

Technology Strategy in Data Networking Industry Acquisitions

by

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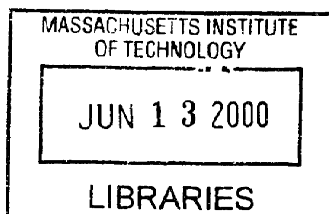
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Submitted to the Alfred P. Sloan School of Management and the Department of Engineering
on May 11, 2000 in partial fulfillment of the requirements for the Degree of
Master of Science in the Management of Technology

ABSTRACT

The telecommunications industry faces growing competition from deregulated markets and rapid technology change, and it is becoming increasingly difficult for companies to invest in an ever-widening range of technology segments such as equipment, networks, and application services. Every player needs an efficient strategy for achieving cost effectiveness of processes and quick commercialization of innovations. In order to identify solution to these problems, this thesis focuses on technology strategies in data networking industry acquisitions.

This thesis follows the acquisition efforts in recent years of two technology industry giants: Cisco Systems and Lucent Technologies. It probes the companies' motivations and rationale behind their acquisitions, the impact upon the firms' portfolio of technological competencies, and potential and actual penetration of new markets and access to new technologies as a result of the acquisitions. In addition, organizational issues posed by technology management and other subsequent effects on their core competencies are discussed.

Comparative analyses of these companies led to key considerations of success/failure factors in acquisition and development (A&D) activities related to firm selection, integration, and evaluation processes. Effective formulas for A&D are summarized as they relate to critical strategic assets such as market, product, technology, value chain, IT, location, organization, people, culture, and vision.

As a result of this study, the thesis produces guidelines for the technology strategy of Nippon Telegraph and Telephone Corporation (NTT). The Japanese telecom industry is currently exposed to more severe competition than ever before due to the partial breakup of NTT in July 1999. The guidelines focus on the importance of recognizing both the A&D execution model and the feasibility of the recommended formulas and execution of consistent technology strategies based on past internal/external know-how and experiences.

Thesis Supervisor: Edward B. Roberts
Title: David Sarnoff Professor of Management of Technology

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Finally, I would like to express sincere gratitude to my wife, Etsuko, and my daughter, Hikari, for their continued support throughout the year.

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An Overview

1.1 Introduction

The telecommunications industry faces growing competition from deregulated markets and rapid technology changes, and it is becoming increasingly difficult for a company to evolve its business simply by investing in a wider range of technology segments such as equipment, network, and application services. Each player needs an efficient technology strategy to achieve cost effectiveness of its processes and quick commercialization of its innovations. In an effort to identify solutions to this question, this thesis focuses on R&D strategies in telecom industry acquisition.

1.2 A Paradigm Shift

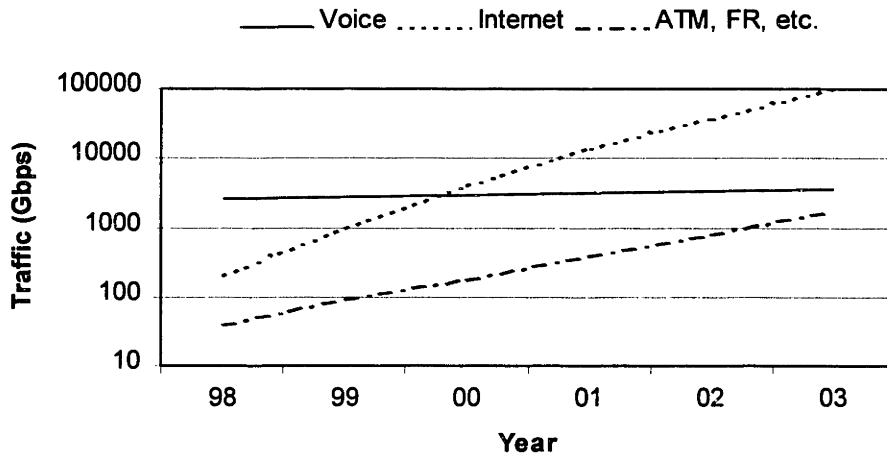
In his book *The Third Wave*, Toffler (1982) predicts the advent of the information-oriented society. He suggests that the Information Revolution of today is the third wave following the Agricultural Revolution and the Industrial Revolution. Although it took about 300 years to move from the Second to the Third wave, the period of rapid technological innovations since the Third wave in 1960s can be divided into four waves. Moschella (1997) classifies these waves into the Mainframe, Personal Computer (PC), Network, and Contents waves.

In the Mainframe Age (1964-1981), when IBM began its development of the computer in 1949, it held the largest share of the computer market, which was designed in the vertical integration model. In 1969, when IBM was prosecuted under the antitrust laws, it held 70% of the market. The PC Age (1981-1994) began the downsizing of computers in which PCs and workstations played the leading roles. The PC Age is also regarded as a horizontally distributed system in which software was independent from hardware. Specifically, the IBM PC/AT was unveiled, with its open architecture of hardware-promoted standardization of OS (Operation System) and MPU (Micro Processing Unit). Subsequently, around 1995, Microsoft and Intel formed the biggest power alignment, called the “Wintel Alliance,” by becoming the *de facto* standard. In October 1997, Microsoft was prosecuted under the antitrust laws for tie-in sales of Windows 95 and Internet Explorer 4.0.

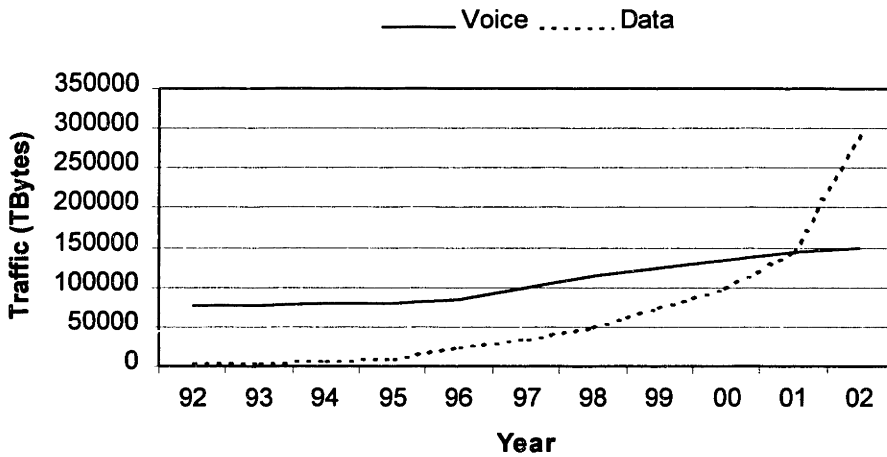
The Internet is the symbol of the Network Age (1994-2005). Since the information-oriented society in 1994 plunged into the Network Age, the number of computers connected to the Internet has increased exponentially, totaling 72,398,092 worldwide as of January 2000 (<http://www.isc.org/ds/host-count-history.html>). The volume of traffic flow on the Internet has doubled every 3.5 months and increased ten-fold per year. As shown in Fig. 1-1, today the volume of data traffic surpasses voice traffic even in the telecommunications network.

In the beginning of the 21st century, a transmission capability of Tera (ten to the twelfth) bits per second will be required for the backbone network of the Internet (*Nikkei Communications*, 1998). It is said that by the year 2005 most advanced countries will have completed building the requisite infrastructure for the high-speed Internet network. With its seamless and transparent features, end users will be freed from the idea that computers, like traditional telephones, are connected to each other via a network. Then will come the shift from the Network Age to the Contents Age (2005-2015).

Telecommunication Traffic in US



Telecommunication Traffic in Japan



Source: <http://www.nec.co.jp/japanese/today/newsrel/9904/2001-03.html>

Fig. 1-1 Voice vs. Data Traffic

In the Contents Age, because the scarcity of network capacity has disappeared, content will be regarded as more important than ever in terms of the law of supply and demand related to bandwidth. Both push technology and streaming technology that apply to broadcast services like TV and radio show tremendous promise. Moreover, because the cost

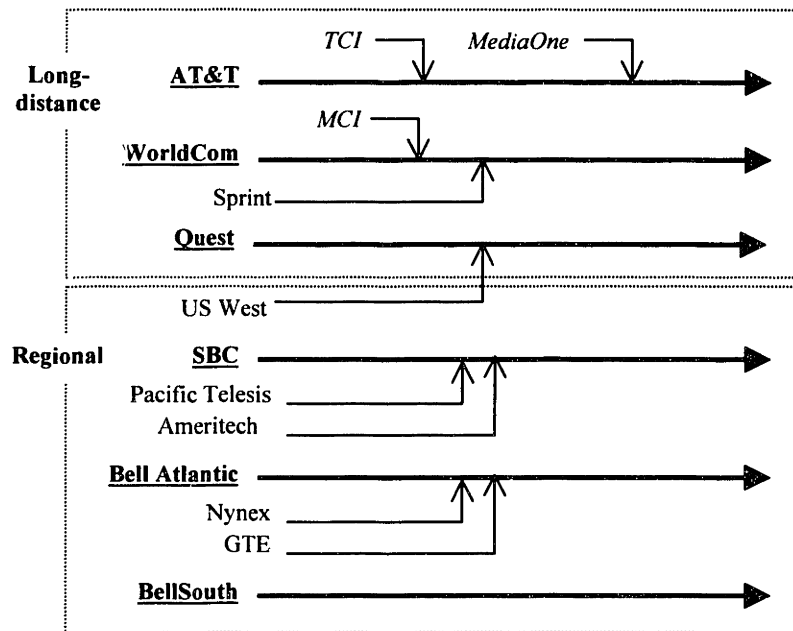
drops dramatically for transactions via network, the evolution of electronic commerce (EC) is expected to have an enormous impact.

1.3 Competition in the Telecommunications Industry

In the United States, under the Telecommunications Act of 1996, entry barriers between regional, long-distance, and international telecom businesses were removed (Rosenbush, 1998). Now that possession of network infrastructure and customer bases controls domination of the marketplace, mergers and/or acquisitions (M&A) are considered the best strategy for remaining competitive. In November 1997, for example, the fourth larger player among long-distance carriers, WorldCom, acquired MCI Communications, the second largest player and, as a result, became MCI WorldCom, the first telecom that offers both local and long-distance service since the breakup of AT&T in 1985. The U.S. government is still investigating that merger from the standpoint of the antitrust laws. However, it is regarded as a true symbol of the Network Age because a network provider was targeted for violation of the antitrust laws – just like IBM in the Mainframe Age, and Microsoft in the PC Age.

The factors that produced the storm of industrial reorganization include technological renovation of the Internet as well as deregulation triggered by the Telecommunication Act of 1996. Operational divisions such as regional, long-distance, and international businesses were made obsolete by the Internet, and then a trend toward deregulation strongly propelled industrial reorganization.

Although, in 1995, there were eight large regional and four promising long-distance carriers, a series of M&As reduced the number to four regional and two long-distance companies (see Fig. 1-2). The only company that has not experienced a merger during this



Source: *Nikkei NewsPaper*, 10/6/99

Fig. 1-2 Telecom Companies in US

time is BellSouth, a Regional Bell Operating Company (RBOC) based in the southeastern U.S. In October 1999, MCI WorldCom acquired Sprint, the third larger player, for about \$129 billion, the highest price ever paid for an acquisition. The name of the new company is WorldCom. M&As in the U.S. telecom industry seem to be settled for the time being after the establishment of WorldCom. The current power diagram of the U.S. telecom industry should not change unless another disruptive innovation dramatically changes the competitive environment.

Global alliances among the telecom giants have formed rapidly under severe M&A competition. As of 1998, there were three major actions (Sugaya, 1999):

- ◆ World Partners was formed by AT&T, Unisource, KDD and Singapore Telecom in September 1993.

- ◆ France Telecom and Deutsche Telecom, in January 1996, organized Global One, purchasing 20% of Sprint's stocks.
- ◆ BT (British Telecom), in November 1996, established Concert by investing in MCI Communications.

However, in July 1998, AT&T and BT announced an alliance plan to establish a global joint venture in the year 2000. As a result, AT&T will break away from World Partners, and World Partners was dissolved at the end of 1999. BT was forced to change its basic strategy for Concert activities because MCI Communications merged with WorldCom.

The most noteworthy point in the joint venture is that AT&T and BT are trying to reform an alliance for the Information Era, based on Internet Protocol (IP), by liquidating the past alliance that assumes integration of traditional telephone network (<http://www.icr.co.jp/newsletter/eye/1998/e98007.html#2>). Specifically, the objective is to build an open computing platform in which software applications communicate through the IP network integrating voice and data transmission. The platform will enable customers to set Quality of Services (QoS) parameters and manage security control by using an Application Program Interface (API). Also, the platform will enable suppliers to provide customers with cost-effective and intelligent services by using Operational Support System (OSS) functionality. It is said that this joint venture, which aims at \$10 billion in sales by 2000, will create new technologies and deconstruction of business models resulting from new relationships between customers and suppliers.

In addition, a business shock occurred when AT&T, in June 1998, acquired TCI (Tele-Communications Incorporated), the biggest CATV company and diversified media enterprise in the U.S. This was the first event symbolizing a fusion of the telecommunication and broadcast industries. Even the Federal Communications Commission (FCC) gave a

welcome to the acquisition because of its potential for offering consumers more long-term choices (<http://www.icr.co.jp/newsletter/trend/series/1998/s98M012.html#1>).

As a result of the merger, AT&T will classify its businesses into three groups: AT&T Consumer Services, AT&T Business Services, and Liberty Media. First, AT&T Consumer Services will be established to unify AT&T's long-distance and international businesses for household use and Internet access businesses (WorldNet) with TCI's cable system business and Internet access and backbone network businesses (At Home). Beginning digital telephone and video services in 2000, AT&T Consumer Services will, in the future, provide a services package consisting of telecommunication, Video On Demand (VOD), and EC (<http://www.att.com/press/0698/980624.cha.html>). Second, based on its existing world-class infrastructure, AT&T Business Services will provide advanced services and wholesale networking for business use. Third, Liberty Media will be organized by merging the program production and distribution businesses of TCI Liberty Media Group and the technology and international investment businesses of TCI Venture Group.

In the United States, where the spread of ISDN lagged because of the AT&T break-up, Internet access began with subscriber line plus modem and leased line services. Currently, cable modem, Asynchronous Digital Subscriber Line (ADSL), and digital wireless technologies are engaged in furious competition to become the next solution for the access network.

In contrast, the backbone network has already evolved into an IP network that transmits telephone, data, image, and movie together in a digital signal. Following development competition among digital compression technologies, "IP over fiber" has become the preferred standard, i.e., IP packets will be transmitted not through Asynchronous Transfer Mode (ATM) and Synchronous Optical Network (SONET) but simply through an

optical fiber network. As discussed for some time now, it is extremely difficult to design a unified access network with any precise insight as to the future of the backbone network.

However, hesitation is forbidden in today's era of competition and desire to be the *de facto* standard. AT&T decided to take the risk and acquire TCI for just such a reason. Microsoft is also investing in the CATV industry worldwide, as shown in Table 1-1. Microsoft's aim is to accelerate a shift to the broadband infrastructure using its great financial power to seize the information pipes through which its software and application services are delivered in households and offices the world over.

Table 1-1 CATV Related Investment of Microsoft

<i>Year</i>	<i>Invested firm</i>	<i>Price (MMS)</i>
<i>1997.6</i>	Comcast (US)	1,000
<i>1999.1</i>	NTL (UK)	500
<i>1999.5</i>	AT&T (US)	5,000
<i>1999.5</i>	Telewest (UK)	3,000
<i>1999.7</i>	Rogers Communications (Canada)	400
<i>1999.8</i>	Globo Cabo (Brazil)	126

Source: *Nikkei NewsPaper*, 9/25/99

1.4 Mergers, Acquisitions, and Strategic Alliances

As shown in Table 1-2, M&As related to telecom, broadcast, information, and contents industries, have been increasing in scale and scope. It is impossible, even for a telecom giant, to cover the broad range of markets and technologies on its own. Therefore, economies of scale and scope as well as technological innovations are crucial for competitive survival in order to enlarge service areas, reduce service costs, and commercialize new services. This is why any company in telecom-related industries cannot help but jump into M&As and strategic alliances.

Table 1-2 M&A in Telecom, Broadcast, Information, and Contents Industries

<i>Year</i>	<i>Acquiring Firm</i>	<i>Acquired Firm</i>	<i>Price (B\$)</i>
1993	Bell Atlantic	TCI	23.0
	AT&T	McCaw Cellular	12.6
	US West	Time Warner Cable	2.5
1995	Walt Disney	Capital Cities/ABC	19.0
	Time Warner	Turner Broadcasting Sys.	7.5
	Westinghouse	CBS	5.4
1996	Bell Atlantic	Nynex	25.6
	BT	MCI	19.0
	SBC	Pacific Telesis	16.7
	WorldCom	MFS Communications	14.0
	US West	Continental Cablevision	5.3
1997	WorldCom	MCI	37.0
	Microsoft	Comcast	1.0
	Microsoft	WebTV	0.4
1998	SBC	Ameritech	62.0
	AT&T	Teleport Communications	12.9
	Northern Telecom	Bay Networks	7.7
	Tellabs	Ciena	6.9
	Alcatel	DSC Communications	4.4

Source: <http://www.icr.co.jp/newsletter/trend/series/1998/s98M012.html#1>

M&As enable the acquiring firm to obtain the necessary management resources very quickly. It has the effect of saving time in the acquisition of technologies, human resources, equipment, a possible brand name, and so on, each of which does not initially belong to the acquirer.

In general, the stock price of the target firm is set higher than its true market value, because an acquirer considers the target firm to be more valuable than the market does. This price difference is called the "acquisition premium." Although it is difficult to quantitatively measure the synergy effects of a merger or acquisition, it is important to properly validate the premium by having a clear view of the potential added value. For example, a variety of management resources must be combined effectively, and assembling these assets can be a time-consuming activity. This is particularly true in the case of facility and equipment investment in industries with complex technologies. If a company is interested in quickly entering a market, then M&A with an existing player may prove to be a more effective

strategy. In this case, it will be worthwhile for the acquirer to pay a premium to the target firm in order to expedite quick entry.

After acquisition, some organizations turn out to be "lemons," as known in economics (Akerlof, 1970). Others quickly deteriorate under the new management of the acquiring firm. The organizational design and resource configurations of the target firm's assets are not likely to fit perfectly with the acquiring organization. One survey (Shrivastava, 1986) found that as many as one-third of merger failures were due to integration difficulties. Incorporating a new unit into an organization is considerably more difficult than arranging the financial deal, and a failure to integrate can destroy an otherwise successful organization.

An interesting example of consolidation problems associated with mergers is illustrated in the 1994 merger of Wellfleet Communications, a producer of hubs and switches for computer networks, and Synoptics, another computer systems company, creating the new entity, Bay Network. The two firms had clear product complementarity and shared a strong research focus. Yet two years later, much of the original management team had left the firm, the product development teams were still not integrated, and earnings were down. Differences in the culture between what appeared on the surface to be relatively similar companies made integration difficult (Oster, 1999). Thus, when contemplating a merger or acquisition, it is important to carefully manage the interdependencies between firms in terms of organization and culture.

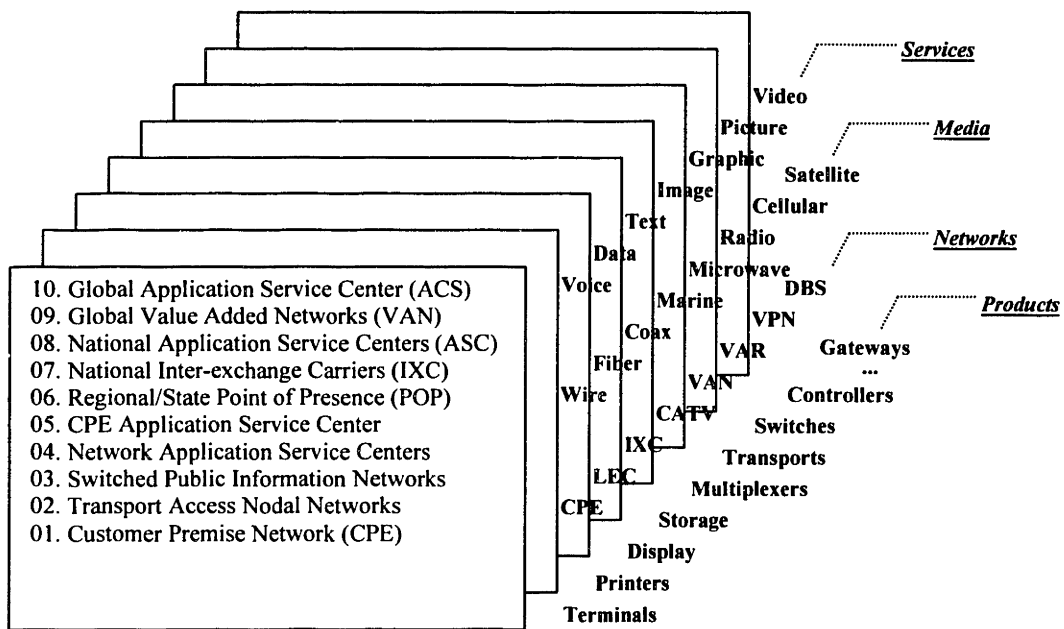
While M&A is often used by firms as a way to move into new areas, another method that firms have increasingly used to broaden their capabilities is the strategic alliance. Strategic alliances take a number of forms such as technical alliance, joint development, joint venture, and outsourcing. Strategic alliances have been particularly common in the high-tech industry. This industry has a number of features favoring alliances. When technology

changes, new combinations of assets are required, and firms begin looking outside their own boundaries to find these assets. Alliances are particularly helpful when there is a risk that the current combinations are valuable only for the current generation of technology. Here the flexibility and lower termination costs of alliances favor them over the classic merger or new investment. High-tech industry also favors speed and alliances as one way to move more quickly. Relative to M&A, alliances tend to be fast and flexible, easier to start or stop. Alliances have some political advantages in globalization, and speed is an aid here, too.

