisco website. It links Cisco's first-tier suppliers to Cisco's ERP order fulfilment systems and inventory databases so that they can respond to customer requests in real time. When customers place orders, they are matched against Cisco's current production schedule, and the first-tier suppliers are notified of any deviations from production forecasts by automatic postings on the extranet. These notices enable suppliers to immediately respond to requests for materials. They also enable Cisco to track and transfer inventory between different manufacturers to respond to component shortages. Purchase orders and invoices are processed electronically. Related applications include:

1. *New product introduction*: Information sharing in design, prototyping, ramp-up, quality assurance and product specification processes between engineering, procurement, manufacturing, and marketing in order to reduce time to market for new products.
2. *Autotest*: testing processes for suppliers' components are made routine, automated in software test programs, and provided to suppliers so problems can be detected at the source.

3. *Direct fulfilment*: automation of information required to support direct shipping of products configured by suppliers directly to customers without going through Cisco.
4. *Dynamic replenishment*: automation of a dynamic replenishment model, which allows market demand information to flow directly through to CMs without any delays and also allows them to track Cisco's inventory levels in real time.

6.4. Intranet–Cisco employee connection

Cisco employee connection (CEC) is an intranet designed to provide information and services to meet the needs of Cisco's employees. CEC provides information and about 80–100 interactive tools for facilities, travel arrangements, technical documentation, human resources, training, sales and marketing, and financial matters. In addition to standard selections by line of business, products, business functions, and company and employee information, CEC has a number of repositories, which group links on particular topics. One such repository is for new hires and provides them with information about the company as well as frequently asked questions. Another set of repositories is for professional staff and provides them with job-specific tools relating to sales, engineering, management, and system engineering.

6.5. IT and the global networked business model

Cisco has simplified its processes both internally and in conjunction with its external partners in order to cut costs, expand its market reach, deliver products more quickly, and improve customer service. These process improvements include: direct shipment to customers by CMs, distribution of software and manuals via the Internet, providing training materials online, recruiting workers online, providing extensive support for resellers, network integrators and distributors, and providing up-to-date technical support to customers.

This simplification of business processes is supported by a corresponding increase in complexity of internal IT, e-commerce, and Internet applications. Cisco's internal applications, such as ERP, product databases, human resources, order processing, and manufacturing planning must be integrated with each other and with the multitude of Web-based applications mentioned above. It also requires integration with some of the internal systems of Cisco's business partners. This comes at a high cost in terms of IT spending on Cisco's part, and also requires corresponding investments by those partners. One channel partner mentioned in an interview that Cisco often pushes it to adopt new technologies faster than it might prefer. On the other hand, the CEO of Flextronics claims that his company benefits from such investments by reducing its own inventory costs, and says the Cisco model is the way everyone will do business eventually (Thurm, 2000).

6.6. Promoting the Cisco model

Cisco created a new business unit called the Internet Business Solutions Group (IBSG) in 1998 to help customers apply Cisco's global networked business model in

Table 6
Summary of financial and operational benefits from Cisco's IT infrastructure and Internet applications in 1998 (Source: Cisco Systems, 1999; various Cisco reports; various teaching case studies.)

Internet applications	Financial benefits (million $)	Operational benefits
Customer care		
Headcount avoidance	75	Quadrupled sales but increased call center staff by only 10% 80% of routine questions answered online
Software distribution	250	Lower distribution costs Eliminate need for printing and shipping 90% of software delivered online
Document publishing	40	Eliminate need for document publishing
Technical support		70% of technical support delivered electronically Decreased technical service calls Utilization of customer technical expertise
Internet commerce		
Savings from online sales	12	Eliminate misconfiguration Reduce order rework from 15 to 2% 98% accurate, on-time delivery
Supply chain management		
Reduced operating cost	75	Reduce engineering changes from 20–25 to less than 10 days
Increased contribution	100	Reduce time to volume for NPIs by 3 months 45% of products untouched by Cisco
Employee services		
Online hiring	8	70% of resumes submitted through website
Productivity increase	4	Increase staff productivity through personal productivity tools, email, shared calendars, groupware, travel reimbursement processing
Total	550	