But there are disadvantages in strategic alliances as well, and the record of success has not been entirely positive. A large-scale study of joint ventures over the period 1924 to 1985 (Harrigan) suggests that just under half the ventures were considered a success by the partners. This figure puts alliances on about the same plane as M&A. In exchange for the flexibility of alliances, some of the goal congruity is lost that usually occurs with activities brought more firmly inside the firm. There is considerable learning as partners begin working together, and this, too, has its costs. Dissolving partnerships can be very difficult, as partners struggle to make sure they are protected in the post-partnership period (Oster, 1999).

1.5 Telecommunications Technology Strategy

To better appreciate what is happening in the information marketplace, it is interesting to look at the Layered Networks' Layered Services (LNLS) model, shown in Fig. 1-3, which illustrates why various technologies are used (Heldman, 1997). This figure shows who is using what forms of media to deliver what type of information services to which users. Also, it examines which suppliers' products are being used in interconnected private and public networks, phased in time to globally extend the application. The LNLS model also helps us understand what is required to meet the following management needs:



Source: Heldman, 1997

Fig. 1-3 Layered Network's Layered Services

- ◆ Establish a competitive base for future revenue opportunities well into the 21st century;
- ◆ Evolve new features in a timely manner from previous features, as user needs become more complex and extensive;
- ◆ Achieve a multi-layered but integrated information infrastructure for supporting and expanding voice-audio services, as well as extending the infrastructure to encompass narrow-band, wide-band, and broadband, data, image, and video services.

We will have to mix and match technology, networks, products, and services differently for different user applications. However, this effort will become increasingly complex as each application requires another layer to provide the total end-to-end solution, with each application resolved somewhat differently. Now it is crucial for each player in the

industry, from a viewpoint of broader ranges of technologies, to form its technology strategy, that is, what technologies to develop, whether to seek technological leadership, and whatever.

Porter (1985) suggests a number of analytical steps in formulating technological strategies for turning technology into a competitive weapon.

- 1) Identify all the distinct technologies and sub-technologies in the value chain.
- 2) Identify potentially relevant technologies in other industries or under scientific development.
- 3) Determine the likely path of change of key technologies.
- 4) Determine which technologies and potential technological changes are most significant for competitive advantage and industry structure.
- 5) Assess a firm's relative capabilities in important technologies and the cost of making improvements.
- 6) Select a technology strategy that reinforces the firm's overall competitive strategy, encompassing all the important technologies.
- 7) Reinforce business unit technological strategies at the corporate level

Technological change is one of the principal drivers of competition. It plays a major role in industry structural change as well as in creating new industries. It is also a great equalizer, eroding the competitive advantage of entrenched firms and propelling others to the forefront. Many of today's great firms grew out of technological changes they were able to exploit. Of all the things that can change the rules of competition, technological change is among the most prominent. Therefore, because of the power of technological change to influence industry structure and competitive advantage, a firm's technology strategy becomes an essential ingredient in its overall competitive strategy.

Acquisition and development have been highlighted in the U.S. Like Cisco Systems' formula, it aims at rapid growth by taking in another company's market and technology through many small-sized acquisitions. When it was established fourteen years ago, Cisco manufactured only one kind of network equipment, the router. By July 1993, just before it undertook its first acquisition, its sales were \$715 million. After that, through a series of acquisitions, the firm metamorphosed into an overall network equipment vendor that offers various products ranging from one end of network to the other. Its sales swelled twelve times in five years (<http://www.tmsystems.co.jp/dia/990330.html>). Cisco has proved that acquiring external technologies has enabled it to become a market leader; at the same time it has fundamentally changed the attitudes regarding R&D in several high-tech industries.

On the other hand, Cisco's investments in gear for telephone carriers have been problematic. Its second-largest acquisition was unsuccessful -- the \$4.4 billion purchase in 1996 of StrataCom Inc., which made data switching systems used in large networks. Although Cisco sells switches to network service providers and emerging telephone companies, traditional telephone operators continue to buy them instead from Nortel, Newbridge Networks, and Ascend Communications (currently part of Lucent). Now Cisco appears to be backing off from StrataCom-type devices known as ATM switches. It has canceled one product and delayed another (*Business Week*, 9/13/99).

Lucent Technologies is another company that has a well-developed, aggressive M&A strategy. In June 1999, it announced the completion of the acquisition of Ascend Communications. Aiming at next-generation networking environments that integrate voice, data, and video, Lucent will offer comprehensive network solutions by combining its core competencies, i.e., optical fiber network and Dense Wavelength Division Multiplexer (DWDM) technologies, and the remote access and Voice over IP (VoIP) lineups of Ascend.

Furthermore, through a series of acquisitions, Bell Laboratories, Lucent's R&D organization, is steadily expanding its expert knowledge in most of the technology fields by forming a wide-ranging portfolio.

Taking a different tack, ThermoElectron's formula is referred to as an innovative technology strategy (Harvard, 1992). Its strategy is to develop unique products within well-defined market niches. One of the company's strengths is its ability to respond quickly to opportunities. ThermoElectron, which started as a diversified technology company, has maintained a unique structure in which the parent company makes three formal contractual agreements with its subsidiaries: a tax-sharing agreement, corporate services agreement, and corporate charter. An important benefit of ThermoElectron's structure is the fact it can reward entrepreneurial ability and retain employees by giving them the chance to run their own public company. In addition to personnel, technology developed within its R&D center sometimes moves from the parent to one of the subsidiaries. Since it was established, ThermoElectron has grown briskly, and its profits and share price seem to move ever upward. Lately, however, earnings have tumbled and the stock has dropped precipitously, undone by problems at some of the subsidiaries and by a corporate management stretched too thin.

Does the fault lie in poor execution or in a fundamentally flawed strategy? A strategy of continually developing new businesses into publicly traded subsidiaries brought ThermoElectron first growth, then grief. George Hatsopoulos, ThermoElectron's founder and chairman, said that they made mistakes but this was still a business model that would be used widely in the 21st century (*New York Times*, 6/6/99).

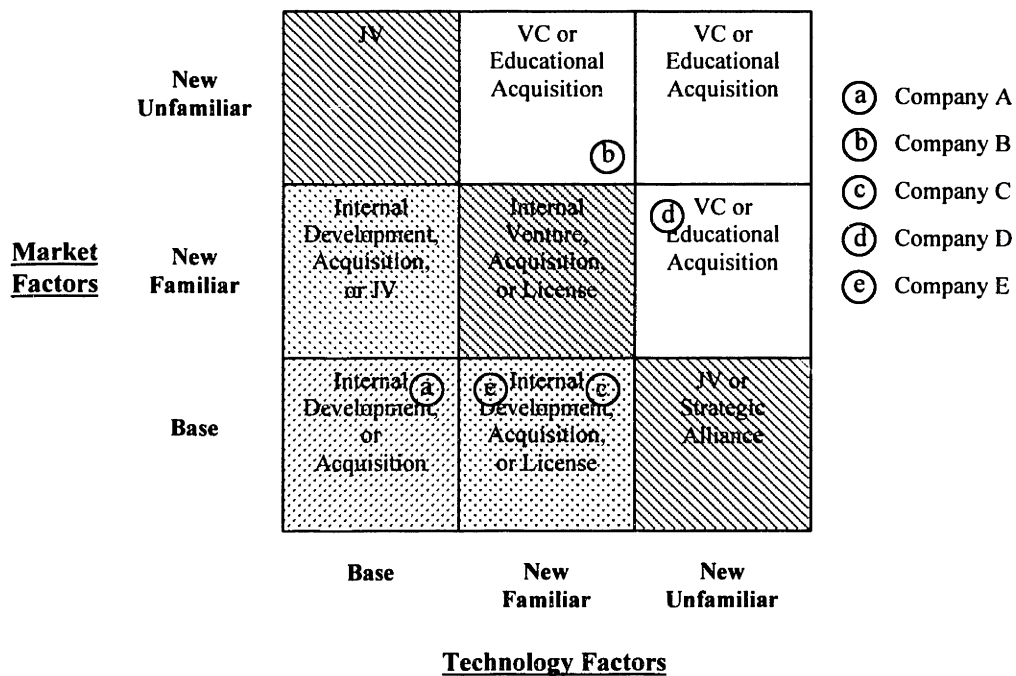
1.6 Objectives of the Thesis Research

To identify efficient technology strategies, this thesis traces the acquisition efforts over the past several years of two telecom-related companies: Cisco Systems and Lucent Technologies. The thesis probes each company's motivations and rationale behind its acquisitions, the impact on the firm's portfolio of technological competencies, potential penetration of new markets, and access to new technologies influenced by the acquisitions.

Specifically, as an analytical methodology for these examinations, the Roberts/Berry Familiarity Matrix (1985) is used. The matrix is constructed with the two axes of technical and market familiarity of acquisitions, using three measures of base, new familiar, and new unfamiliar on each axis. Fig. 1-4 depicts several assessments of a company's five acquisitions on this grid, now divided by different shading into three overall zones to indicate regions of roughly similar 'familiarity'. Within the lower left 'base-familiar' zone, acquisitions are assumed to be capable of adding depth to the company's existing market and technical skills and knowledge, with only incremental broadening.

Empirical studies of acquisition strategies show that "related acquisitions" tend to become successful additions to the firm (Healy, 1997). In contrast, acquisitions that are denoted as 'new unfamiliar-new unfamiliar' would be essentially unrelated to the company's core knowledge. While such acquisitions might have the potential to dramatically add new skills and new market opportunities to the acquiring firm, the research literature indicates that such "unrelated acquisitions" usually fail and are frequently divested. The diagonal 'marginal' zone suggests a middle ground in regard both to potential gains and likely risk of failure of the acquisitions.

In addition, this thesis discusses organizational issues posed by technology transfer problems and other subsequent effects on core R&D. It also touches on key organizational



- (a) Company A
- (b) Company B
- (c) Company C
- (d) Company D
- (e) Company E

Source: Roberts/Berry, 1985

Fig. 1-4 Familiarity Matrix for Acquisitions

challenges that may determine the company's ability to capitalize on the substantial technology potential offered by the acquired firm. Management's goal is a seamless organization in which the different business sectors operate as though they are one entity. Primary sources of information are annual reports, press releases, magazine articles, supplemented by field study.

Eventually, through this research study, I plan to produce a guideline for the R&D strategy of my company, NTT (Nippon Telegraph and Telephone Corporation), Japan's telecom titan. The Japanese telecom industry is currently exposed to more severe competition than ever due to the historic breakup of NTT in July 1999. In particular, the breakup of AT&T in 1984 offers NTT some thoughts about R&D. Like Bellcore, the shared laboratories of the RBOCs, it is possible that NTT's R&D power will shrink because of the

demoralization and exodus of researchers. NTT's researchers will also be likely to focus not on basic research but on short-term development because of limited budgets and immediate profits required by business units. In addition, there is criticism that the current R&D structure of NTT cannot withstand global competition (Nonaka, 1996).

Ultimately, it may be better that NTT follows AT&T's successful strategy in which AT&T entered new businesses by aggressively purchasing high-tech ventures. It is a curious feature of the NTT group that the holding company involves a huge R&D organization. In other words, 3,200 researchers engage in R&D while the number of brains in the holding company is only 400 (<http://www.ntt.co.jp/about/index.html>). The organizational design of R&D departments could become a decisive factor in the future success of NTT, which is a technology-oriented company. Today, NTT needs great leadership if it is to successfully and flexibly combine technical genius with business opportunities.

The Networking Industry

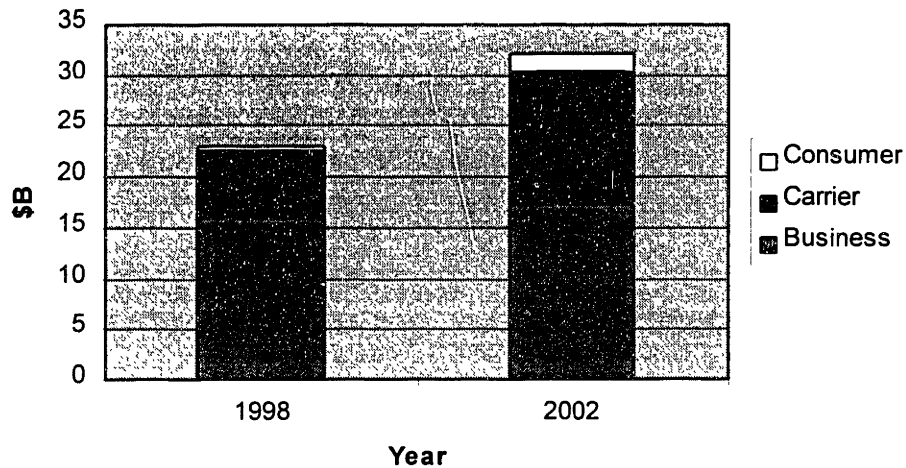
2.1 Industry Trends

For the past ten years, data networking companies have had extraordinary success selling hubs, switches, and routers to large enterprises, medium-size business customers, and telecom companies (see Table 2-1). Vendors across the board have experienced meteoric growth and amazing margins. Following client/server LAN buildouts and the growth of LAN internetworking, 3Com and Cisco have grown from small companies with a few hundred million dollars in revenue to multibillion-dollar corporate giants. Also, with demand outstripping supply, vendors have enjoyed healthy balance sheets every quarter. While Cisco commands the highest margins, 3Com and Cabletron have also enjoyed gross margins in the 50% range.

Table 2-1 Networking Industry

	<i>LAN</i>	<i>WAN</i>	<i>Telecom</i>
Product	Hubs, NICs, Ethernet switches	Routers, RAS	Voice switches, frame switches
Technology	Ethernet, Token Ring, ATM	Leased line, frame relay, ISDN, ATM	Circuit switching, frame switching
Buyers	IT managers	Telecom managers, IT managers	Carriers
Key players	Cisco, 3Com, Bay (Nortel), Cabletron	Cisco, Ascend (Lucent)	Newbridge, Nortel, Lucent

Source: Hannigan, 1998



Source: Hannigan, 1998

Fig. 2-1 Networking Dollars Shift

Forrester Research (see Hannigan, 1998) sees a major shift in sales and growth opportunities for data networking vendors after ten years spent harvesting the low-hanging fruit in the business market (Fig. 2-1). Two forces -- price wars within the LAN sector and the ascendance of the Internet -- are converging to end the LAN boom years. The LAN equipment business, a longstanding cash cow for vendors, is about to undergo a major upheaval as Ethernet switches become easy to build and cheap to buy.

With Ethernet and IP becoming *de facto* standards for corporate networks, LAN switches can be optimized, i.e., capabilities in Ethernet and IP packet forwarding can be burned into hardware. Therefore, building an ultra-fast LAN switch is a matter of assembling the parts. Since the heart of a switch will be held in a few hardware chips, prices for desktop Fast Ethernet switches are expected to hit \$80 per port -- down from \$700 per port of a few years ago (Hannigan, 1998). In two years, class-of-service features will be standard in all Fast Ethernet switches for a minimal price premium.

With blazing performance and the ability to prioritize critical traffic, LAN infrastructure upgrades should last a decade. Shipments of Fast Ethernet switches will rise dramatically for the next three years as corporations retire their shared hubs. But, the switching buildout is a double-edged sword for equipment makers as the LAN market experiences more competition and lower margins.

Besides the competitive pressures of the LAN market, the rapid growth of the Internet is also dramatically changing the market dynamics for equipment suppliers. By 2002, two million businesses and thirty million consumers will get connected to the Internet. This surge will create a huge demand for access gear and backbone routing switches (Lopez, 1998). Voice traffic is growing at 7% per year while data requirements are growing exponentially. By 2002, voice volumes will be a minor compared with the amount of bandwidth consumed by Internet traffic. Service providers will cap their investment in existing voice networks in favor of IP routers, switches, and access gear. In addition, as Internet computing applications displace mainframe and client/server applications, corporations will favor Internet VPNs (Virtual Private Network) for connecting applications. By 2003, Internet VPNs will have eclipsed frame relay as the WAN technology of choice (Nitzke, 1998). Therefore, the ascendance of the Internet promises big rewards and high cost for equipment vendors.

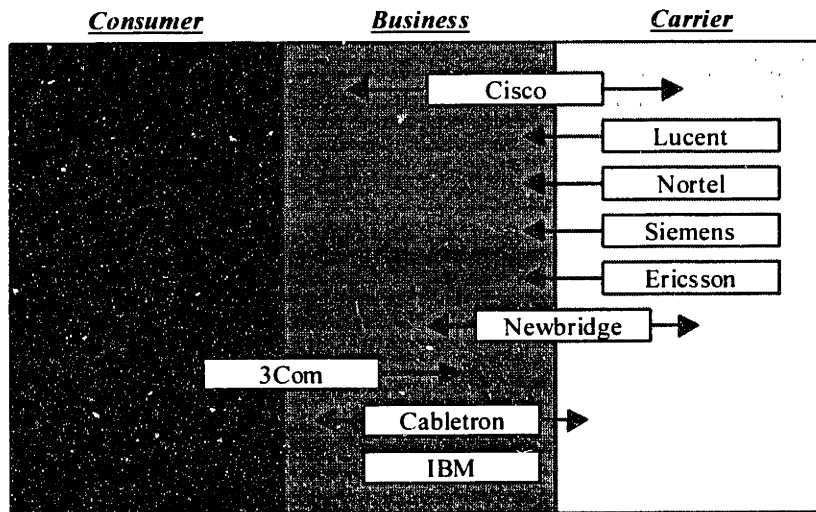
Serving the expanding market for access gear and routing switches promises vendors healthy growth and strong margins as providers pay a premium for products that can deliver carrier-class scale and reliability. On the other hand, vendors must invest enormous amounts of money to bring products and service organizations up to the stringent requirements of carriers.

2.2 Strategies for Data Networking Companies

By 2002, nearly half of all data networking equipment will be sold to carriers and service providers. Forrester Research (Hannigan, 1998) projects that competition in the core LAN business, combined with increasing price pressures, and numerous opportunities to sell data gear to service providers will focus vendors on the following:

- ◆ Reduce reliance on the LAN business. Although shipments of LAN ports will increase for another three years, revenues will flatten as prices continue to decline. In 2001, port shipments will also begin to decline as the enterprise market becomes saturated.
- ◆ Target growth in carrier sales. As the LAN equipment business slows down, providers like UUNet, Qwest, and Sprint will invest billions to build out their frame relay and Internet networks.
- ◆ Seek ground-level entry with consumers. The Internet will introduce networking to masses of consumers and “mom-and-pop” businesses. This army of new buyers will look for basic Internet access first, but by 2002 they will spend several billion dollars a year on consumer routers and hubs to network multiple PCs and printers (Kasrel, 1998).

For the next two years, network equipment providers will hurry to expand their product portfolios in an attempt to shake off competitors and establish a foothold in the growing market for carrier gear and nascent consumer space (Fig. 2-2). For example, 3Com is highly successful at selling to small and medium-size businesses through indirect and retail channels. To expand its base into larger accounts, 3Com will deliver its high-end routing switch and rely on alliances with switchmakers Newbridge and Siemens to keep Cisco in check in the carrier market. Moreover, eager to gain a share of the data networking action,



Source: Hannigan, 1998

Fig. 2-2 Vendors Expand

companies like Lucent and Nortel are spending huge quantities of money to compete against Cisco. With Nortel's acquisition of Bay Networks, it will go head-to-head with Cisco in the business (Hannigan, 1998).

Most vendors realize that success in every market is a difficult task. End-to-end networking companies will stumble because the following markets, which they are trying to attack, have different business models and diverse customer requirements (Table 2-2).

Table 2-2 Three Network Markets

	<i>Consumer</i>	<i>Business</i>	<i>Carrier</i>
<i>Sales channels</i>	Retail, Internet	VARs, distributors, outsourcers	Direct
<i>Equipment margin</i>	15%	30%	More than 50%
<i>Management</i>	None	Policy management tools	Service management platform
<i>Product requirements</i>	Simplicity, ease-of-use	Manageability	Scale, reliability
<i>Key success factors</i>	Brand	Distribution	Support

Source: Hannigan, 1998

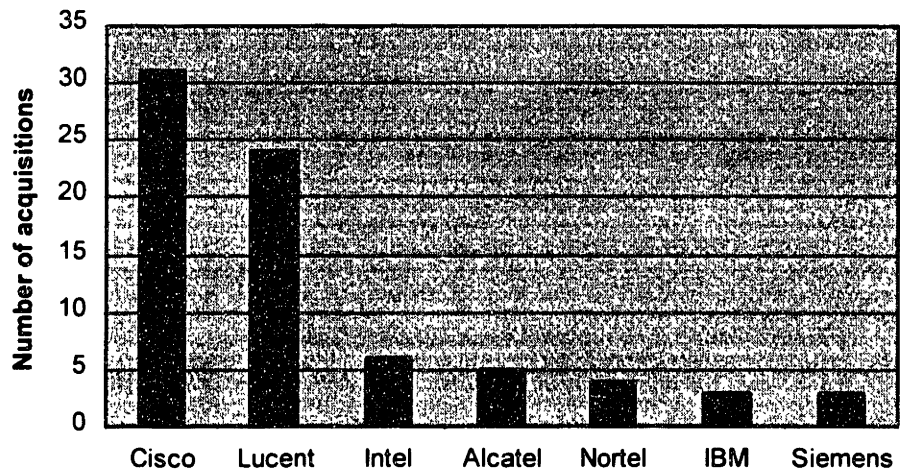
- **Consumer Market:** The emerging market for consumer and very small business networking will be characterized by buyers who want self-configuring products from household names. Success in this segment will require simplicity and brand. Home-area hubs and switches aimed at small businesses must deliver blackbox, plug-and-play ease of setup. Easy tools to help configure a router interface will not be good enough for consumer buyers. Moreover, products will be sold directly over the Internet and through retail stores like CompUSA and Radio Shack. Successful vendors will have brand names that are recognized in every home. Smart electronics vendor will leverage brand presence to cross-sell stereos, PCs, TVs, and appliances with simple home power management and parental control tools in the network gear.
- **Business Market:** Successful models in this market will depend on channels and management. With users purchasing gear from third parties, vendors will be dependent on outsourcers like AT&T Solutions (<http://www.att.com/solutions/>) and VARs like Vanstar. Vendors that are able to thrive on thin margins by leveraging volume manufacturing, distribution channels, and an Internet commerce presence will win as the vast majority of network equipment is moved through indirect channels. Besides, with the switching performance ceiling broken, users will look beyond raw throughput when making decisions to buy. Policy management software and directory-enabled network gear will be mandatory to help large companies automate the administration and debugging of large networks of switches and routers.
- **Carrier Market:** Selling scalable and highly reliable backbone routing switches will be a prerequisite for the carrier market, but suppliers will differentiate with multiple services and network applications. Carrier buyers are too smart to let their business depend on one vendor's switching products or proprietary management platforms. To drive more

switch business, smart vendors will sell multi-vendor integration and support services in addition to network products. Also, vendors lacking the software to collect IP billing records, automatically provision Internet VPN, and define and enforce class-of-service and security policies will be shown the door. Leading players will partner with commerce and customer service applications vendors like Ariba and Vantive to support customer-facing solutions.

2.3 Networking Industry Acquisitions

Appendix A shows a list of recent acquisitions, most in the last three years, in the networking industry (<http://www.techfest.com/networking/comp/acquisit.htm>). Also, in order to complement this information source, the reader can see a running record of mergers and acquisitions in both the networking and data communication industry as reported in the ATM Digest Website (<http://www.atmdigest.com/mergers.htm>). Fig. 2-3 shows recent acquisitions in each of the most acquisitive companies, based on Appendix A.

The next two chapters trace the acquisitions of Cisco Systems and Lucent Technologies. Both companies have executed a sufficient number of deals to enable an analysis of the characteristics of their acquisitions. A comparison of the two giants proves quite interesting because they are different types of data networking companies. Cisco is a generalist that succeeds in multiple markets, while Lucent is a specialist that delivers best-in-class products to a single target market (Hannigan, 1998). From a technological perspective, Cisco is the king of data networking, while Lucent is the king of voice communications.



Source: <http://www.techfest.com/networking/comp/acquisit.htm>

Fig. 2-3 Recent Acquisitions (1997-1999)

Cisco Systems

"How companies use information technology will define their success in the coming era of virtual business."

---G. Ferguson, Andersen Consulting (Nov. 1996)

Source: http://www.cisco.com/warp/public/756/gnb/gnb_wp.htm

3.1 Company Overview

Cisco Systems was founded in 1984 by a small group of computer scientists from Stanford University who were seeking an easier way to connect different types of computer systems. The company shipped its first product in 1986. Since becoming a public company in 1990, Cisco's annual revenues have increased from \$69 million in 1990 to \$12.2 billion in fiscal 1999. Cisco has grown into a multinational corporation with more than 20,000 employees in over 200 offices in 55 countries. Cisco is the worldwide leader in networking for the Internet.

a) Strategy

Cisco's strategy for achieving technology excellence is to focus on internal product development and blend that with acquisitions and partnerships. This strategy has enabled Cisco to add many new products, acquire more than 50 companies and develop dozens of

partnerships to help the company pursue emerging markets and achieve market share leadership (http://www.cisco.com/warp/public/749/ar99/letter/letter_index.html).

Cisco's number one priority and passion continues to be customer focus. The company is committed to helping its customers become agile by implementing Internet business models that will position them for success in today's fast-based business environment. Its leading-edge customers deploy networks that deliver data, voice, and video capabilities over a single network.

In contrast to many technology companies, Cisco does not take a rigid approach that favors one technology over alternatives and then imposes that on customers as the only answer. Cisco's philosophy is to listen to customer requests, keep track of all technological alternatives, and provide customers with a range of options from which to choose. Cisco develops its products and solutions around widely accepted industry standards. In some instances, technologies developed by Cisco have themselves become industry standards.

Cisco provides end-to-end networking solutions that customers use to build a unified information infrastructure of their own or connect to someone else's network. An end-to-end networking solution also provides a common architecture that delivers consistent network services to all users (<http://www.cisco.com/warp/public/750/corpfact.html>).

In addition, agility is the key to success in an environment that is changing faster than ever as political alliances disappear and deregulation opens new markets and increases competition. Cisco captures the momentum of the Internet, responding instantly to changing market conditions and customer demands. Employees, customers, suppliers, and business partners must all collaborate in ways that enable them to be more productive, adapt rapidly to change, and make effective decisions.

Cisco and its customers are proving that networking and the Internet can fundamentally and profitably change the way companies do business. Cisco describes this change in its "Global Networked Business" model. A Global Networked Business is an enterprise, of any size, that strategically uses information and communications to build a network of strong, interactive relationships with all its key constituencies. The Global Networked Business model employs a self-help model of information access that is more efficient and responsive than the traditional model of a few information gatekeepers dispensing data as they see fit (http://www.cisco.com/warp/public/756/gnb/gnb_wp.htm).

Cisco is a good example of a Global Networked Business. By using networked applications over the Internet and its own internal network, Cisco realizes at least \$550 million a year in operating costs savings while improving customer/partner satisfaction and gaining a competitive advantage in areas such as customer support, product ordering, and delivery times. Cisco is the world's largest Internet commerce site, with 83% of its orders transacted over the Web (<http://www.cisco.com/warp/public/750/corpfact.html>). In comparison, about 50% of Dell's sales currently are Web-enabled, and about 40% of Dell's technical support activities and 70% of Dell's order-status transactions occur online (http://www.dell.com/us/en/gen/corporate/factpack_000.htm).

b) Customers and Markets

Cisco's customers are in three main target markets:

- ◆ **Small/Medium Businesses** - Companies with a need for data networks of their own, as well as connection to the Internet and/or to business partners.

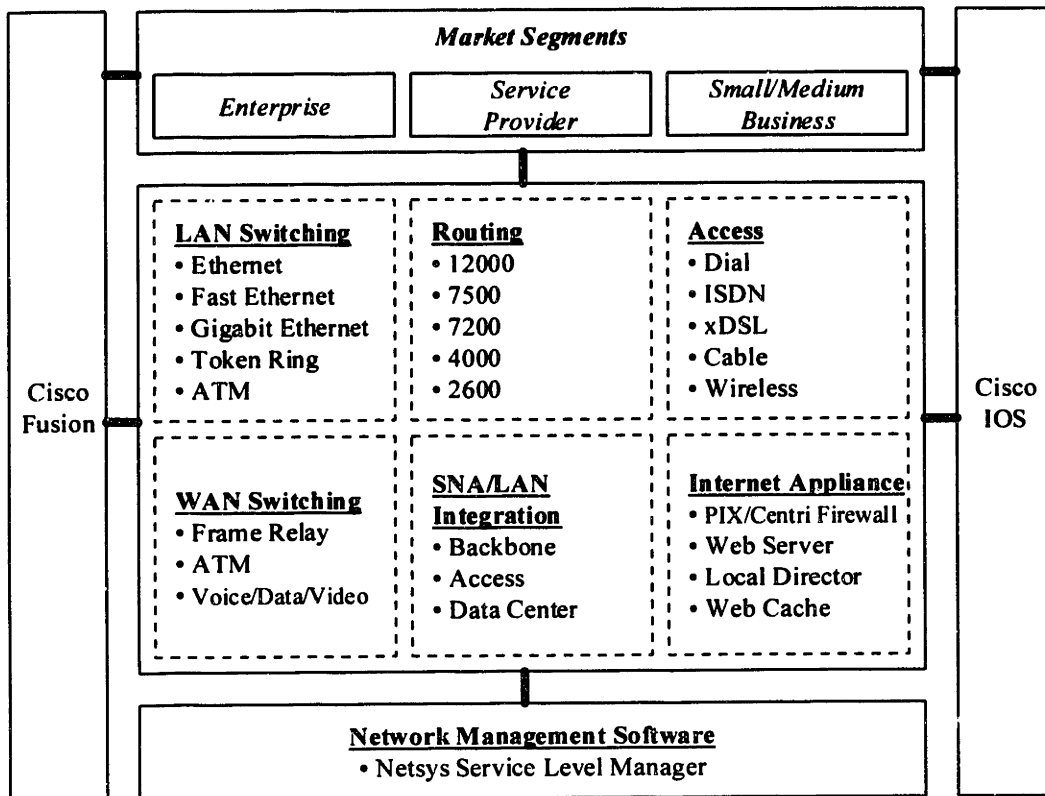
- ◆ **Enterprises** - Large organization with complex networking needs, usually spanning multiple locations and types of computer systems. Enterprise customers include corporations, government agencies, utilities, and educational institutions.
- ◆ **Service Providers** - Companies that provide information services, including telecommunication carriers, Internet Service Providers, cable companies, and wireless communication providers.

Cisco holds the number one market share position in 16 of the 20 key markets in which it competes. Also, Cisco holds the number two position in the remaining four areas. Some of these new emerging market opportunities include broadband access, VoIP (Voice over IP), and optical internetworking (Cisco, 1999).

c) Products and Services

Cisco sells its products in approximately 115 countries through a direct salesforce, distributors, value-added resellers, and system integrators. Headquartered in San Jose, California, it also has major operations in Research Triangle Park, North Carolina, and Chelmsford, Massachusetts, as well as more than 225 sales and support offices in 75 countries (<http://www.cisco.com/warp/public/750/corpfact.html>).

Cisco offers the industry's broadest range of hardware products used to form information networks or give people access to those networks; Cisco IOS™ software, which provides network services and enables networked applications; expertise in network design and implementation; and technical support and professional services to maintain and optimize network operations. Cisco is unique in its ability to provide all these elements, either by itself or together with partners. Fig. 3-1 maps out Cisco products and the markets for which they are targeted.



Source: http://www.cisco.com/warp/public/750/images/market_segment.pdf

Figure 3-1 Products and Markets

d) Financial Review (Cisco, 1999)

Net sales grew to \$12.2 billion in 1999 from \$8.5 billion in 1998. The 43.2% increase in net sales during the year was primarily a result of increasing unit sales of the followings:

- ◆ LAN switching products such as the Catalyst™ 5000 family
- ◆ The Catalyst 2900 series of switches for small enterprise network
- ◆ Access server such as the Cisco 2600 and 3600 families

- ◆ High-performance WAN switching and routing products including the IGX™ and BPX™ switches
- ◆ The Cisco 12000-gigabit switch router and increased maintenance service contract sales

Table 3-1 Consolidated Statements of Operations

<i>Years Ended:</i>	<i>07/31/99</i>	<i>07/25/98</i>	<i>07/26/97</i>
Net Sales	\$12,154	\$8,488	\$6,452
Cost of sales	4,240	2,924	2,243
Gross margin	7,914	5,564	4,209
Expenses:			
R&D	1,594	1,026	702
Sales and marketing	2,447	1,572	1,164
General and administrative	418	262	206
Purchased R&D	471	594	508
Total operating expenses	4,930	3,454	2,580

Source: Cisco Systems, 1999 Annual Report

(in millions)

Gross margins decreased slightly to 65.1% during 1999 from 65.6% in 1998. The decrease is due primarily to Cisco's continued shift in revenue mix towards its lower-margin products and the continued pricing pressure seen from competitors in certain product areas. As a result, Cisco is attempting to mitigate this trend through various means, such as increasing the functionality of its products, continuing value engineering, controlling royalty costs, and improving manufacturing efficiencies.

R&D expenses increased by \$568 million in 1999 compared with 1998 expenditures, an increase to 13.1% of net sales from 12.1% in 1998. The increase reflects Cisco's ongoing R&D efforts in a wide variety of areas such as data, voice and video integration, DSL technologies, cable modem technologies, wireless access, dial access enterprise switching, security, network management, and high-end routing technologies, among others. A significant portions of the increase was due to the addition of new personnel, partly through

acquisitions, as well as higher expenditures on prototypes and depreciation on additional lab equipment. For the near future, R&D expenses are expected to increase at a rate similar to or slightly greater than the sales growth rate, as Cisco continues to invest in technology to address potential market opportunities. Cisco also continues to purchase technology to bring a broad range of products to the market in a timely fashion.

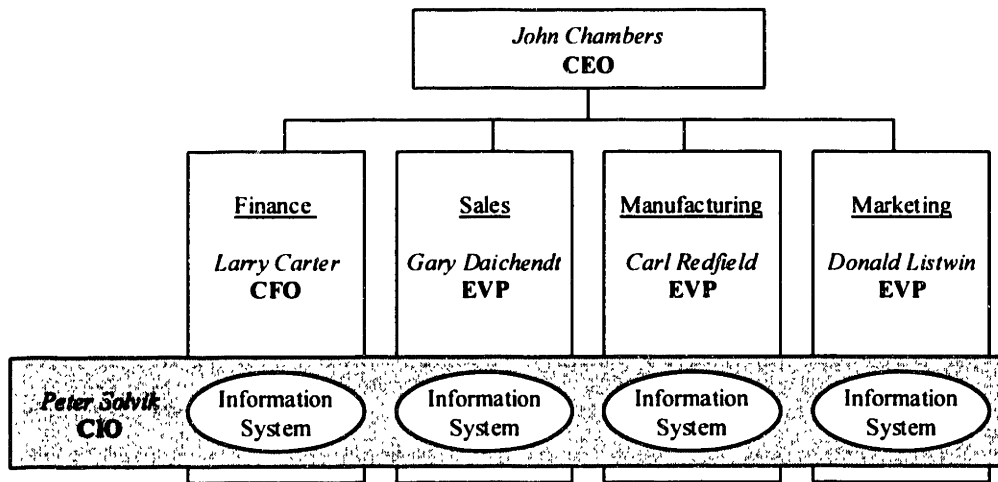
Sales and marketing expenses increased by \$857 million in fiscal 1999 over fiscal 1998, an increase to 20.1% of net sales in 1999 from 18.5% in fiscal 1998.

General and administrative expenses rose by \$156 million in fiscal 1999 over fiscal 1998, an increase to 3.4% from 3.1% of net sales. The increase primarily reflects increased level of amortization for acquisition-related intangible assets and \$16 million of cost associated with the acquisition of GeoTel.

e) Organization and Culture (Honjo, 1999)

Cisco's organizational structure is open and flat. People come together from various companies and individual leaders collaborate within the business units. Moreover, the company forges open partnerships with its customers, suppliers, and business partners. Also, the organization has been flexibly changing. First, John Chambers, President and CEO divided business units for each product. Then, the organization has recently changed into lines of business for each market. The following organizational features allow Cisco to keep on self-reproducing.

- ◆ Independent individuals
- ◆ Management that is open and controllable from the top
- ◆ Matrix organization
- ◆ Extensible outside the company



Source: Honjo, 1999

Figure 3-2 Cisco Organization

For example, the salesforce is mutually self-reliant and formed for individual customers in the target region. However, sales personnel work in close cooperation with the marketing and engineering teams that are responsible for the same customers. This flexible collaboration enables customers to receive the broad range of Cisco's services. In addition, Cisco's Information System (IS) section is distinctive because it partners with individual departments for sales, marketing, manufacturing, and so on (Fig. 3-2). Supported by the IS section, each department can invest in and build its own information infrastructure. Such flexibility is rare, even in the U.S.

Cisco's culture is expressed by key words such as *customer, frugality, stretch goal, agility, team work, empowerment, open communication, and trust*. Also important is Cisco's credo to acquire good things from the outside and not to hesitate to part with bad projects.

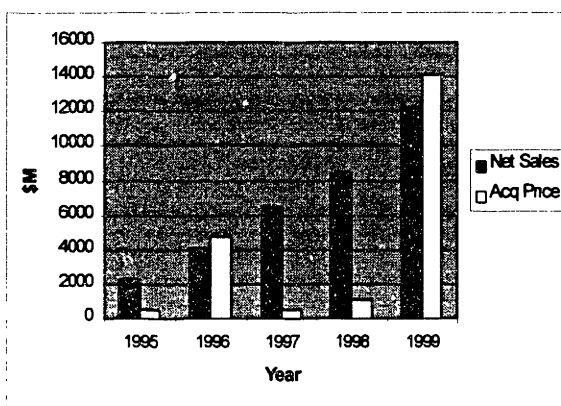
3.2 Analysis of Cisco's Acquisitions

Cisco actively supplements its internal development efforts with partnerships, minority investments, and acquisitions to offer customers a broad range of networking solutions for the Internet. Fig. 3-3 shows both Cisco's net sales and the number of acquisitions for each year. As the number of acquisitions increases, net sales have also grown every year.