their own businesses. IBSG operates under Cisco's Customer Advocacy Organization as a 'service to Cisco customers' offering solutions in seven areas: e-commerce, customer care, workforce optimization, supply chain management, Web foundation, e-Learning, and e-Publishing. As described in its promotional brochure, "Cisco's IBSG works in conjunction with customers, management consultants, systems integrators and independent software vendors to help customers understand and apply Cisco's global networked business model. With the global networked business model, IBSG is able to help customers plan an accelerated deployment of Internet business solutions to achieve competitive advantage in the new global marketplace" (IBSG, 1998).

IBSG works with the customer and one or more business partners to offer advisory services, education and training, and short-term consulting engagements.

Software vendors offer software solutions and consulting firms offer process reengineering and IT implementation services. IBSGs key partners include Cap Gemini Ernst & Young, First Consulting Group, IBM, iXL, KPMG, Netigy, and Participate.com (Cisco Systems: Internet Business Solutions, 2001).

IBSG does not charge a fee for most of its services, although its partner companies do. Cisco treats IBSG as more of a promotional operation, evangelizing the Cisco message and helping customers put Cisco technology to use. The expected payoff is in increased sales of Cisco products, expansion of the customer base, and creating new case studies of the payoffs from investment in Internet (and specifically Cisco) technologies.

6.7. Benefits and costs of Cisco's Internet and e-commerce investments

Cisco claims it is the single largest user of e-commerce in the world, with 90% of its $18.9 billion in FY2000 sales coming online. It also says that 82% of customer inquiries are handled online, and 100% of its orders to suppliers such as Flextronics and Jabil Circuit are managed electronically (McIlvaine, 2000).

Cisco and the media have made much of the large benefits and low costs from its own use of computer networking, but it is all self-reported (Table 6). Cisco claimed to achieve over $550 million in 1998 in reduced costs from transferring most of its business to the Internet. By 2000, the figure reported was $1.4 billion.

While some of these benefits involve real cost savings, many of them are actually cost avoidance—labor savings from not having to hire more people due to automation. For example, Cisco's sales increased four-fold between 1995 and 1998 but its support engineers only doubled. If Cisco had not built the technical help application, it says it would have had to hire another 1000 support engineers at $75 million annually.[9] Similarly, software downloads reportedly saved $250 million in 1998.

Equally important for a company working to promulgate its technology standards is the effect of the Internet on creating a business ecology around Cisco technologies. This includes software companies that design applications to run on Cisco networks, services companies that provide network integration and support, and most importantly, the network engineers that build and run Cisco networks. By providing online training, technical support, and the open forum for engineers to help each other solve problems, Cisco continues to expand the cadre of professionals who understand Cisco's technologies and are more likely to select them in the future.

Although there is no overall estimate of costs, the CCO application is estimated by an outside industry analyst as having an initial capital cost of $100 million and annual operating costs of $10 million. Of course, this excludes the cost of Cisco's information infrastructure and IT applications. There are also significant costs involved in continually updating product information, technical support documents and other information on the website. Since most of Cisco's IT costs are borne by functional departments,

[9] It is not clear if sales growth increases demand for engineering support on a one-to-one basis. It does not seem logical that a corporation with 20 Cisco routers should need twice as much support as one with 10, so the difference would probably depend more on the number of new customers needing support. Cisco does not provide these details in its estimates of headcount avoidance.