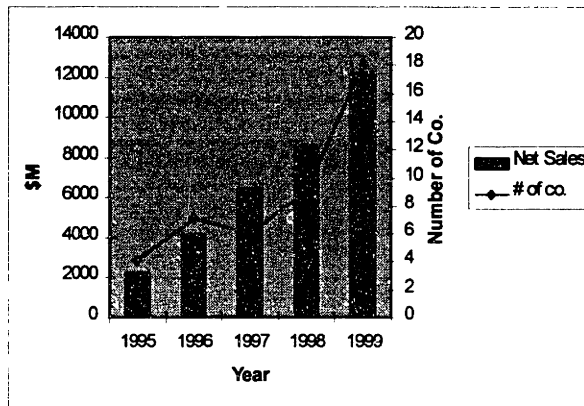
3.2.1 Statistics

The reader can see an overview of all the Cisco acquisitions at the Cisco's Website (<http://www.cisco.com/warp/public/750/acquisition/summarylist.html>). Appendix B also provides a summary of Cisco's acquisitions, including the following details:

- Name of acquired company
- Date when the acquisition was completed
- Acquisition price
- Number of the employees involved in the acquired company
- Year when the acquired company was founded
- Location of the acquired company's headquarters
- Core competence in technology
- Organization related issue in the acquisition
- Other comments

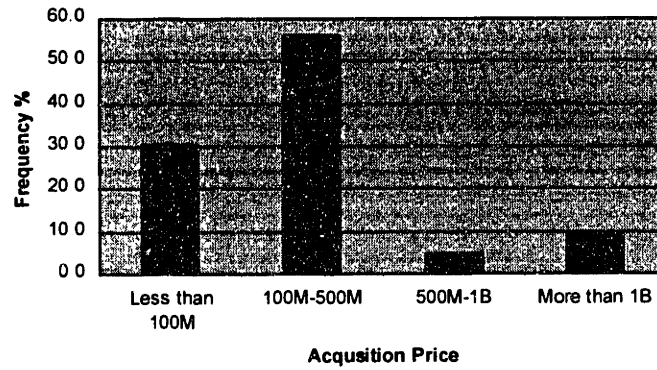


Source: Author



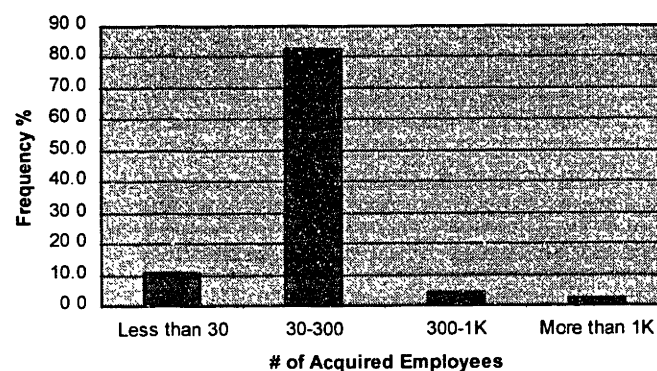
Source: Author

Figure 3-3 Net Sales and Acquisitions



Source: Author

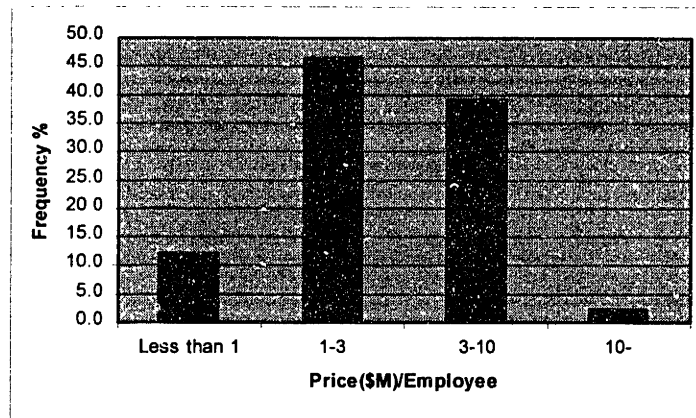
Figure 3-4 Distribution by Acquisition Price



Source: Author

Figure 3-5 Distribution by Acquired Employees

The analysis of Cisco's acquisitions begins with the target company's value (acquisition price), the number of employees, age, and headquarters location. Figure 3-4 shows acquisitions by acquisition price. Eighty-five percent of Cisco's acquisitions are for companies whose price is less than \$500 million. Cisco is inclined to acquire relatively small companies in terms of value. Most of the billion dollar acquisitions happened in 1999.



Source: Author

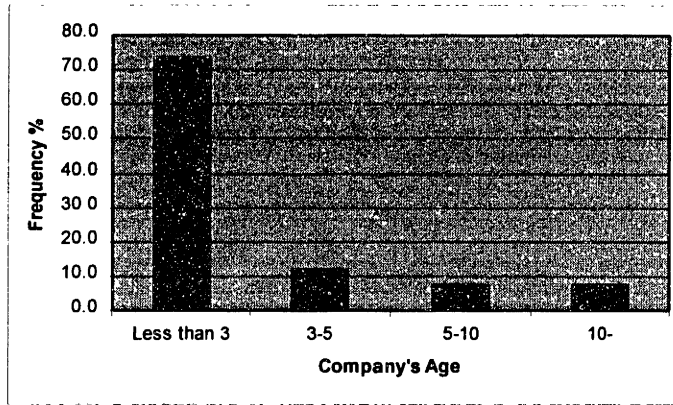
Figure 3-6 Distribution by Price per Employee

Figure 3-5 shows acquisitions in terms of the number of acquired employees. More than 80% of Cisco's acquisitions target small companies that have 30 to 300 employees.

Figure 3-6 shows acquisitions based on acquisition price per acquired employee. For approximately 45% of the acquisitions, Cisco pays \$1-3 million per employee. For approximately 40% of the acquisitions, Cisco pays \$3-10 million per employee. Thus, Cisco's strategy is to invest in companies with product/market potential, although most of the acquired companies are small.

Figure 3-7 shows acquisitions by company age. Because more than 70% of the acquired companies are less than three years old, Cisco is apt to buy startup companies as a way to acquire their new technologies.

Figure 3-8 shows acquisitions by headquarters' location. Approximately half of the acquired companies are from West Coast. Because Cisco's headquarters is in San Jose, California, the company considers cultural fit and geographical proximity to be important factors for these businesses. Eighty-eight percent of the acquired companies are in the United States.



Source: Author

Figure 3-7 Distribution by Company's Age



Source: Author

Figure 3-8 Distribution by Company's Location

Next I analyze a series of Cisco's acquisitions by placing each one into the Familiarity Matrix, which provides a uniform framework for assessing the acquisitions in terms of their initial market and technology-relatedness to Cisco. Although it is, in general, difficult to exactly define "familiarity", I have tried to establish metrics that draw the Familiarity Matrix for the acquisitions by company. Appendix C shows the metrics for the Familiarity Matrix.

Table 3-2. Familiarity Factors for Cisco's Acquisitions

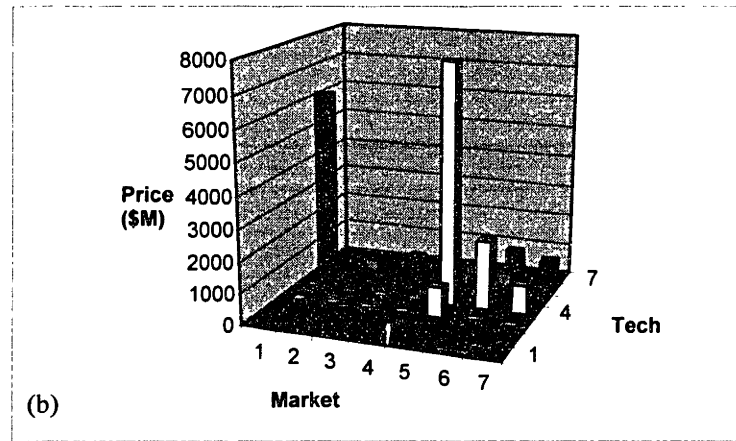
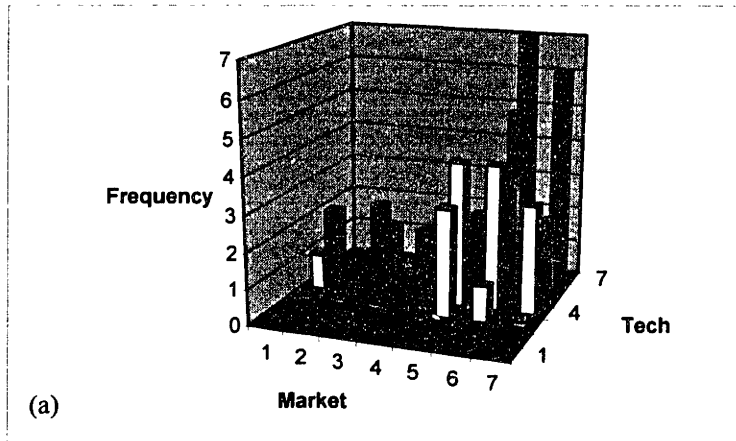
Acquired company	Technology	Product Integrity	Buyer Segmentation	Functionality	Competitive position
<i>Growth Networks, Inc.</i>	Semiconductor design	High	Service Provider	WAN	Leader
<i>Altiga Networks</i>	VPN	High	Enterprise	Access	Leader
<i>Compatible Systems Corp.</i>	VPN	Middle	Service Provider	Multi-service	Leader
<i>Pirelli Optical Div.</i>	DWDM	High	Telecom	WAN	Leader
<i>Internet Engineering Group, L.L.C.</i>	High-speed routing software	Middle	Service Provider	Multi-service	Leader
<i>Worldwide Data Systems, Inc.</i>	VoIP	Middle	Service Provider	Multi-service	Equal
<i>V-Bits, Inc.</i>	Digital video processing	Low	Service Provider (CATV)	Others	Leader
<i>Aironet Wireless Communications, Inc.</i>	Wireless LAN	Middle	Enterprise	Campus	Leader
<i>Tasmania Network Systems, Inc.</i>	Caching	High	Enterprise	Multi-service	Leader
<i>WebLine Communications Corp.</i>	Collaboration	Middle	Enterprise	Others	Leader
<i>Cocom A/S</i>	Digital video broadcasting	Low	Service Provider (CATV)	Access	Leader
<i>Cerent Corporation</i>	Optical cross-connect	Middle	Service Provider	WAN	Leader
<i>Monterey Networks, Inc.</i>	Optical cross-connect	Middle	Service Provider	WAN	Equal
<i>MaxComm Technologies, Inc.</i>	ADSL	Middle	Consumer	Access	Leader
<i>Calista, Inc.</i>	IP-based PBX	Middle	Enterprise	Campus	Leader
<i>StratumOne Communications, Inc.</i>	Semiconductor design	High	Service Provider	WAN	Leader
<i>TransMedia Communications, Inc.</i>	Media gateway	Middle	Service Provider	WAN	Leader
<i>Ameva Technologies, Inc.</i>	Unified communication middleware	Middle	Enterprise	Multi-service	Leader
<i>GeoTel Communications Corp.</i>	Call-center application	Middle	Enterprise	Multi-service	Leader
<i>Sentient Network, Inc.</i>	ATM emulation	Middle	Service Provider	WAN	Equal
<i>Fibex Systems</i>	Digital loop carrier	Middle	Service Provider	Access	Equal
<i>Pipelinks, Inc.</i>	SONET/SDH	High	Service Provider	WAN	Equal
<i>Selsius Systems, Inc.</i>	IP-based PBX	Middle	Enterprise	Campus	Leader
<i>Clarity Wireless Corp.</i>	Wireless	Middle	Service Provider	Access	Leader
<i>American Internet Corp.</i>	IP address management	High	Service Provider	Network management	Leader
<i>Summa Four, Inc.</i>	Programmable switch	Middle	Telecom	Multi-service	Leader
<i>Class Data Systems</i>	Policy networking	High	Enterprise	Network management	Equal
<i>Precept Software, Inc.</i>	IP/TV	High	Enterprise	Multi-service	Leader
<i>NetSpeed, Inc.</i>	xDSL	Middle	Telecom	Access	Leader
<i>WheelGroup Corp.</i>	Network security	Middle	Enterprise	Network management	Leader
<i>LightSpeed International, Inc.</i>	Voice signaling translation	Middle	Enterprise	WAN	Equal
<i>Dagaz</i>	xDSL	Middle	Service Provider	Access	Equal
<i>Ardent Communications Corp.</i>	DSP	High	Service Provider	WAN	Equal
<i>Global Internet Software</i>	Firewall	High	Enterprise	Network	Equal

Group					
SkyStone Systems Corp.	SONET/SDH	Middle	Telecom	management	
Telesend	xDSL	High	Telecom	WAN	Equal
Metaplex, Inc.	SNA	High	Enterprise	Access	Equal
Netsys Technologies, Inc.	Performance management	High	Enterprise	Multi-service Network management	Equal
Granite Systems, Inc.	Gigabit Ethernet	High	Enterprise	Campus	Equal
Nashoba Networks, Inc.	Token Ring	High	Enterprise	Campus	Equal
Telebit's MICA Technologies	Digital modem	High	Consumer	WAN	Equal
Stratacom, Inc.	ATM switch	High	Telecom	WAN	Leader
TGV Software, Inc.	IP service software	High	Enterprise	Multi-service	Leader
Network Translation, Inc.	Firewall	High	Enterprise	Campus	Equal
Grand Junction Networks, Inc.	Fast Ethernet	High	Enterprise	Campus	Leader
Internet Junction, Inc.	Internet gateway software	High	Enterprise	Campus	Equal
Combinet, Inc.	ISDN	High	Enterprise	Campus	Leader
LightStream Corporation	ATM switch	Middle	Enterprise	Campus	Leader
Kalpana, Inc.	Ethernet	High	Enterprise	Campus	Equal
Newport Systems Solutions	Remote access	High	Enterprise	Access	Leader
Crescendo Communications, Inc.	CDDI, FDDI, etc.	Middle	Enterprise	Campus	Leader

Source: Author

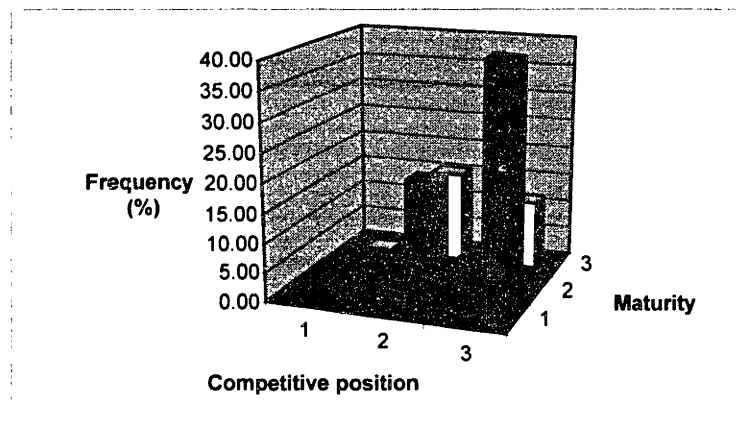
Table 3-2 shows important factors used in creating the Familiarity Matrix for each of Cisco's acquisitions. The columns, *Technology* and *Product Integrity*, are key factors for measuring technology familiarity. Levels of *Product Integrity* are classified into high, middle, and low, each of which was defined through investigations of press releases and journal articles, as shown in Appendix C. The columns, *Buyer Segmentation* and *Functionality*, are key factors for measuring market familiarity. The right-hand column, *Competitive Position*, is used to evaluate the technology portfolio matrix shown in Fig. 3-10.

Figure 3-9 results from plotting the levels of technology and market familiarity, both of which are calculated, based on the metrics for the Familiarity Matrix of Appendix C. The vertical axis of Fig. 3-9 (a) and (b), respectively, shows the number of acquisitions and cumulative acquisitions price.



Source: Author

Figure 3-9 Familiarity Factors for Cisco's Acquisitions



Source: Author

Figure 3-10 Technology Portfolio in Cisco's Acquisitions

Cisco's acquisitions are focused on *base familiar* zone, as shown in Fig. 3-9 (a). In addition, Cisco executes some acquisitions in the *new familiar* zone (and *new unfamiliar* zone specifically for markets). However, from a financial point of view, the investment is not necessarily intensified into the familiar zone as known from Fig. 3-9 (b).

Finally, I analyzed a series of Cisco's acquisitions by placing each one into the technology portfolio matrix which provides a uniform framework for assessing the acquisitions in terms of technological competitive position and maturity (Roussel, 1989). This matrix measures fitness for success.

Figure 3-10 shows Cisco's technology portfolio. The technological competitive position for each acquisition is shown in Table 3-2. I regard a target company as a leader when the company is a leading developer in the corresponding technology field. If information sources (such as press releases) do not include any comment on leadership of the company but shows the acquired company's technology excellence, the level of competitive position is defined as equal. If nothing is shown, it is regarded as a follower. Technological maturity emerges from Table C-4, a mapping table of technology items, and maturity was decided by the author. As shown in Fig. 3-10, Cisco tends to acquire leading companies in evolving technology areas.

3.2.2 Cisco's Formula

In most acquisitions, the acquirer tends to get mired in the endless details of integrating the new company into the existing culture, which results in slowed growth and downsized workforces and expectations. No wonder the stock price of an acquiring company generally drops on the day a takeover is announced. Not so with Cisco, which has built a formula for friendly acquisition and accelerated integration that allows it to acquire small,

fast-growing companies, meld the workforces and product lines, and move forward without missing a beat.

Acquisition Criteria: There are four key acquisition issues, and for big acquisitions, there is a fifth (<http://www.strategy-business.com/thoughtleaders/97209/page9.html>). Cisco does not do acquisitions when there is no alignment around these issues.

- 1) First, if the visions are not the same about where the industry is going and what role each company wants to play in the industry, there will be constant tension. Therefore, the visions of both companies must be examined, and if they are dramatically different, Cisco backs away.
- 2) Second, it is essential to produce quick wins for shareholders. For instance, if Cisco did not produce a win with Crescendo in the first year, the shareholders would have been unhappy with Cisco. And if wins are only short term, then it is not strategic. Shareholders have to benefit from any acquisition.
- 3) Third, there has to be long-term wins for all four constituencies -- shareholders, employees, customers, and business partners.
- 4) Finally, the chemistry has to be right, which is hard to define.
- 5) The fifth element -- for large acquisitions -- is geographic proximity. Geography is key. If a large acquisition is located some distance away, there will be problems. If it is an engineering or technology acquisition, remoteness is less of a problem. But if the acquisition combines two large companies and the center of manufacturing or marketing is in San Jose and the other company is in Boston, the future is limited.

With this philosophy, Cisco has actually made few mistakes. Management believes there are two keys to a successful acquisition: doing the homework to select the right company, and applying an effective and replicable integration process once the deal is struck (<http://www.strategy-business.com/thoughtleaders/97209/page2.html>). Companies are evaluated, approached, acquired, and integrated with remarkable speed and efficiency given the usual legal and cultural complexities surrounding such deals.

Firm Selection: Cisco management has created a matrix for emerging markets (which it constantly updates) and has identified niches, from Internet hardware and software to ATM switches and routers, in which it intends to become a market leader. These markets are found through conversations with customers, reading the trade press, attending industry conferences, and listening to endless entreaties from bankers and entrepreneurs. Once a market is identified, Cisco prefers to have its internal R&D organization develop a product. At least 70% of its products are developed internally. But the rule is that if Cisco does not have the resources to become a market leader within six months, it looks to buy its way into that market (<http://www.strategy-business.com/thoughtleaders/97209/page3.html>).

The profile of a target acquisition is defined by a clear set of guidelines: a company must be fast-growing, focused, entrepreneurial, culturally similar to Cisco, and geographically desirable. Cisco shies away from staid, old-line companies, slow movers, and turnaround candidates with hidden agendas. The model looks for early-stage Ciscos, known inside the company as “Cisco Kids”.

Integration Process: Cisco's integration process is tailored to each acquisition yet incredibly quick (Goldblatt, 11/8/99). For each, Cisco assembles a customized packet of

information that includes descriptions of Cisco's structure and employee benefits, a contact sheet, and an explanation of the strategic importance of the newly acquired company. The day the acquisition is announced, human resources and business development teams travel to the acquired company's headquarters. There they meet in small groups with people from the acquired company to set expectations and answer questions. The goal is to be smoothly shipping the acquired company's products under the Cisco label by the time the deal is officially closed, usually in three to six months.

For example, even before the ink is dry on a deal, Cisco's IT department sets in motion an aggressive integration of the new company's technology. A six-person IT team is dedicated to the task and follows a strict methodology. Within four weeks or less, the group integrates all systems, including toll-free support numbers, electronic mail, sales automation, Websites, and product order systems (Hiebert, 2000). The idea, says Cisco's chief information officer, Peter Solvik, is to present the acquired company to its customers as part of Cisco as soon as possible, usually within 100 days (<http://www.strategy-business.com/thoughtleaders/97209/page2.html>).

Thus far, Cisco has spent approximately \$21 billion and added more than 5,000 employees to its own rapidly expanding workforce. Cisco pays approximately \$4 million per person in an acquisition. Also, there tends to be little "insider versus outsider" politicking. In such an environment, Cisco has developed a culture that is extremely accepting and welcoming to acquired employees.

Employees who have just been acquired often feel uncomfortable. When Cisco absorbs a company, it makes a no-layoffs pledge; its turnover rate for employees acquired through acquisitions is only 2.1%, versus an industry average of more than 20% (Goldblatt, 1999). How do employees feel so comfortable that they want to remain with that company

five or ten years later? They have to see a future. They have to see a culture they want to be part of. They have to see an opportunity to do what they were doing before -- or even more. Cisco devises ways to sustain its growth in terms of organization, people management, corporate vision, and culture or chemistry.

Decentralization: Cisco has become a prototype for the networked corporation: a decentralized set of business units that leverage the company's marketing, sales, manufacturing, and distribution strengths. With this model, Cisco is reinventing itself, becoming a one-stop shopping option in a market that has long been far too technologically complex to allow any one vendor to grab such a role. Cisco insists on having leaders from the various business units involved along the way because an internal group must embrace an acquired company with a show of ownership or sponsorship. Otherwise, it will flounder and die (<http://www.strategy-business.com/thoughtleaders/97209/page3.html>).