Table 7
Cisco's financial performance, 1992–2000 (sources: Hoover's Online, 2001; O'Reilly, 1998; Cisco Annual Reports)

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Revenue (million $)	340	649	1300	2200	4100	6400	8500	12 200	18 900
Net income (million $)	84	172	315	456	913	1049	1350	2096	2668
Net profit margin (%)	24.9	26.5	25.3	21.3	22.3	16.3	16.0	17.2	14.1
SG&A/revenue (%)	21.0	19.7	21.0	21.8	21.6	21.2	21.5	23.3	24.1
ROA (%)	26	29	29	23	25	19	15	14	9
ROE (%)	34	36	36	29	32	24	19	18	11
Earnings/share ($)	0.02	0.04	0.06	0.08	0.16	0.17	0.21	0.31	0.36
Employees	882	1451	2443	4086	8792	11 000	15 000	21 000	34 000
Revenue/employee ($)	385 488	447 278	532 133	538 424	466 333	581 818	566 667	580 952	555 882
Stock price at FY close ($)	0.75	1.59	2.27	3.27	6.58	9.00	17.43	34.63	65.44

it is difficult to pin down the actual costs of its Internet and e-commerce initiatives. Overall, we estimate that Cisco's IT expenditures run about 6.5% of revenues, a number more than double that of computer equipment manufacturers on average, a number that has been confirmed by Cisco as being a reasonable estimate (Kraemer and Dedrick, 1999).

7. Firm performance

Cisco's revenues and net income have increased dramatically since 1992, and its stock price soared to the point that the company briefly had the highest market capitalization of any company in the world, at over $550 billion in the early 2000. Since then, however, Cisco's stock dropped from a high of $82 to as low as $13.19 in April 2001.

In terms of key performance indicators, Cisco's gross margins have remained above 60%, but its net margins steadily decreased from a high of 26.5% in 1993 to 14.1% in 2000 (Table 7). Another key variable, revenues per employee, grew rapidly in the early 1990s, but has declined slightly since then. Cisco's overhead (SG&A) has grown from 21.6% of revenues in 1996 to 24.1% in 2000. Cisco's return on equity (ROE) dropped from 32% in 1996 to just 11% in 2000, partly because Cisco's issuance of stock as currency for acquisitions has greatly increased its stockholders' equity.

These data suggest that Cisco's business model allowed it to maintain a high growth rate, even as it grew from a mid-sized company with less than 1000 employees into a very large company with 34 000 workers as of 2000. Some of the decline in performance indicators can probably be attributed to Cisco's expansion into new markets, such as telecommunications, where the company must acquire new customers. This requires greater expenditures for sales and marketing, as well as customer service, than does selling more equipment into existing corporate accounts. However, the decline of important indicators of management performance may have called into question the company's claims that its heavy use of the Internet and e-commerce was translating into better overall performance.

Full year data for FY 2001 are not yet available as of this writing, but quarterly data show that sales continued to grow at Cisco's historical pace prior to Q2, ending in January 2000, when there was some slowing. In Q3, sales completely collapsed, falling to $4.73 billion, compared with $4.93 billion for the same period the previous year, and 30% below Q2 revenues of $6.75 billion. Pro forma net income fell to $230 million, compared with pro forma net income of $1.0 billion for the same period a year earlier. Cisco announced it was writing off $2.2 billion in inventory, accumulated in expectation of continued growth in demand, and laid off 8500 workers.

7.1. Implications of the collapse of 2001

"We believe the Internet is a historic economic change agent and that Cisco's Internet expertise will enable our customers to successfully navigate through the market transition and come out stronger than before." John Chambers (McIlvaine, 2000).

"(Computer) systems are not a crystal ball for the future, but a good indicator of where you are." John Chambers (Wong and Heskett, 2001).

Any case study of Cisco written before late 2000 would see almost nothing but success, and look for reasons to explain that success. Going from startup to the world's most valuable company in less than 20 years was certainly extraordinary. Cisco rode the crest of the networking wave that started with corporate networking and expanded to the Internet in the late 1990s. It also benefited from its focus on creating a proprietary standard that came to dominate the network equipment market, and from an organizational structure that supported a possibly unprecedented rate of growth for a company. There were questions about some of Cisco's claims about the benefits it received from its own Internet use, and questions about the cost of some of its acquisitions from the financial community. But it was hard to quarrel with success.