People Management: Management encourages new arrivals to become part of the integration teams for subsequent acquisitions, figuring that these workers have a fresh understanding of the trauma of joining a large company in a takeover. In addition, management immediately lets the new employees know their roles and titles. A new employee's stock options continue to vest at the old rate but the options are now for Cisco stock, a big selling point. With its surging stock price, Cisco boasts hundreds of millionaires among its employees, thus making stock options in Cisco most welcome. The company is quick to point out that \$1,000 invested in Cisco stock in 1990 would be worth more than \$100,000 today (<http://www.strategy-business.com/thoughtleaders/97209/page4.html>). Management is aware that people are the crucial asset that is being acquired, i.e., engineers who have proven

they can build a great product and are poised to create the next generation under Cisco's banner (Hiebert, 2000). Cisco works hard to retain the CEO of the acquired company for at least six months after the deal is closed. If you don't retain executive management, you don't retain the rank and file.

Vision: Cisco is bold. It made the conscious decision, for example, that it was going to attempt to shape the future of the entire industry. Cisco decided to play aggressively and do in the networking industry what Microsoft did with PCs and IBM did with mainframes. Cisco also began to think a couple of years into the future about what could happen. Before that, it never thought beyond a year. Cisco began to set goals that many people would have thought impossible, and it made those goals part of its culture (<http://www.strategy-business.com/thoughtleaders/97209/page6.html>).

On the other hand, Cisco moved to a “non-religious” view about the technology. When something changes faster than Cisco anticipated, or it makes some other mistake, then Cisco adjusts quickly and doesn't spend a lot of time with the "Not Invented Here" syndrome, trying to protect political decisions made two years ago.

Culture/Chemistry: From the beginning, Cisco built a culture that depends on people from different environments and backgrounds. There is no mold there. It has a culture that accepts outsiders with the realization that brain power is what counts, and if the brain power fits into the culture, that's how the company wins. It is interesting that when Andy Grove, CEO and chairman of Intel, visited Cisco, he asked the group, "How many of you are here through acquisitions?" About 30% raised their hand. He was quite candid and said Intel could not have done that (<http://www.business2.com/articles/1999/10/text/chambers.html>).

Cisco has a culture that not only accepts new ideas and people, but also thrives on it. Cisco does not think in terms of being just a router or networking company. It defines itself broadly, which lets people be creative in filling that playing field. Such an environment also means that colleagues do not always see eye-to-eye. They think disagreement is fine -- it's a healthy way of debating things (Drexhage, 1999). In addition, "hot-desking" is an interesting aspect of its cultures. Like a high school cafeteria, office space is claimed on a first-come, first-served basis. Employees arrive at the office, select from available wired workstations, plug in and log on (<http://www.forbes.com/forbes/98/0907/6205054a.htm>).

3.2.3 Success or Failure?

Not all of Cisco's acquisitions have been successes.

Lightstream Corporation

When Cisco acquired Lightstream, that company had only \$1.5 million in hardware revenue. Cisco paid \$120 million for it. One year later, its run rate was \$45 million. It might be well on the path to success, perhaps even a home run. However, the acquisition of LightStream for \$120 million is also viewed by some analysts as a letdown. Cisco expected the buy to result in a switch to wide area networks but that never happened. A managing director at Morgan Stanley Dean Witter is sure that Cisco's expectations must have been much higher (Drexhage, 1999).

StrataCom, Inc.

Cisco will not rule out larger acquisitions if the industry changes faster than expected or where there is more integration than expected. Until the purchase in 1996 of StrataCom

for \$4.5 billion in stock, its biggest acquisition by far, Cisco never used an investment banker, preferring to pursue small, privately held technology companies in uncomplicated and friendly deals. The explanation offered was, "If you are a year late, that market might not exist anymore. We'd rather learn from our mistakes." (<http://www.strategy-business.com/thoughtleaders/97209/page2.html>)

Now that Cisco has killed off its ATM switch for the core of enterprise and service provider networks, the company's plans for the WAN market are unclear. Cisco is banking on increased sales of WAN switching gear to enterprises and service providers to drive the company's growth. The company's long-term WAN switching strategy for enterprises and service providers still has not jelled three years after Cisco's \$4 billion acquisition of StrataCom. The death of the 20G bit/sec TGX 8750 seems to leave Cisco without a core IP/ATM WAN switch to challenge offerings from Ascend, Newbridge Networks and Nortel Networks, and with a gaping hole in its end-to-end voice/data systems story. The only apparent gain from StrataCom is that Cisco bought its way into the AT&T and WorldCom public frame relay networks (Duffy, 1999).

Perhaps the most important thing about the StrataCom takeover is that it taught Cisco the advantages of thinking small. Cisco usually targets little companies because their employees are easier to integrate. Big firms can result in duplicate functions and culture clashes. Also, people close to Cisco's largest acquisition say it was difficult because StrataCom was too large and its product too developed. Cisco had trouble integrating elements of its operating system into StrataCom's switches (Goldblatt, 11/8/99).

Granite Systems, Inc.

Granite Systems, a company started by the founder of Sun Microsystems, which Cisco bought for \$220 million in stock, has not been a blockbuster. Analysts say the 1996 acquisition of Granite, a maker of so-called gigabit Ethernet switches, didn't work because Granite's product wasn't as far along as Cisco believed. Critics say Cisco paid too much for Granite, and that due diligence was not thorough enough, owing to difficulties arising from an advanced silicon chip design (Drexhage, 1999). One of the toughest parts of post-merger integration is getting products integrated into the firm's portfolio and making products line up in the release cycle (Hiebert, 2000).

Ardent Communications Corp.

Cisco's unusual decision to back a startup with the express intent of buying it has not worked out as well as expected. Cisco had an idea about the product and wanted it fast and in Cisco mode. Cisco made an early investment in the company, a maker of integrated voice, video and data equipment to hook up company branches with headquarters. It took two seats on the board and worked closely with Ardent's engineers. Cisco acknowledges now that it micromanaged the company too much (Holson, 1998). It is a tricky balance between telling them what you want and letting them act as a startup.

Others

"They were my mistake," John Chambers said. Cisco made the mistake of acquiring software companies without having the distribution channels. Cisco underestimated its existing channel's ability to move stand-alone software. In looking at what Cisco did with its acquisitions of GeoTel Communications and Amteva Technologies, it has changed. Cisco is

building an overlay organization to move the software. In addition, Cisco admits to some disappointments, such as Newport Systems Solutions (August 1994, \$90 million) and TGV Software (January 1996, \$115 million). In both cases, the returns have not matched expectations (<http://www.business2.com/articles/1999/10/text/chambers.html>).

Lucent Technologies

4.1 Company Overview

Lucent Technologies was formed as a result of AT&T's restructuring, and Lucent became a fully independent company, separate from AT&T, on September 30, 1996. The company designs, builds, and delivers a wide range of public and private networks, communications systems and software, data networking systems, business telephone systems and microelectronic components. Lucent employs approximately 153,000 persons in more than 90 locations, of which 76.5% are located in the United States (Lucent, 1999).

Bell Laboratories is the R&D arm of Lucent, with organizations located in 20 countries (<http://www.bell-labs.com/>).

a) Strategy

In the past few years, Lucent has steadily added new technologies and capabilities. These have been generated both by Bell Labs innovations and by acquiring technology and talent, and all have helped deliver next-generation networks to Lucent's customers. Last year, Lucent introduced a record 128 products that originated at Bell Labs, whose researchers earned 1,020 patents during the year, more than ever before. In addition, Lucent acquired

industry-leading companies to help address the industry's highest growth areas (<http://www.lucent.com/investor/annual/99/english/chairman2.html>).

Lucent's strategy is to meet its customers' needs by offering an end-to-end solutions platform. This strategy brings together the core products of switching, transmission, software, messaging, and optoelectronics with the new portfolio offerings obtained through strategic acquisitions as well as the R&D coming out of Bell Labs. These new offerings are in the areas of data packet switching, access products, software, and services (Lucent, 1999).

Despite a large number of employees, fat R&D budgets, and cumbersome development cycles, Lucent does well selling million-dollar switches to service providers. On the other hand, the company had a hard time trying to thrive on commodity Ethernet switches that produced razor-thin profit margins. With the acquisition of Internet player Ascend Communications in 1999, and an installed base to grow from, Lucent can use voice, network software, and its NetCare™ multi-vendor integration services to crack open ISP accounts.

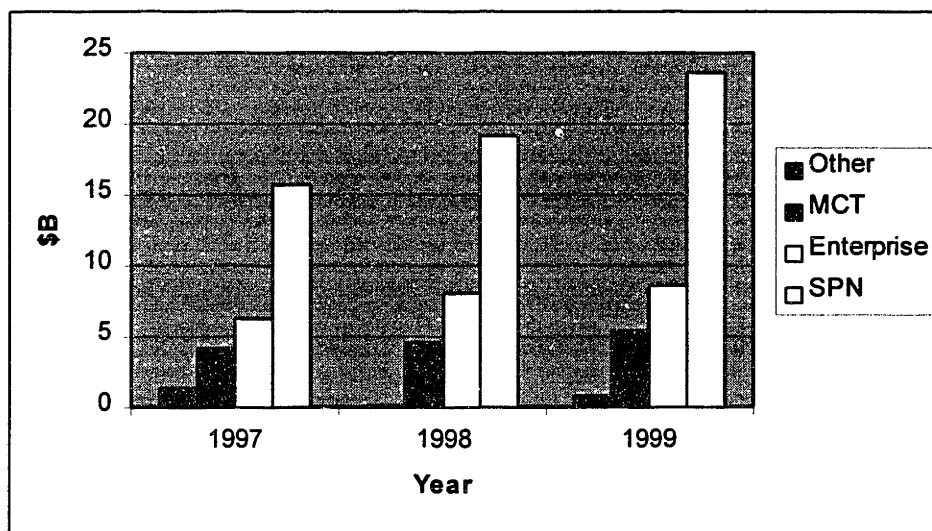
Also, it is a Lucent's strategy to build long-term alliances with major industry players, such as Telefonica Data, that need to build a network based on Internet protocol technology (Lucent, 1999).

b) Customers and Markets

Lucent operates in the global telecommunications networking industry, with three reportable segments: Service Provider Networks, Enterprise Network, and Microelectronics and Communications Technologies (Lucent, 1999).

- ◆ **Service Provider Networks (SPN)** - SPN provides public networking systems and software to telecommunications service providers and public network operators around the world.
- ◆ **Enterprise Network (Enterprise)** - Enterprise develops, manufactures, markets, and services advanced communications products and data networking systems for business customers, including small and mid-sized businesses, multinational Fortune 500 companies, government agencies, and schools.
- ◆ **Microelectronics and Communications Technologies (MCT)** - MCT designs and manufactures high-performance integrated circuits, IT systems, and optoelectronic components for applications in the communications and computing industries.

These three operating segments are strategic market units that offer distinct products and services. They were determined based on the customers and the markets that Lucent serves. Each marketing unit is managed separately, as each operation requires different



Source: Lucent, 1999 Annual Report

Fig. 4-1 Lucent Revenue by Segment

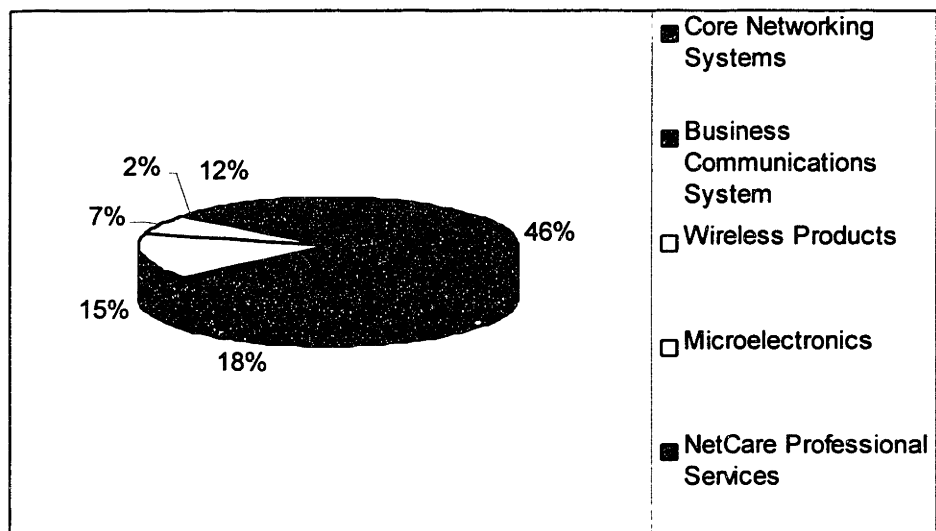
technologies and marketing strategies. Figure 4-1 shows segment revenues for the past three years. The SPN segment represents about 62% of the total external sales for 1999.

The fourth core business segment is NetCare Professional Services, which promises to be the global leader in providing multi-vendor voice/data/video convergence solutions (<http://www.lucent.com/news/corpinfo/business.html>).

- ◆ **NetCare Professional Services** - This business deliver the industry's most comprehensive portfolio of network professional services and software solutions to help both service provider and enterprise customer (more than 10,000 customers worldwide) deploy next-generation voice and data networks.

c) Products and Services

Figure 4-2 shows products and service revenues. Table 4-1 summarizes key products and market positions.



Source: Lucent, 1999 Annual Report

Fig. 4-2 Products and Services Revenue, 1999

Table 4-1 Lucent's Key Products and Market Positions

	<i>Key Products</i>	<i>Marketing Positions</i>
SPN	Switching and transmission systems for voice and data; data networking routing switches and servers; wireless network infrastructure; optical networking systems; communications software; support services.	No. 1 in optical networking No. 1 in ATM switching No. 1 in frame relay technology No. 1 in remote access technology No. 1 in VoIP gateways No. 1 in U.S. in central office switching systems No. 1 in U.S. in wireless infrastructure
Enterprise	Communications servers for voice and data; e-business solutions; customer relationship management applications; messaging systems and applications; wireless and conferencing systems; IP-based and LAN/WAN products; network cabling for buildings; network management software; support services.	No. 1 in call centers No. 1 in messaging No. 1 in unified messaging No. 1 in cabling systems for buildings No. 1 in U.S. in voice communications servers No. 1 in U.S. in in-building wireless systems
NetCare	Services for the life cycle of a network, including planning, design, implementation, operations, maintenance, education and software; VitalSuite network monitoring and management software, and eSight interactive customer care Web site.	No. 1 in network professional services No. 1 in multivendor capabilities No. 1 in U.S. in network services
MCT	Integrated circuits for wireless and wired communications, computer modems and networks; optoelectronic components for communications systems; power systems; optical fiber; cable; connectivity solutions.	No. 1 in communications integrated circuits (ICs) No. 1 in application-specific ICs No. 1 in read-channel ICs No. 1 in communications optoelectronics No. 1 in SONET/SDH ICs No. 1 in power equipment
Bell Labs	Supports other Lucent units by providing basic research and product and service development. Recent innovations include Internet switching and transmission products, wireless systems and record-setting optical networking systems.	In 1999, Bell Labs produced the first high-capacity, all-optical communications router, the first software switch for IP networks, the fastest transmission of information over optical fiber using a single wavelength, and the most sensitive geolocation technology for pinpointing wireless 911 calls.

Source: <http://www.lucent.com/investor/annual/99/glance.html>

d) Financial Review (Lucent, 1999)

Total revenues for 1999 increased 20.4% to \$38,303 million compared with 1998, mainly due to increases in sales from all reportable operating segments. Revenue growth was driven by sales increases globally (see Table 4-2).

Table 4-2 Lucent's Income Statement

<i>Years Ended</i>	<i>1999</i>	<i>1998</i>	<i>1997</i>
<i>Revenues</i>	\$38,303	\$31,806	\$27,611
<i>Costs</i>	19,688	16,715	15,318
<i>Gross margin</i>	18,615	15,091	12,293
<i>Expenses:</i>			
<i>R&D</i>	4,510	3,903	3,185
<i>SG&A</i>	8,417	6,867	6,254
<i>Purchased R&D</i>	282	1,683	1,255

Source: Lucent, 1999 Annual Report

(in millions)

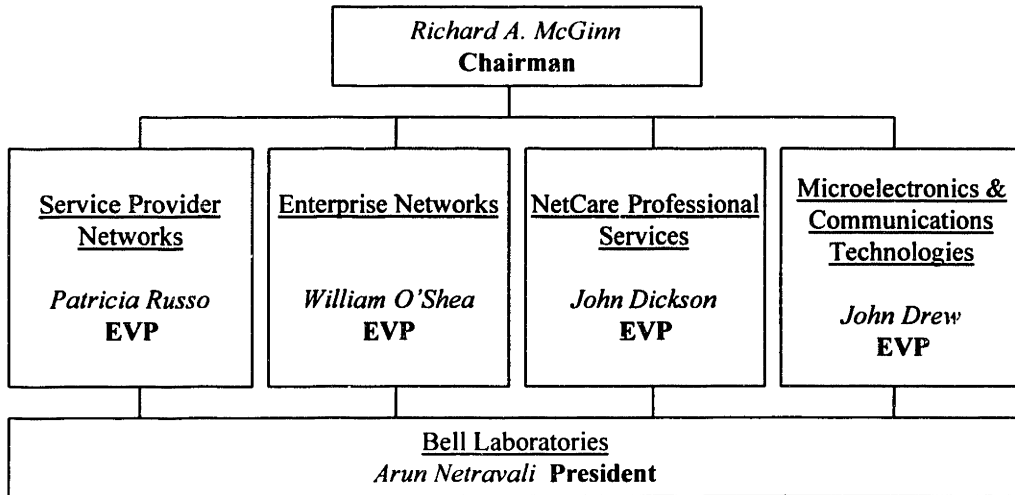
Gross margin percentage increased 1.2 percentage points from 1998. The increase in gross margin percentage for the year was due to a more favorable mix of products.

R&D expenses in 1999 increased \$607 million, or 15.6%, and decreased 0.5% percentage points as a percentage of revenues compared with 1998. The dollar increases were primarily due to increased expenditures in support of wireless, data networking, optical networking, switching, and microelectronic products. The 1999 decrease in R&D as a percentage of revenues includes more custom contract work that is recorded in costs as opposed to R&D. Purchased in-process R&D expenses for 1999 reflect charges associated with the acquisitions of Stratus, Quadritek, Sybarus, WaveAccess and Enable.

Operating (selling, general, and administrative) expenses increased \$1,550 million, or 22.6%, and increased 0.4 percentage points as a percentage of revenues comparing 1999 with 1998. The dollar increases are attributable to higher sales volumes, investment in growth initiatives, and increased amortization of goodwill and existing technology.

e) Organization & Culture

As described above, since October 1999, Lucent has realigned into four core businesses to sustain growth and respond to customers needs for converged network



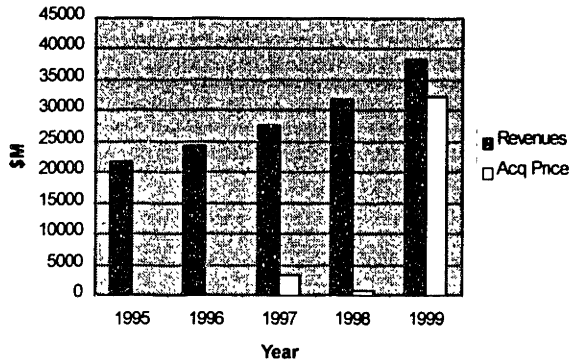
Source: Author

Fig. 4-3 Lucent's Organizational Structure

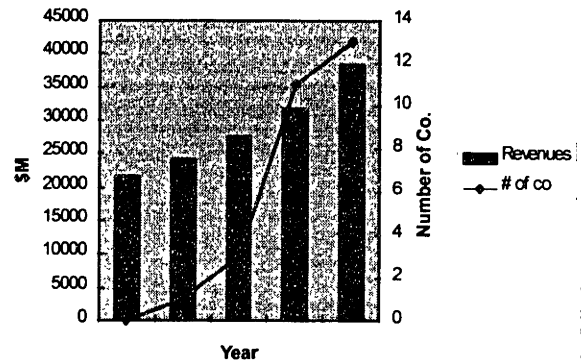
solutions (<http://www.lucent.com/press/1099/991026.cob.html>). Fig. 4-3 shows Lucent's organizational structure.

4.2 Analysis of Lucent's Acquisitions

As part of Lucent's continued efforts to provide its customers with end-to-end communications solutions, the company completed a number of acquisitions in recent years. Fig. 4-4 shows both Lucent's revenues and the number of acquisitions for each year. As the number of acquisitions increased, revenues have also grown every year. An overview of all the companies Lucent has acquired can be seen at Lucent's Website (<http://www.lucent.com/news/timeline.html>). Appendix B summarizes Lucent's acquisitions.



Source: Author



Source: Author

Fig. 4-4 Revenues and Acquisitions

4.2.1 Statistics

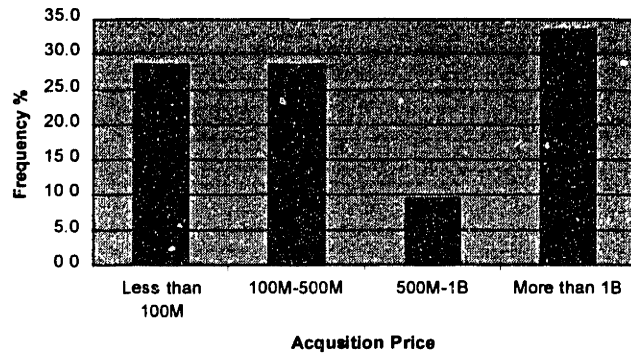
This section analyzes Lucent's acquisitions, first in terms of the acquired company's value, the number of employees, age, and headquarters location. Then, the Familiarity Matrix and the technology portfolio are discussed.

Figure 4-5 shows the acquisitions by acquisition price. Unlike Cisco, Lucent's acquisitions do not reflect any pattern in regard to the company's price.

Figure 4-6 shows acquisitions by the number of acquired employees. Although Lucent targets small companies with 30 to 300 employees, the size of the acquired companies is not as important to Lucent as it is to Cisco.

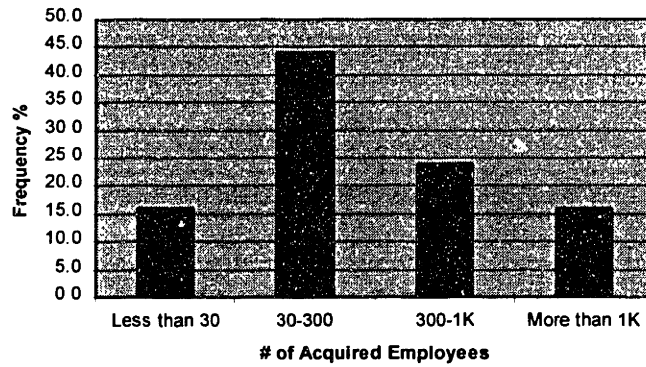
Figure 4-7 shows acquisitions by acquisition price per acquired employee. Lucent does not pay more than \$10 million per person for its acquisitions. In fact, Lucent generally pays less than \$1 million per employee in its acquisitions. Thus, Lucent does not invest as much in product/market potential as Cisco.

Figure 4-8 shows acquisitions based on the companies' ages. Unlike Cisco, Lucent acquires both mature companies as well as start-up companies.



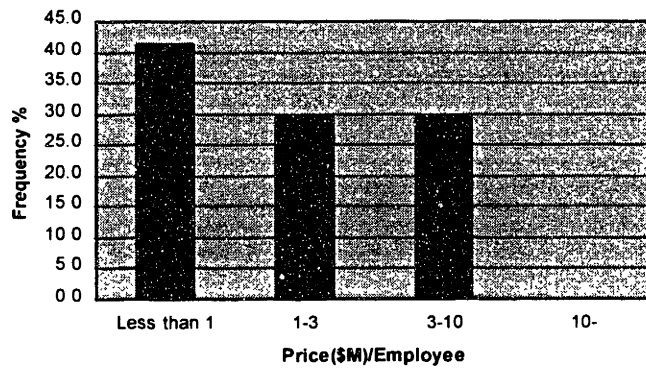
Source: Author

Fig. 4-5 Distribution by Acquisition Price



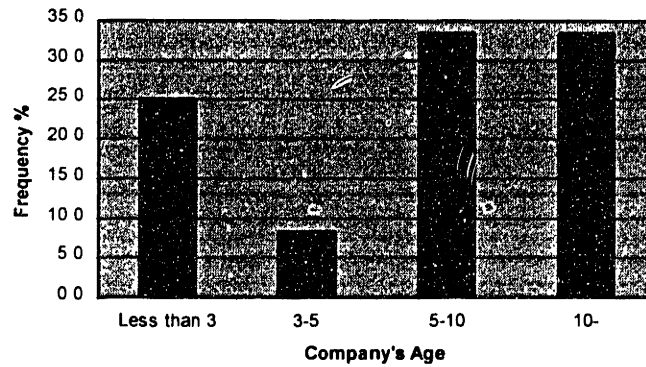
Source: Author

Fig. 4-6 Distribution by Acquired Employees



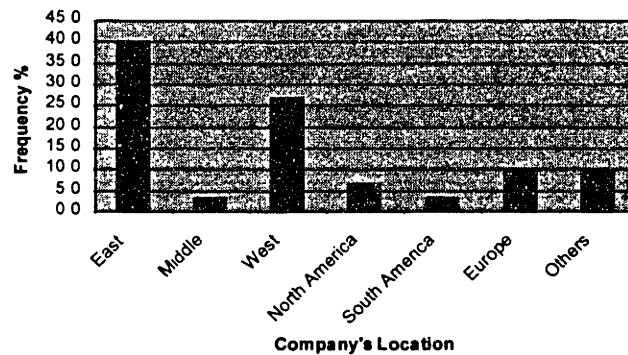
Source: Author

Fig. 4-7 Distribution by Price per Employee



Source: Author

Fig. 4-8 Distribution by Company's Age



Source: Author

Fig. 4-9 Distribution by Company's Location

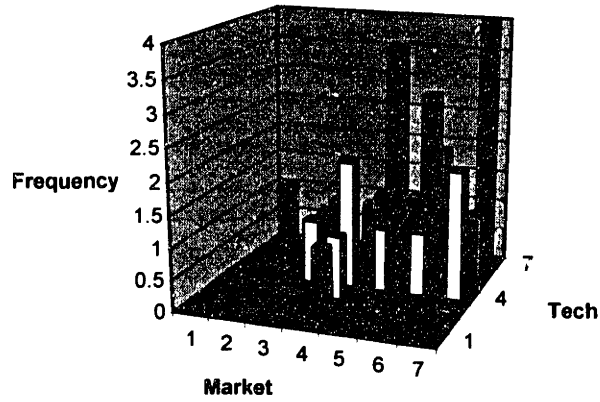
Figure 4-9 shows acquisitions based on company headquarters location. Approximately 40% of the acquired companies are headquartered on East Coast where Lucent's headquarters are also located. Like Cisco, Lucent seems to consider cultural fit and geographical proximity as important factors in their businesses. In particular, international firm selection is focused on market acquisitions (Tottle, 2000).

Table 4-3 highlights the crucial factors that create the Familiarity Matrix for each of Lucent's acquisitions.

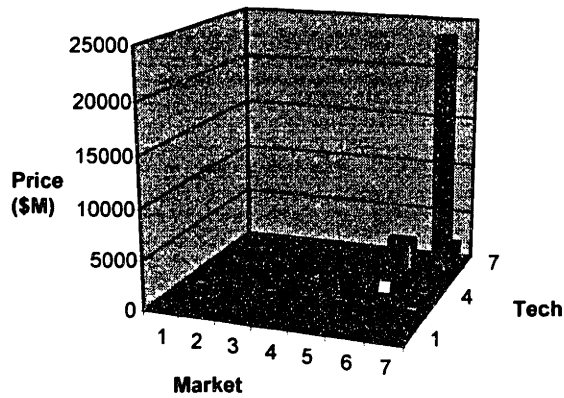
Table 4-3 Familiarity Factor for Lucent's Acquisitions

Acquired company	Technology	Product Integrity	Buyer Segmentation	Functionality	Competitive position
<i>Ortel Corporation</i>	Optoelectronics	Middle	Service Provider (CATV)	Access	Leader
<i>VTC, Inc.</i>	Semiconductor design	High	Enterprise	Others	Leader
<i>SpecTran</i>	Fiber optics	High	Enterprise	Access	Equal
<i>Xedia Corp.</i>	IP VPN	Middle	Service Provider	WAN	Equal
<i>Excel Switching</i>	Programmable switch	High	Service Provider	WAN	Leader
<i>International Network Services</i>	Network consulting	High	Telecom	Network management	Leader
<i>CCOM</i>	CTI	High	Enterprise	Multi-service	Equal
<i>Nexabit Networks</i>	DWDM	High	Telecom	WAN	Equal
<i>Ascend Communications</i>	ATM switch, etc.	Middle	Telecom	WAN	Leader
<i>Batlk Equipamentos</i>	Switching system	High	Telecom	WAN	Equal
<i>Zetax Tecnologia</i>	Switching system	High	Telecom	WAN	Equal
<i>Mosaix</i>	Call-center application	Middle	Service Provider	Multi-service	Equal
<i>Enable Semiconductor</i>	Semiconductor design	Middle	Enterprise	Campus	Leader
<i>Kenan Systems Corp.</i>	Billing management	Middle	Service Provider	Network management	Leader
<i>Sybarus Technologies</i>	Semiconductor design	Middle	Telecom	WAN	Equal
<i>Wave Access</i>	Wireless	Middle	Enterprise	Access	Equal
<i>Pario Software</i>	Network security	High	Service Provider	Network management	Equal
<i>Quadritek</i>	IP address management	Middle	Enterprise	Network management	Leader
<i>JNA</i>	Data networking	Middle	Enterprise	WAN	Equal
<i>LANNET</i>	ATM switch	Middle	Enterprise	WAN	Leader
<i>MassMedia</i>	High-speed internetworking	High	Enterprise	WAN	Leader
<i>SDX Business Systems PLC</i>	Call-center application	Middle	Service Provider	Multi-service	Leader
<i>Yurie Systems</i>	ATM access	High	Service Provider	WAN	Leader
<i>Optimay GmbH</i>	Cellular	High	Consumer	Others	Equal
<i>TKM Communications, Inc.</i>	Call-center application	Middle	Service Provider	Multi-service	Leader
<i>Hewlett-Packard's LMDS Wireless Business</i>	Microwave radio	Middle	Service Provider	Access	Equal
<i>Prominet Corporation</i>	Gigabit Ethernet	Middle	Enterprise	Campus	Leader
<i>Livingston Enterprise</i>	Remote access	High	Service Provider	Access	Leader
<i>Octel Communications</i>	Messaging	Middle	Enterprise	Multi-service	Leader
<i>Triple C Call Center</i>	Call-center application	Middle	Service Provider	Multi-service	Leader
<i>Agile Networks</i>	VLAN	Middle	Enterprise	Multi-service	Equal

Source: Author



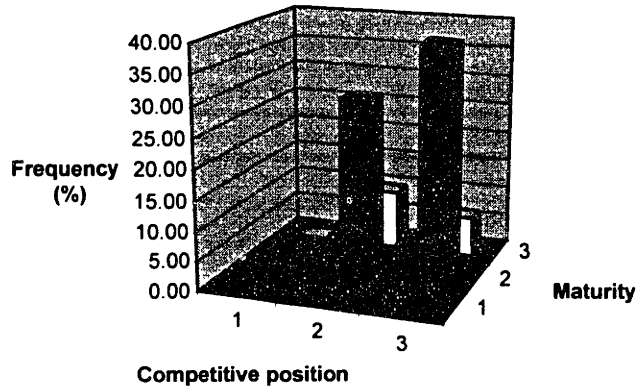
(a)



(b)

Source: Author

Fig. 4-10 Familiarity Matrixes for Lucent's Acquisitions



Source: Author

Fig. 4-11 Technology Portfolio in Lucent's Acquisitions

Figure 4-10 plots the levels of technology and market familiarity. Lucent's acquisitions are focused on *base familiar* and *new-familiar* zones, as shown in Fig. 4-10 (a). However, from a financial point of view, Lucent invests intensively into the *base familiar* zone, as shown in Fig. 4-2-7 (b), despite small investment in the *new-familiar* area of technology.

Figure 4-11 shows Lucent's technology portfolio. The technological competitive position for each acquisition is shown in Table 4-3. Fig. 4-11 uses the Table and Table B-4. This result shows that Lucent tends to acquire leading or equal companies in evolving technology areas.

4.2.2 Lucent's Formula

It is a long-anticipated fight. The two companies' core businesses -- Lucent's gear for voice networks and Cisco's for data networks -- are rapidly converging. However, so far, the rivalry has been low-key. These two giants do not attack each other, preferring instead to steal business from the weak. In a market that is growing 14% a year, Lucent is on track to increase its sales by 20% before acquisitions (Woolley, 1999).

Market Acquisition: While Lucent's Ascend acquisition is seen as a direct challenge to Cisco, it simply reinforces Lucent's position as a supplier to big carriers. That is in contrast to Nortel, Lucent's traditional rival, which acquired Bay Networks in 1998 to attack Cisco's original market, corporate networks. Lucent knows its old businesses are vulnerable, and it is mentally divided into two parts: attackers and defenders. While more attention gets paid to the 50% of Lucent's business playing defense, the other 50% has plenty of surprises to throw at Cisco (Woolley, 1999). If Lucent can move features buried in voice switching, and add

data services like voice over the Internet, it will win. Actually, Lucent has started to find a way to either dump the code directly from digital phone switches into computers that will control the new class of switch, or to create a way of automatically translating the old code into something a new machine could understand (Kupfer, 1998). Both Cisco Systems (with its acquisition of StrataCom, Inc.) and Lucent (with its acquisition of Agile) have the same goal: to create integrated, interoperable product lines that satisfy both the enterprise customer and the carrier market. Lucent seems to be operating on the theory that carriers will be increasingly important distribution channels for enterprise-level equipment (Turner, 1996).

New Products: In the last two or three years, Lucent Technologies has taken a number of steps to address its data networking opportunity through acquisitions and internal development, specifically with more than 30 new products introduced in 1998 alone (*Business Wire*, 6/13/99).

With a decades-old tradition of manufacturing, Lucent is moving to the Internet more slowly. The company says it now sells 30% of its equipment on-line and expects to boost that to 40% by the end of 2000. What makes e-engineering so complicated for Lucent is that operations have to be rebuilt from the ground up. Not only does Lucent have to change its way of doing business, but so do its suppliers and customers. In addition, old hands in e-business say that the Lucent and its peers still have a lot to do to catch up with Cisco and other e-business pioneers such as Dell and Intel (Rosenbush, 1999).

IT (Power Systems): What Lucent is doing at Power Systems is just the tip of the iceberg. Some executives believe that the company's most complicated products, particularly the multimillion-dollar telephone switches bought by AT&T and Bell Atlantic Corp., will always

be sold best face-to-face rather than over a Website. But Lucent is beginning to take e-commerce lessons from Power Systems and apply them throughout the rest of its companies. Like Cisco, Lucent will take advantage of IT as a way of efficient integration for a series of acquisitions (Rosenbush, 1999).

Organization: Concurrent with its merger with Ascend, Lucent established a Broadband Networks Group led by Lucent's chief operating officer and group president (*Business Wire*, 6/13/99). The new group consists of the Ascend organization and Lucent's Data Networking Systems, Optical Networking, and Communications Software groups. Lucent has brought a top manager from Ascend as a group president in this new unit focused on delivering broadband, multiservice networks (Nakamura, 2000). In addition, Lucent opened a Bell Labs research center in Palo Alto; launched a \$100 million venture fund with headquarters; bought INS, a company that consults in the design and integration of telecom and data communications networks; and introduced a host of data networking products (Goldblatt, 11/22/99). All this activity takes Lucent directly into the path of Cisco Systems; it is competing to make networking equipment that supports entire e-industries, rather than remain a manufacturer of old-line telecom switches. Now, Lucent is reinventing itself as a startup.

Vision: Lucent bought Ascend, in part, to hang on to customers like AT&T and the Baby Bells which are retooling their networks to carry information in the language of the Internet. Since Ascend makes computers and software that control phone networks as well as routers that carry traffic on the Internet, the combined outfit can help the phone companies bridge the gap from telecom to data communication (Kupfer, 1999). On the other hand, Cisco argues

that CATV and other companies entering the phone business might not want to spend billions to build a metered billing system, preferring to charge a flat fee. A phone call would take up only 1% of the bandwidth available to a household on a reengineered cable system, so the cable operator could afford to make voice free without breaking a sweat.

What does Lucent think of this? "It's rubbish," says Richard McGinn, Chairman and CEO. "A multi-hundred-billion-dollar-a-year business isn't going to go away" (Kupfer, 1999). In Lucent's view, however low their costs might fall, phone companies will base the price of a service on its value to the customer. As phone networks begin to carry video and data, customers who buy large bundles of services might pay a low price for voice, but those who don't, won't.

Culture/Chemistry: Lucent is fighting a prevailing -- if naïve -- mindset that it is stuck providing for old voice networks, while Cisco dominates the equipment behind Internet protocol networks. The former is a stodgy, slow-growth business; the latter, an exciting, hyper-charged one. An analyst always compares Lucent to the story about the blind men and the elephant. One blind man rubs against the elephant's leg and thinks it's a tree, but another one thinks the trunk is a snake. In other words, depending on where you touch Lucent, you get a different story (Goldblatt, 11/22/99).

On the other hand, in Lucent's culture, there is a much more open, accepting, and fluid portion than one might think in a company that had a long parentage before it went public. In addition, Cisco's ability to leverage its marketing power may be what Lucent worries about most. Cisco may be the most aggressive selling machine in the industry. By contrast, Lucent focuses on making the product, not selling it (Kupfer, 1998).

In facing off against Cisco, Lucent knows that transience is a prerequisite. For starters, Lucent wants to expunge Bell Labs' "Not Invented Here" bias. Lucent knows it can't hope to develop everything internally, because it has already purchased several small companies that can beef up Lucent's data portfolio (Kupfer, 1998).

4.2.3 Success or Failure?

Not all of Lucent's acquisitions have been home runs.

Ascend Communications

The reason analysts think Lucent bought Ascend is to play catch-up with rivals Cisco and Nortel. Lucent lags in demand for frame relay products and has been losing business to its two main rivals. On top of that, Lucent has been trying to develop an ATM switch for almost two years and has failed to produce any substantial products (Malik, 1999).

There may be more negatives for Lucent than meets the eye. For example, Ascend's high-speed routers, the GRF series, have not made a dent in the market, and Cisco routers remain dominant. Lucent, which lacks any data routers, is going to be left in the cold once again, despite the acquisition.

Also, it is said that there was a problem in integration of both companies' sales teams (Tottle, 2000).

Livingston Enterprises

Lucent spent more than a billion dollars to acquire Livingston Enterprises, a company that competes with Ascend in the remote access arena. Analysts say that this will be another area where the marriage might face a rocky path (Malik, 1999).

Others

While IP networks treat all information as data packets, ATM can handle real-time voice and video along with data. The IP vs. ATM debate has been raging within the technology business for a long time now. An analyst says Lucent should buy one of the terabit router startups, such as NetCore Systems, that are focussing on IP. Lucent should pursue NetCore's strategy: "ATM+IP," that is, the networking products have to support ATM and IP at the same time (Malik, 1999).

Cisco and Lucent: Acquisition Characteristics and Comparisons

5.1 Overview

For telephone companies the key is building the network of the future while keeping up with traffic growth on the network of the present. Lucent wants to provide the nuts and bolts for this transition. But it does not yet make great products for moving data over networks based on the rules of the Internet. Cisco, on the other hand, has made its fortune building private data networks for corporate customers. Although that sector is still strong, growth has slowed recently while competition has increased. Thus, Cisco is turning its attention to the customers that are demanding more equipment than ever -- telephone companies.

Lucent and Cisco each have different talents they will use to woo the phone companies. Lucent starts with a century of experience making equipment for the telecommunications companies (telcos), and its biggest selling point with them is the reliability of its switches and networks. Telcos measure the performance of their systems out to five decimal points (Kupfer, 1998).

Cisco has done the most to disrupt the relationship between telcos and their once-traditional infrastructure vendors, especially since acquiring StrataCom. Cisco is renowned

for its ability to assist carriers in moving into the data world. Lucent also has cultivated the Internet service provider business. It offers a suite of products ranging from the repackaged Ascend access gateway to servers and intelligent network equipment (Titch, 1997).

Table 5-1 Cisco vs. Lucent (Acquisition Inclinations)

<i>Viewpoint</i>	<i>Cisco</i>	<i>Lucent</i>
	<u>Data Analyses</u>	
Acquisition price	Small in value	No specific preference
Acquired employees	Small in the number of people	No specific preference
Price per employee	Aggressive investment in product/market potential	Play-it-safe investment in product/market potential
Target company's age	Less than 3 years old	Relatively mature
Location of the target co.	West Coast	East Coast
Technology familiarity	Base, New-familiar	Base, New-familiar (, unfamiliar)
Market familiarity	Base, New-familiar, unfamiliar	Base (, New-familiar)
Tech competitive position	Leader	Leader, equal
Technology maturity	Evolving	Evolving
	<u>Considerations</u>	
Acquisition criteria	Articulated. (vision, short-term & long-term wins, chemistry fit, and geographic proximity)	Not articulated.
Formula		
1) Primary Strategy	1) Deliberate firm selection	1) Market acquisition
2) Secondary Strategy	2) Quick integration process	2) New product release
3) Organization	3) Decentralization	3) Moving to e-engineering
4) People	4) Employee encouragement	4) Reinventing as a startup
5) Culture	5) New idea & people acceptable	5) Blind men and elephant
6) Vision	6) Stretch goal but non-religious about technology	6) Network convergence plus value-added services
Success or failure? (Major failure factors discussed by analysts)	<ul style="list-style-type: none"> • Too large firm • Highly developed product • Technology unfamiliarity • Too much micro-management • No distribution channel 	<ul style="list-style-type: none"> • Technology unfamiliarity • Market unfamiliarity • Problem in sales-force integration

Source: Author

A comparison of the two companies discussed in Chapters 3 and 4 with respect to a series of attributes, is summarized in Table 5-1, followed by a brief discussion of each point.