Since the collapse of Cisco's stock price, which evaporated nearly $400 billion in market value, there have been questions and criticisms of the company's management, and of the inability of its vaunted global networked business model to anticipate and respond more effectively. The point of view expressed by John Chambers is that Cisco was hit by a '100-year flood' that simply went beyond anything the company could have anticipated.

Chambers denies that the company was blinded by its past success to the possibility of such a downturn, and defends his aggressiveness in building up inventory in advance of expected sales. "If a company has grown 30–50%, and on the higher end of that range for the past 10 years… if each time a hesitation occurs in the market, and the company pulls back on inventory and (does) not have an aggressive acquisition strategy, then you can't be the major company we are today. We take calculated risks and we're not going to change that" (Wong and Heskett, 2001). However, it is clear that Cisco was charging ahead even in December 2000, when competitors such as Nortel Networks and Lucent Technologies were reporting rapid declines in demand (and when the impacts of interest rate hikes in the spring started to slow the US economy, and many of Cisco's dot.com customers were clearly in trouble). At the time, Chambers confidently stated that Cisco would take the opportunity to grab market share from its competitors and did not revise growth expectations downward (Heskett, 2000).

To be fair, it is easy in hindsight to criticize management, and few other companies in the technology sector have fared much better than Cisco in the market downturn. One question raised, however, is why Cisco's touted information systems and networked business model failed to help it anticipate and mitigate the effects of the downturn. Cisco's information systems people indicate that the information systems 'worked perfectly'. Top management says that customers changed their buying plans very suddenly, and that the information systems picked up these changes as soon as the information was available, and that Cisco was quick to warn Wall Street of a possible earnings shortfall.

However, the inability of Cisco's sales forecasting systems to offer any advance warning suggests limitations of even the best 'digital nervous system'. In the end, an information system is only as good as the data entered into it, and if the people gathering the information fail to pick up on market signals or are unwilling to be the bearers of bad news, then the system will not provide the warning signs that might mitigate the impacts of a major market shift.

8. Conclusions

Cisco's approach to strategy and structure reflects a common line of management literature in the 1990s that calls on companies to unbundle the different elements of their businesses (product innovation, operations, customer service), concentrate resources on the most strategic activities, and leverage the capabilities of external partners as much as possible for the rest (e.g. Treacy and Wiersema, 1995; Hagel and Singer, 1999). Cisco uses the Internet and e-commerce as part of a strategy aimed at product and technology leadership, and to support an organizational structure designed to carry out that strategy. This structure enables Cisco to focus resources on technology innovation and acquisition and leverage the capabilities of others for operations and customer relations.

In terms of product and technology strategy, Cisco consciously worked to establish its IOS as a proprietary standard for network equipment. It built a business ecology consisting of providers of complementary assets to attract users to its IOS standard. Cisco has done so in a variety of ways, including licensing the IOS to hardware vendors, providing technical support to software and services providers, and offering training programs for network engineers. It has used the Internet as a major element in this process, sharing information with its key constituencies online, providing training and support tools via the web, and creating a virtual community of engineers and other users who help each other with problem solving. Cisco also promotes greater use of the Internet and of Cisco technologies through its IBSG and its coterie of business partners who help customers to implement Web-based applications in their own companies.

In terms of organizational strategy, Cisco has created a virtual organization that incorporates its suppliers and business partners to make its value chain more efficient. This allows it to maintain operational quality and flexibility in a very dynamic market and technology environment, and to provide a high level of customer service. It also reduces costs in a number of areas, from order fulfilment and manufacturing to providing technical support and network integration services.

Cisco has used the Internet to implement its strategic focus and to leverage its virtual organization. Building on top of its core enterprise systems for manufacturing and order fulfilment, Cisco has developed a large array of Internet, intranet, and extranet applications that link all elements of its value network. It has engineered its business processes to simplify the physical provision of goods and services and has developed a complex web of information systems to support the simplified physical processes.