5.2 Comparison of Cisco and Lucent

1. Value/Size/Age

Cisco, which retains the entrepreneurial spirit of a startup, purchases relatively small, young companies. Cisco recognizes that statistics indicate that 50% of large-scale mergers fail.

Lucent, which traces its corporate history back to the late 19th century, built from the ground up on digital systems under enormous pressure from rivals, does not seem to focus on specific value, size, and age, of the target companies.

Acquiring small companies is important in this industry. For example, US West wanted to buy Netspeed's products but did not want to rely on a small supplier. Eventually, Cisco announced the acquisition of Netspeed (Holson, 1998). Although Cisco and Lucent have found success in delivering scalable network solutions for Internet business, most members of the new vendor crop offer more specialized products. As carriers look to move ahead with plans to develop and expand into end-to-end services, they have four principal but interrelated aspects to consider: access, security, performance management, and quality of service. Many of the vendors offer solutions in these specific areas. On the other hand, customers don't want more vendors in their network or environment, but they want fewer (Titch, 1997). Therefore, firms have to align, based on how customers are purchasing.

2. Price per Employee

Cisco has aggressively invested in product/market potential, while Lucent has preferred to stay with safe investments.

3. Geographical Proximity

Both companies consider geographical proximity to be an important factor in their acquisitions. This comes from cultural fit and efficiency in marketing and manufacturing.

4. Familiarities

Both companies have chosen, with almost every acquisition, to operate in relatively basic markets and technologies. Because their goal is to dominate every market and technology from voice to data, their challenges in the *new-familiar* zone are aggressive. The majority of acquisitions have brought new capabilities and new technologies to enhance both companies' core business sectors. This is illustrated in the Familiarity Matrices of Fig. 3-9 and Fig. 4-10. These inclinations are similar to the empirical studies of acquisition strategies, showing that “related” acquisitions tend to become successful additions to the firm (Healy, 1997).

5. Technological Focus

The acquisitions of both companies are focused on leading-edge technology and evolving processes. This is one reason why they stand to benefit substantially from the technologies and potential market opportunities through the acquisitions.

6. Maintain Acquisition Strategy

It is important to continue the acquisition criteria and strategy. **Cisco** has five acquisition criteria (described in Chapter 3.2.2) and **Lucent** has rigid market-oriented acquisition strategies (described in Chapter 4.2.2). These make both companies' acquisitions more consistent and lead both companies to great success. Specifically, **both** companies analyze their market opportunities extensively. Thus, the process of selection is carefully performed. Time is spent evaluating the key ingredients for an acquisition, and if it is not, then the probability of a successful merger is greatly reduced.

7. Use of IT

Both companies are more likely to use IT and virtual enterprise, rather than physical relocation, to enhance information sharing and minimize personal problems.

8. Organization Structure

Cisco executives form a cohesive organization with dozens of diverse units. Following the Hewlett Packard model, Cisco made the conscious decision to break the company into business units with little overlap in technology (<http://www.strategy-business.com/thoughtleaders/97209/page9.html>). For instance, when Crescendo came in, all Cisco did was turn it into a separate business unit and kept Cisco's central engineering capabilities on the side. Thus, each organization runs autonomously.

9. Internal Development

While continuing to aggressively pursue more acquisitions, management must constantly reinforce and emphasize the value of its own internal development organization.

By shopping for disparate technologies to supplement its product line, **Cisco** faces the challenge of tying all these varied products into a seamless network for its customers.

10. People/Communication

Cisco believes people are crucial because if you are acquiring technology, you are also acquiring people. **Cisco** believes acquirers should track employees carefully and receive monthly reports on attrition rates, not only for its own company, but also for the acquired company (<http://www.business2.com/articles/1999/10/text/chambers.html>). In addition, **Cisco** soon starts an aggressive program of weeding out people who cannot keep pace and deliver superior performance that produces results. There are a few who do not survive the program, but they usually just move on (Hiebert, 2000).

Both companies are undergoing a metamorphosis to unify disparate corporate cultures, increase communications between divisions, and support loyalties to old communities. It is interesting that even **Lucent** is reinventing itself as a startup (Goldblatt, 11/22/99). Fundamentally, the networking industry has been dominated by small companies. The reason for its fragmentation was time-to-market, i.e., having the fastest time-to-market is an overriding factor (<http://www.strategy-business.com/thoughtleaders/97209/page9.html>). **Lucent** has challenged that organizational unification by becoming a behemoth with entrepreneurship.

11. Cultural Integration

Integration of chemistry becomes vital in an acquisition, and **both** companies seem to maintain flexibility in their respective cultures.

Cisco establishes its own culture, one where it is easy to accept new ideas and people (<http://www.business2.com/articles/1999/10/text/chambers.html>).

Lucent has a mysterious culture—something akin to the story of the blind men and the elephant (Goldblatt, 11/22/99).

12. Corporate Vision

Both companies maintain their own unique vision through their acquisitions. The ultimate goal for both is to be Number One in the converged data networking industry. In addition, both companies have specific visions: “non-religious” about technology for Cisco, and value-added service offering for Lucent. Both companies hope that these specific visions will sweep away their fears, that is, the “Not-Invented-Here” syndrome for Cisco (<http://www.strategy-business.com/thoughtleaders/97209/page6.html>) and Network-Commodity pressures for Lucent (Kupfer, 1998).

13. Failure Factors

As the result of a series of acquisitions, there are several failure factors: technology and market unfamiliarity, integration difficulties due to too-large size; highly developed product; and too much micro-management. However, **both** companies have modified their formulas as quickly as possible based on lessons learned from their experiences.

14. Value Chain

Not having a distribution channel for the acquired product is a big problem. Entrepreneurs who have been acquired are driven by the desire to "build breakthrough products that can change the world overnight." Clearly, by leveraging the acquirer's sales, marketing, and distribution might, a startup's product stands a far greater chance of having a profound impact on the market (<http://www.strategy-business.com/thoughtleaders/97209/page4.html>).

15. Frequency of Acquisitions

Both companies believe there is no limit to the number of acquisitions that they can undertake in a year (Tottle, 2000). Specifically, Cisco sees the possibility of as many as two per month or more (Hiebert, 2000).

Application to NTT

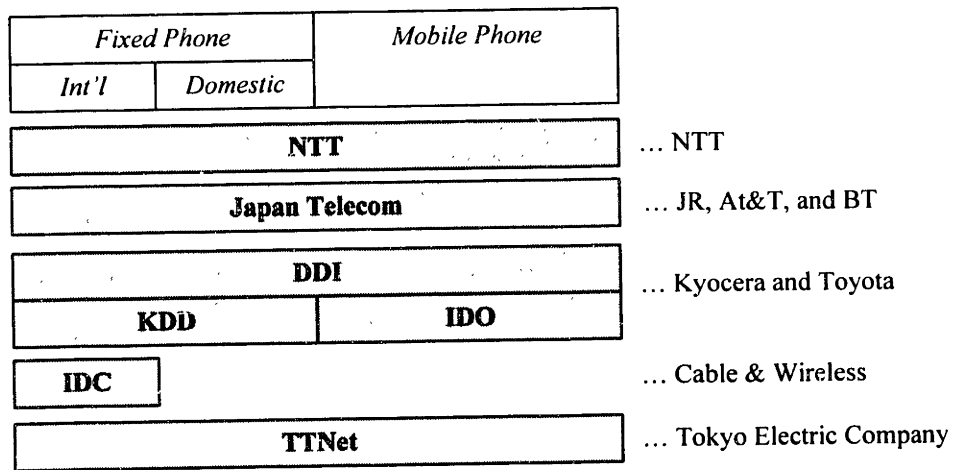
6.1 NTT in the Telecommunications Industry

NTT, Japan's telecom giant, was privatized following the implementation of the Telecommunication Business Act in 1985. This changed a monopolistic market into a highly competitive one, and quickly brought multiple telecom companies into the industry. Since then, NTT has aggressively opened its network, taking a basic stance that promotes mutual cooperation with New Common Carriers (NCCs). This has resulted in accelerated reductions of service rates, especially for long-distance calls. Whereas NTT's operating profit once tended to decrease, it has recently shown an upward tendency because of the dramatic diffusion of ISDN and revenue increases from mobile telephone services.

The NCCs appear to be losing ground in the price competition with NTT (*Nikkei Newspaper*, 9/21/99). Just after NTT was allowed to participate in international businesses through a reorganization agreement in 1996, survival games in the industry began, mainly in the long-distance and international segments (see Fig. 6-1).

6.1.1 Competitors

There are currently two leading long-distance NCCs: Japan Telecom and DDI. Japan Telecom, established by the former Japan National Railway, merged with ITJ, an international NCC, in 1997. In 1999, Japan Telecom further solidified its position in



Source: *Nikkei NewsPaper*, 4/6/00

Fig. 6-1 Competitive Telecom Industry in Japan

globalization and next-generation mobile services by accepting capital investment from British Telecom and AT&T amounting to one-third of its total equity.

In Spring 2000, DDI (founded by Kyocera Corporation in 1984) will merge with IDO (whose parent company is Toyota) to acquire a position in mobile businesses and with KDD, an international incumbent telecom established in 1953, to gain a position in international business (*Nikkei NewsPaper*, 4/6/00).

In addition, NTT and Cable and Wireless (C&W) were both trying to acquire International Digital Communications (IDC), an independent international NCC. In 1999, C&W eventually won the takeover race (*Nikkei NewsPaper*, 11/9/99).

As for regional NCCs, TNet (founded by Tokyo Electric Company) has been a threat to NTT as it has expanded its business domain into the international and mobile markets.

Recently, the marketplace became even more competitive with the appearance of new telecommunication services such as the CATV network, communications satellites, and so

on, none of which utilize NTT's network infrastructure. For example, Jupiter Telecom, a CATV company in Tokyo, offers inexpensive telecommunication services using its own cable network.

Another serious competitor is likely to be Internet Service Providers (ISPs) because the Internet is a very different type of infrastructure from NTT's existing network (Toda, 1997). In fact, Internet telephone services are already being provided at lower prices than traditional telephone service. In response to the explosive Internet boom, in December 1996 NTT began its own ISP business by building a TCP/IP-based network named OCN (Open Computer Network).

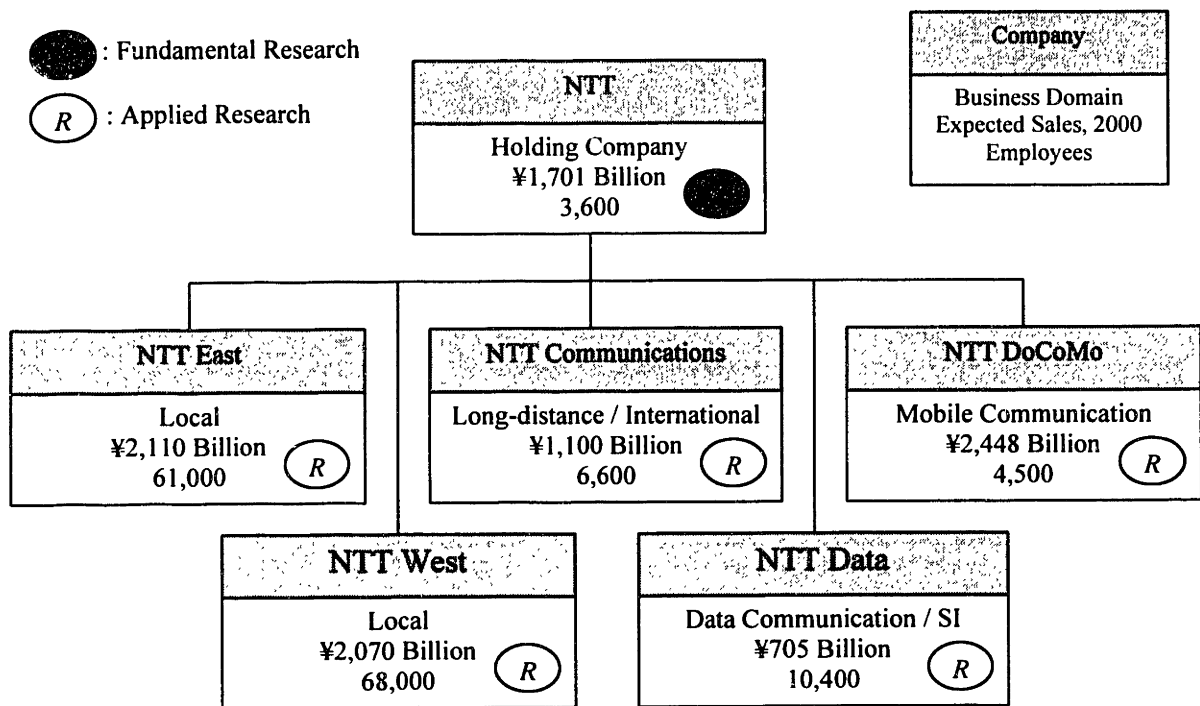
It is apparent that in this new Information Age, even small companies cannot be overlooked because the Internet-related industry has the potential for enormous growth in the future.

In summary, the arena of telecommunications is diversified over the broad scope of businesses and technologies. Many players, ranging from traditional companies like NTT to startup ventures like ISPs, are jostling in a very competitive Japanese marketplace.

6.1.2 NTT Today

On July 1, 1999, NTT was divided into four companies: a holding company, east and west local companies, and a long-distance company (see Fig. 6-2). In allowing this to occur, NTT at last put an end to the continuing controversy with MPT (Ministry of Posts and Telecommunications), which was determined to completely break up the company despite stubborn resistance from NTT.

The result was the largest group enterprise in Japan, with a total 240,000 employees. NTT Data and NTT DoCoMo also joined the holding company, although they have so far



Source: *NTT Technical Journal*, 2000

Fig. 6-2 NTT Group

remained independent at the tops of their respective fields, i.e., data and mobile communications. Jun-Ichiro Miyazu, representative director and president since 1997, stated at the beginning of the historic reorganization:

NTT was reorganized in an inevitable wave of globalization and in the midst of expanding business domains. NTT considers this reorganization as an ideal opportunity to strengthen the capacity to adjust to changes in our business environment. We plan to maximize the merits of the pure holding company overseeing the operations of the entire group.

---Jun-Ichiro Miyazu (1999)

Source: <http://www.ntt.co.jp/vision/e/index.html>

The holding company performs fundamental R&D, while each company within the NTT group performs more specialized applied research as shown in Fig. 6-2. Of these two types of research, the fundamental research done by 3,200 researchers is essential for

enabling the NTT group as a whole to create new business opportunities. These research efforts include important network technology and various new technologies relating to advancing future business management strategies. NTT's R&D Laboratories make ever effort to broaden and deepen its research activities and to focusing on contributing to the academic community and standards-setting organizations (*NTT Technical Journal*, 2000).

With the start of the new millennium, NTT will produce many new advances that will affect the way we live: cyberspace with virtual communities, digital money enabling real-time business transactions, and amusement centers accessible from anywhere at anytime. NTT foresees a new global "Information Sharing Society" with the ability to gather information and exchange ideas and resources instantaneously (http://www.ntt.co.jp/RD/RDOFIS/en_mis001.html).

Accordingly, NTT has established targets for the next five years and beyond, dividing them into first, second, and third waves, and classifying the information-sharing markets in the new global society into four types: Contents, Platforms, Networks, and Terminal software

	First Wave	Second Wave	Third Wave
	Information Sharing Platforms Service	Media Bazaar	Mega-contents
Contents		Mass Media Servers	Authoring Support
Platforms	EC Servers	Downloads	Micro Payments
Networks		Live Network Events	Interactive Multimedia
Terminals SW	Network TV	Optical Network TV	Personal Video Appliance
▲			
Core Tech.	Human Interface, Security, Software Engineering, Device, etc.		

Source: *NTT Technical Journal*, 2000

Fig. 6-3 NTT R&D Vision

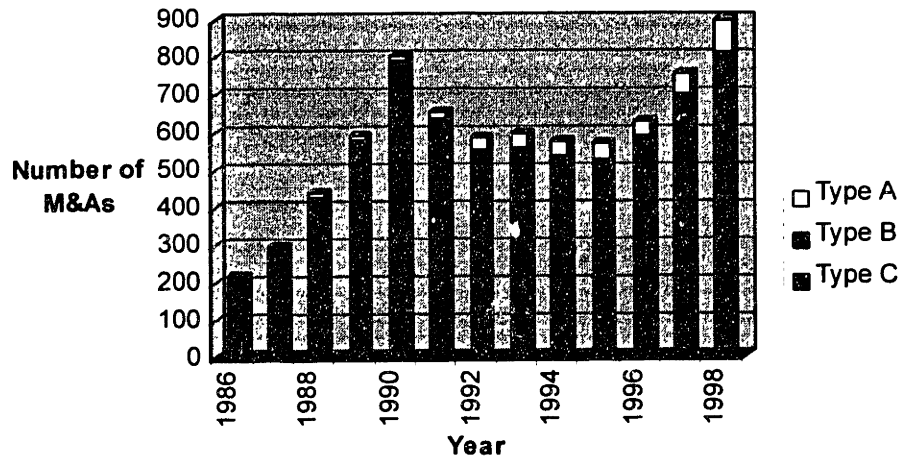
(Fig. 6-3). NTT has designated three R&D Laboratory groups to concentrate on particular areas of each wave and level. Each R&D team, while working independently, will also function within the organization framework as a whole, thus maintaining an appropriate balance (http://www.ntt.co.jp/RD/RDOFIS/en_vis001.html). However, the Laboratories are likely to fall into short-term development without innovations, in the sense that R&D budgets are allocated according to the one-sided requirements of the business units.

6.2 M&As IN JAPAN

The number of M&As in Japan increased rapidly in the latter half of the 1980s, then began to decrease after reaching a peak in 1990, and since 1996 has begun to increase again (Fig. 6-4). The characteristics of Japanese M&As today are (Nishino, 1999):

- ◆ Most M&As occur for reasons related to restructuring due to the long-term recession which has continued since the collapse in 1993 of the economic bubble.
- ◆ Major M&As derive from global industrial reorganizations as a result of the "Big Bang" deregulation, specifically in financial and telecommunications industries.

M&As in Japan are less likely to be successful compared to those in the United States. One reason is the acquiring company does not treat the acquired employees on the same equal footing as its own employees. Acquired employees become discouraged because they often lose opportunities for promotions. Also, it is difficult to fill gaps in compensation and labor conditions because the labor unions do not try to work together to smooth the restructuring that inevitably occurs as the result of an M&A. Because Japanese people have a traditionally conservative corporate culture, most acquiring companies expect it may take ten years or more to produce a sense of unity between the acquiring and the acquired



Source: Nishino, 1999

Type A: Overseas firm acquired domestic firm
 Type B: Domestic firm acquired overseas firm
 Type C: Domestic firm acquired domestic firm

Fig. 6-4 M&As in Japan

companies. The probability of success of large-scale M&As, in particular, is extremely low (Nishino, 1999).

Another reason for little success is that, unlike the United States, Japan does not have an environment that encourages the growth of startup companies. This is especially problematic because enterprises find they cannot evolve their businesses through acquiring innovative ventures or spinning off their most promising units. Prominent differences in culture, institutions, financial affairs, and education make it difficult to incubate startups. Consequently, enterprises have little opportunity to use external resources with technology innovations.