The leverage provided by Cisco's control of technology standards and its virtual organization model led to high growth and profits. As long as the Internet and other networks continued to grow exponentially, Cisco's profits mirrored or even exceeded that growth. However, when demand for network equipment fell off, Cisco was as vulnerable as many of its competitors.

Although Cisco's information systems worked well in reporting the slowdown in sales once it occurred, it appears they did not work well in forecasting the slowdown in demand. In fact, faced with a number of warning signs, from rising interest rates, the collapse of many Internet companies who were Cisco customers, and falling revenues at other major network equipment companies, Cisco continued to build its inventory in anticipation of maintaining its historically high rates of sales growth. Cisco's CEO says that the company

has learned from the experience, and is putting in place measures to avoid being caught off-guard in the future.[10] However, the lesson was an expensive one for one of the most admired firms in the network economy.

This paper has highlighted two different but related strategies involving inter-organizational relationships that firms might follow to achieve competitiveness: a business ecology to reinforce product and technology leadership, and the virtual organization to carry out functions in the firm's value chain. We defined a business ecology as a broad community of firms and individuals that add value to a technology standard by supplying complementary assets to the core product. The presence of such assets makes the standard more attractive to potential customers. We distinguished a business ecology from the concept of a virtual organization, which consists of the core firm and a number of other firms with whom the core firm contracts to carry out its business functions, such as manufacturing, distribution or customer service and support.

Cisco is both the sponsor of a business ecology and the coordinator of a virtual organization. But, Cisco may be unusual as there are only a few other firms in the information industries that are in the position to create a business ecology (e.g. Microsoft, Intel, Sun, and IBM), as there are a limited number of technology standards around which to develop such an ecology. On the other hand, most firms must be part of such an ecology, as they must develop products that are compatible with industry standards.

Given the decentralized structure of the information industries, most firms also must be leaders or followers in one or more virtual organizations. Some firms might be a leader in one and a member in another. An interesting research issue then concerns the demography of firms as regards these inter-organizational relationships. What are the characteristics of firms that avail themselves of one arrangement or the other, and to what extent are their choices limited by virtue of their technology, role in an industry's value chain, or other factors? What are the competitive consequences for leaders and followers, both in times of high growth and stagnation? To what extent are information systems necessary to the functioning of a virtual organization, and can they reduce the vulnerability of its participants? Finally, to what extent are these arrangements found outside the information industry in the broader economy, and to what extent are the consequences similar or different? These are questions that warrant further research.

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References

Arthur, W.B., 1996. Increasing returns and the new world of business. Harvard Business Review 74 (4), 100–109.
Berinato, S., 1998. Stuck in Cisco's GRP. PC Week 15 (20), 10 May 18.

[10] Cisco conference call with analysts, May 8, 2001.

Besen, S.M., Farrell, J., 1994. Choosing how to compete — strategies and tactics in standardization. Journal of Economic Perspectives 8 (2), 117–131.

Bresnahan, T.F., Greenstein, S., 1999. Technological competition and the structure of the computer industry. The Journal of Industrial Economics XLVII (1), 1–40 March.

Chen, S., 1999. One-on-one chambers on outsourcing at Cisco. Electronic Buyers' News April 12, 1.

Cisco Systems, 1999. Gaining competitive advantage through Internet business solutions. Company Overhead Presentation.

Cisco Systems Annual Reports, 1999 and 2000.

Cisco Systems: Internet Business Solutions, 2001: http://www.cisco.com/warp/public/779/ibs/.

Cotteleer, M., Austin, R.D., Nolan, R.L., 1998. Cisco Systems, Inc.: Implementing ERP. Case study. Harvard Business School, Cambridge, MA.

Curry, J., Kenney, M., 1999. Beating the clock: corporate responses to rapid change in the PC industry. California Management Review 42 (1), 8–36.

Cusumano, M., Mylonadis, Y., Rosenbloom, R., 1992. Strategic maneuvering and mass-market dynamics: the triumph of VHS over beta. Business History Review 66 (1), 51–94 Spring.

Dedrick, J., Kraemer, K.L., 1998. Asia's Computer Challenge: Threat or Opportunity for the United States and the World? Oxford University Press, New York.

DiCarlo, L., 1999. Software gave Cisco edge over rivals — and partners. PC Week February 12, 16.

Donlan, T.G., 2000. Cisco's bids: its growth by acquisition will pose problems. Barron's May 8, 31.

Dot-com death toll still rising, 2001. Reuters, June 6: http://news.cnet.com/news/0-1007-200-6208359.html?tag = nbs.

Ernst, Young, 1998. Creating Value Through Global Networked Business. Cisco Systems, San Jose, CA.

Garud, R., Kumaraswamy, A., 1993. Changing competitive dynamics in network industries: an exploration of Sun Microsystems' open systems strategy. Strategic Management Journal 14, 351–369.

Hagel III, J., Singer, M., 1999. Unbundling the corporation. Harvard Business Review 77 (2), 133–144 March–April.

Heskett, B., 2000. Cisco CEO: What, me worry? CNET News.com http://news.cnet.com/news/0-1004-200-3989419.html.

Hoover's Online, 2001: http://hoovers.com/.

Internet Business Solutions Group, 1998. IBSG: Solutions for Competing in a Global Internet Economy. Cisco Systems, San Jose, CA.

Katz, M.L., Shapiro, C., 1985. Network externalities, competition, and compatibility. American Economic Review 75 (3), 424–440.

Kraemer, K.L., Dedrick, J., 1999. Leveraging the Global Networked Business Model: Cisco Systems. Center for Research on Information Technology and Organizations http://www.crito.uci.edu/itr/publications/pdf/CISCO-FEB99.PDF.

Langlois, R., 1992. External economies and economic progress: the case of the microcomputer industry. Business History Review 66 (1), 1–50 Spring.

McIlvaine, B., 2000. John Chambers: Cisco — Riding the Wave of Web-Based Tools Leads to Net Results. Electronic Buyers' News December 18, 42.

McKinsey & Co, 1998. Computer Industry Report. McKinsey, New York November.

Morris, C., Ferguson, C., 1993. How architecture wins technology wars. Harvard Business Review 71 (2), 86–96 March–April.

Moore, J.F., 1993. Predators and prey: a new ecology of competition. Harvard Business Review 71 (3), 75–86 May–June.

Nolan, R.L., Porter, K.A., Darwall, C.L., 1998. Cisco Systems, Inc.: Case Study. Harvard Business School, Cambridge, MA.

O'Reilly, C., 1998. Cisco Systems: the Acquisition of Technology is the Acquisition of People. Case Study. Graduate School of Business, Stanford University, Palo Alto, CA.

Porter, M.E., Millar, V.E., 1985. How information gives you competitive advantage. Harvard Business Review 63 (4), 149–160 July–August.

Rankin, D., Parent, M., 1997. Cisco Systems Inc.: Managing Corporate Growth Using an Intranet. Case Study. Richard Ivey School of Business, The University of Western Ontario, London, Ontario.

Roberts, E., 1995. Momentum building for Cisco's IOS. CommunicationsWeek April 17, 1.

Schlender, B., 1997. Computing's next superpower. Fortune 135 (9), 88 May 12.
Teece, D., 1986. Profiting from technological innovation: implications for integration, collaboration, licensing and public policy. Research Policy 15 (6), 285–305 December.
Thurm, S., 2000. Eating their own dog food — Internet builder Cisco goes online to buy, sell, hire, keep customers happy. The Wall Street Journal April 19, B1.
Treacy, M., Wiersema, F., 1995. The Discipline of Market Leaders. Addison-Wesley, Reading, MA.
West, J., Dedrick, J., 2000. Innovation and control in standards architectures: the rise and fall of Japan's PC-98. Information Systems Research 11 (2), 197–216 June.
Wong, W., Heskett, B., 2001. Is Cisco ready for a turnaround?. CNET News.com http://news.cnet.com/news/0-1014-201-5641590-0.html; April 17.