Only recently has this situation begun to change to something more like the U.S. (Watabe, 1997). Research parks and venture support institutions are actively working to forge closer ties between industry and academia (<http://www.krp.co.jp/link/venturelink.html>). This is an era when new products/services are developed by coordinating industry needs and

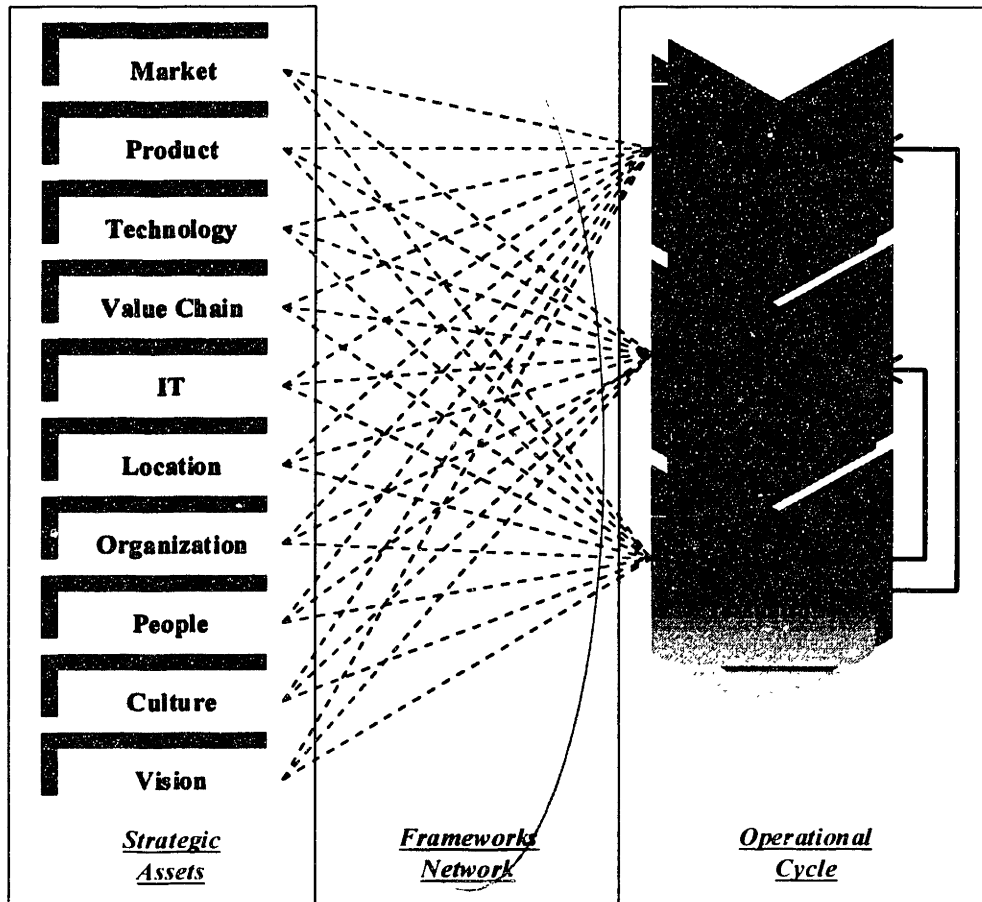
technical skills with academic seeds and intellectual properties. In particular, the alliance between KRP (Kyoto Research Park) and YRP (Yokosuka Research Park) is notable (*Nikkei Newspaper*, 2/24/00). This partnership will drive collaborative R&D between the contents-related ventures of KRP (<http://www.krp.co.jp/HP98Ehtml/index.html>) and the telecom-related enterprises of YRP (<http://www.yrp.co.jp/>). An entrepreneurial environment similar to Silicon Valley is being established in which big companies can enter into new business developments with startups.

6.3 Guidelines for NTT's Technology Growth Strategy

NTT faces growing competition from deregulated markets and rapid technology changes, and the company needs an efficient strategy that covers a broad range of technology segments in order to achieve quick commercialization of its innovations. Also, it needs to develop new mechanisms for leveraging its tremendous technology base across multiple new business opportunities.

Just as Cisco and Lucent take the initiative of acquisition and development as a necessary strategy for growth, so too for NTT, acquisitions are an indispensable methodology for enabling the company to reinforce its less-profitable businesses and to develop new markets—especially because since March 2000 corporate accounting in Japan shifted to a consolidated basis. NTT has actually looked for opportunities to invest in new business development by participating in the high-tech venture fund, Ignite Group, a U.S. venture capital company (*Nikkei Newspaper*, 2/12/00).

Based on actions and suggestions derived from the case studies of Cisco and Lucent, I can now offer some models and guidelines for NTT as it creates a technology strategy focused on acquisition and development.



Source: Author

Fig. 6-5 A&D Execution Model

6.3.1 A&D Model

Fig. 6-5 depicts an A&D Execution Model which gives corporate managers a map for building their technology strategy throughout acquisitions. This model has three fundamental components: operational cycle, strategic assets, and frameworks network.

- ◆ The operational cycle depicts the cycle of acquisition activities: firm selection, integration, and the evaluation processes. The results of the evaluation process are fed back into the other two processes.

- ◆ Strategic assets are management resources that play an important role in the firm's A&D execution, derived from discussions in Chapter 5.
- ◆ Frameworks network means a group of frameworks used as decision-making tools to perform each process in the operational cycle. For instance, in this thesis the Familiarity Matrix and Technology Portfolio are essential for effective market and technology selections. Acquirers should take into account possible frameworks for all the strategic assets, which can vary from advocated gears to their proprietary gears. In addition, acquirers should consistently apply various frameworks as they craft their strategies.

Table 6-1 illustrates the applicability of effective formulas to NTT, as outlined by the factors in Chapter 5. On the feasibility scale of the table, a score in the right position means the corresponding formula is more applicable to NTT. It is important to recognize what factors will be obstacles or bottlenecks that may prevent NTT from executing certain A&D activities, and then reducing the uncertainty by developing optimal solutions to critical questions.

Table 6-1. Applicability of Individual Formula

<i>Strategic Assets</i>	<i>Effective Formula</i>	<i>NTT's Position (Feasibility)</i>
Market	• Select familiar markets	-----X--
	• Listen to customers' requirements	-----X----
Product	• Do not acquire highly developed ones	-----X--
	• Integrate the product rapidly and seamlessly	-----X----
Technology	• Select familiar technologies	-----X--
	• Focus leading edge technology and evolving processes	-----X----
Value Chain	• Provide one-stop shopping	-----X----
	• Challenge vertical/horizontal integration	-----X----
IT	• Provide a unified IT system quickly	-----X-----
Location	• Consider geographical proximity	-----X--
	• Do not move the location of the acquired company	-----X-
Organization	• Purchase young, small/medium companies	-----X--
	• Form a cohesive but autonomous organization agilely	-----X-----
	• Emphasize the value of its own internal development organization	-----X--
People	• Track monthly reports from individual units	-----X--
	• Keep acquired employees	-----X-----
	• Treat acquired employees equally	-----X-----
Culture	• Do not perform too much micro-management	-----X-
	• Shift to behemoth with entrepreneurship	-----X-----
Vision	• Accept new ideas and employees aggressively	-----X-----
	• Aim at stretch goals	-----X--
Holism	• Evolve value-added businesses	-----X--
	• Be "non-religious" about technology	-----X-
	• Measure everything	-----X-----
	• Feedback the problem flexibly	-----X-----
	• Maintain the criteria and strategies	-----X-

Source: Author

6.3.2 Feasibility Check

Integrating an IT System

For example, NTT finds it difficult to quickly provide a unified IT system for its acquired companies because NTT already has its own proprietary system. As a temporary solution, NTT should adopt Lucent's formula, i.e., installing Lucent's IT system into small and medium acquired firms but letting large acquired firms use their own IT systems (Tottle,

2000). For efficient integration after acquisitions, however, NTT should begin to develop a new mechanism like Cisco's IT team and Global Network Business model described in Chapter 3.

Measuring Success

Also, in the evaluation process for potential acquisitions, there are many unmeasurable results of activities. Unless NTT can measure the success or failure of specific activities, there is no basis for whether to embark on such activities another time. In fact, having no specific measures for acquisition success is as a significant problem (Tottle, 2000). Although it is impossible to establish the perfect evaluation system, NTT should consider establishing something like Cisco's evaluation system which measures such things as customer satisfaction, employees' attitudes, contribution margin of the business units, etc. (Honjo, 1999). At Cisco, the success of an acquisition when entering a new business area is defined as realizing more than 1% of revenues from the acquired company's business. And like Lucent, NTT should continually supervise its acquisitions by building an organization similar to Lucent's Post-Merger Integration Team (Tottle, 2000).

Integrating Acquired Personnel and SBUs

NTT's public-servant persona makes it difficult to handle the incorporation of acquired employees or other entrepreneurial environments into the company. NTT should seek ways to overcome these key obstacles as quickly as possible. For example, in order to cultivate entrepreneurship, the creation of a new ventures group may be the best way, as when Bell Labs built Phantom World (Chesbrough, 2000). Also, stock options would be useful for motivating and encouraging entrepreneurs. Actually, the number of the firms that

introduced stock option is 381, 10% of the registered companies in Japan, as of the end of the March 2000 (*Nikkei Newspaper*, 4/10/00). NTT must seek optimal alternatives for these problems, and identify changes in its system, organization, and norms.

6.3.3 Information Base

Finally, we would urge the importance of accumulating know-how and experience gained through acquisition activities -- regardless of whether they are successes or failures -- and compiling an information base that can be used in future strategy planning. Accordingly, NTT should investigate how it can accomplish its goals by reviewing past cases which commercialized earlier technologies out of R&D organizations. At the same time, NTT should conduct external benchmarking activities to determine how to best use corporate resources to invest in new technology development. Building an information base will be a key success factor for executing an effective A&D strategy.

Conclusions

As networks converge, it seems clear that the biggest firms will survive by adopting a technology strategy that integrates acquired capabilities into current products and services and assertively adapts their technology strengths toward future business opportunities. Diversifying beyond the boundaries of telecom, broadcast, information, and content industries might afford growth, stability, and profitability that one company alone could not support. Acquisitions are rapidly changing the character of global, fast-growing, and competitive industries.

This thesis has traced the acquisitions of two of the largest data networking companies, Cisco Systems and Lucent Technologies, from the perspective of technology strategy. Following each company's acquisition efforts over the past several years, the thesis probed the companies' motivations and rationale behind their acquisitions, the impact on the firms' technology portfolios, potential penetration of new markets, and access to new technologies. In addition, organizational issues that grew out of managing the new technologies and other subsequent effects on the companies' core competencies were discussed.

Comparative analyses of the most acquisitive and variously talented companies led to determining the key considerations and success/failure factors in A&D (Acquisition and

Development) activities consisting of firm selection, integration, and evaluation processes. Effective formulas for A&D were summarized for individual critical strategic assets such as market, product, technology, value chain, IT, location, organization, people, culture, and vision.

The most important lessons learned are the following:

- Deliberate firm selection based on market/technology familiarities and cultural/organizational/vision fit.
- Retention and maintenance of key managers and engineers, and quick integration of market, product, technology, organization, and culture.
- Continuous supervision of all A&D activities and flexible countermeasures to cope with unexpected problems.

Finally, the thesis offered a guideline for NTT, to assist the company as it seeks to identify, develop, and implement its own effective strategies for developing new markets and innovative technologies, based on an application of the analyses and arguments in this thesis.

In summary, corporate managers need to understand the A&D execution model and examine a series of frameworks that will help them to craft technology strategies. At the same time, it is important to recognize the firm's position as it considers the feasibility of each formula proposed in this thesis, and executes technology strategies based on past internal/external know-how and experience.

A

Networking Acquisitions

The following is a list of major acquisitions by the firms listed below, mostly focusing on the last three years, in the networking industry:

- ❑ **3Com**
 - US Robotics 2/97
 - NBX Corp 2/99 (equipment for voice/data integration)
- ❑ **Adaptec**
 - Skipstone, Inc. 3/97 (IEEE 1394 Serial Bus (Firewire) products)
- ❑ **Alcatel**
 - DSC Communications 6/98 (telecom products including digital switching, transmission, access and network management)
 - Packet Engines 10/98 (gigabit ethernet technology)
 - Xylan 3/99 (LAN & ATM switches)
 - Assured Access Technology 3/99 (remote access products)
 - Genesys Telecommunications Lab 9/99 (enterprise interaction management software)
- ❑ **Applied Micro Circuits Corp**
 - Cimaron Communications 3/99 (SONET/SDH ASIC cores)
- ❑ **Cabletron**
 - Yago Systems 1/98 (Gigabit Ethernet equipment)
 - NetVantage Inc 6/98 (Ethernet workgroup switches)
- ❑ **Cisco**
 - Crescendo Communications 9/93 (CDDI/FDDI products)
 - Newport Systems Solutions 8/94 (software based routers for remote networks)
 - Kalpana 10/94 (Ethernet switching products)
 - LightStream 12/94 (ATM switching products)
 - Combinet 8/95 (ISDN remote access networking products)
 - Internet Junction 9/95 (Internet gateway software)
 - Grand Junction 9/95 (Fast Ethernet switching products)
 - Network Translation 10/95 (Internet firewall hardware and software)
 - TVG Software 1/96 (Internet software for connecting disparate computer systems)
 - StrataCom 4/96 (ATM and Frame Relay WAN switching equipment)
 - Telebit Corp's MICA Technologies 7/96 (Modem ISDN Channel Aggregation technologies)
 - Nashoba Networks 8/96 (Token-Ring switching technologies)
 - Granit Systems 9/96 (multilayer Gigabit Ethernet switching technologies)
 - Netsys Technologies 10/96 (network management and performance analysis software)
 - Metaplex 12/96 (SNA to IP migration)
 - Telesend 3/97 (IDSL equipment)
 - Skystone Systems Corp 6/97 (SDH/SONET technology)
 - Ardent Communications Corp 6/97 (integrated voice, LAN, video over ATM & Frame Relay)
 - Global Internet Software Group 6/97 (security support for Windows NT networks)
 - Dagaz xDSL Business of Integrated Network Corp. 7/97 (xDSL technology)
 - LightSpeed International Inc 12/97 (voice signaling translation technology)

- WheelGroup Corp 2/98 (network security software)
 - NetSpeed Inc 3/98 (DSL technology)
 - Precept Software Inc 4/98 (integrated voice, data, & video solutions)
 - CLASS Data Systems 5/98 (software for policy based QOS over IP)
 - Summa Four, Inc 7/98 (telecom signaling and switching equipment)
 - American Internet Corp 8/98 (software for IP address management & Internet access)
 - Clarity Wireless 9/98 (wireless communications technology)
 - Selsius Systems 10/98 (telephone equipment for voice/data integration)
 - Pipelinks Inc 12/98 (SONET/SDH routers)
 - Fibex Systems 4/99 (Integrated Access Digital Loop Carrier (IADLC) products)
 - Sentient Networks 4/99 (ATM Circuit Emulation Services (CES) products)
 - GeoTel 4/99 (Call routing communications software)
 - Amteva 4/99 (integrates voicemail, email, and fax traffic over IP networks)
 - TransMedia Communications 6/99 (technology for voice over Internet)
 - StratumOne Communications 6/99 (high performance semiconductor technology)
 - Calista 8/99 (Internet based phone technology)
 - MaxComm Technologies 8/99 (broadband Internet access technology)
 - Cerent 8/99 (optical transport systems)
 - Monterey Networks 8/99 (optical transport systems)
 - Cocom A/S 9/99 (high speed Internet access solutions)
 - Webline Communications 9/99 (consumer service and e-commerce application software)
 - Aironet Wireless Communications 10/99 (wireless LAN equipment)
 - V-Bits 10/99 (digital video processing systems for cable television service providers)
 - Worldwide Data Systems 12/99 (consulting and engineering services for converged data and voice networks)
 - Pirelli SpA optical unit 12/99 (fiber-optic network equipment)
- **Ericsson**
- Torrent Networking Technologies 4/99 (high speed edge routers)
 - TouchWave 4/99 (enterprise IP-telephony solutions)
- **GEC**
- **Fore** 4/99 (ATM Switching Products)
 - ❖ RainbowBridge Communications, Inc (RCI) 6/95 (routing software)
 - ❖ Applied Network Technology, Inc (ANT) 6/95 (Ethernet switches)
 - ❖ CellAccess Technology, Inc (CAT) 12/95 (ATM and Frame Relay access products)
 - ❖ ALANTEC Corp 2/96 (Ethernet/FDDI intelligent switching hubs)
 - ❖ Nemesys Research Limited 11/96 (ATM video distribution and conferencing)
 - ❖ Scalable Networks, Inc. 11/96 (Ethernet switching technology)
 - ❖ Cadia Networks 12/96 (Carrier access technology)
 - ❖ Berkeley Networks 8/98 (multi-Gigabit switching & routing solutions)
 - ❖ Euristix Limited 2/99 (telecommunications software technology)
- **Hayes**
- Cardinal Technologies, Inc. 3/97 (Modems)
 - Access Beyond, Inc. 12/97 (Network access products)
- **IBM**
- CommQuest Technologies 2/98 (semiconductors for wireless, cellular, and satellite communications)
 - DataBeam 6/98 (voice over IP and multimedia conferencing technologies)
 - DASCOM 9/99 (web security technology)
- **Intel**
- Shiva 10/98 (LAN and remote access products)
 - Level One Communications 3/99 (semiconductors for telecom and networking)
 - Dialogic Corp 6/99 (products that merge phone & fax functions into computers)
 - Softcom Microsystems 7/99 (semiconductor products for networking and communications)
 - IPivot 10/99 (products that make Internet transactions faster and more secure)
 - DSP Communications 10/99 (cellular digital and voice technologies)
- **Larscom**
- NetEdge 12/97 (ATM edge access equipment)
- **Lucent Technologies**
- Agile Networks 10/96 (data switching)
 - Triple C Comm. 3/97 (systems integration)
 - Octel Comm. 9/97 (voice messaging)

- Livingston Enterprises 10/97 (remote access products for Internet)
- Prominet Corporation 1/98 (Gigabit Ethernet switching)
- Hewlett-Packard's LMDS division 2/98 (broadband wireless)
- TKM Comm. 3/98 (call-center integration)
- Optimay GmbH 4/98 (GSM cellular telephone software)
- Yurie Systems 5/98 (ATM access equipment)
- SDX Business Systems 6/98 (integrated voice and data switching solutions)
- Lannet division of Madge Networks 7/98 (Ethernet products)
- MassMedia Communications 7/98 (network signalling software)
- Quadritek Systems 10/98 (next generation IP network administration software)
- Pario Software 11/98 (network security software)
- WaveAccess Ltd. 11/98 (packet radio technology)
- Kenan Systems 1/99 (billing software)
- **Ascend** 1/99
 - ❖ NetStar 5/96 (IP routers)
 - ❖ InterCon 2/97 (IP client software)
 - ❖ Whitetree 2/97 (Switched Ethernet, ATM)
 - ❖ Cascade 3/97 (ATM & Frame Relay Switches)
 - ❖ Stratus Computer 8/98 (fault tolerant computers, switches, & software)
- Sybarus Technologies 2/99 (SONET/SDH semiconductors)
- Enable Semiconductor 3/99 (Ethernet semiconductors)
- Mosaix 4/99 (call center software)
- Nexabit Networks 6/99 (high performance switching/routing equipment)
- SpecTran 7/99 (fiber optic cable manufacturer)
- International Network Services (INS) 8/99 (computer network integrator)
- Xedia 8/99 (internet access routers)
- Excel Switching 8/99 (telecommunications network switches)
- ❑ **MRV Communications**
 - Whittaker Xyplex 1/98 (wide area computer network products)
- ❑ **Newbridge Networks**
 - UB Networks 1/97 (LAN Products)
 - Castleton Network Systems 9/98 (packet voice technology)
- ❑ **Nokia**
 - Ipsilon Networks 12/97 (IP switching products)
- ❑ **Nortel Networks**
 - **Bay** 6/98 (formed by 10/94 merger of Synoptics (Hubs) and Wellfleet (Routers))
 - ❖ Centillion Networks 5/95
 - ❖ Xylogics 12/95 (remote access servers and concentrators)
 - ❖ Performance Technology 3/96 (Internet access devices)
 - ❖ ARMON Networking, Ltd 4/96 (management probes)
 - ❖ LANcity 10/96 (cable modems and head end cable devices)
 - ❖ Penril Datability Networks 11/96 (digital signal processing and modem technology)
 - ❖ NetICs 12/96 (autosensing Ethernet switching)
 - ❖ Isotro 4/97 (IP address management)
 - ❖ Rapid City Communications 6/97 (gigabit ethernet and routing switch technology)
 - ❖ New Oak Communications 1/98 (extranet access and VPN technologies)
 - ❖ Netsation 2/98 (multi-vendor network management)
 - ❖ Netwave Technologies 6/98 (wireless LANs)
 - ❖ Phase2 Networks 6/98 (layer-3 routing and switching software)
 - ❖ Netserve 7/98 (technology that puts telephone calls over cable systems)
 - Shasta Networks 4/99 (IP services for telco environment)
 - Periphonics 8/99 (voice and data networking)
 - Qtera 12/99 (optical networking equipment)
 - Promatory Communications 1/00 (Internet access developer)
- ❑ **Novell**
 - Netoria, Inc. 5/99 (directory enhancement software)
 - Ukiah Software 6/99 (policy based network management software)
- ❑ **Olicom**
 - CrossComm 6/97 (ATM and multiprotocol router technology)
- ❑ **PMC-Sierra**

- Integrated Telecom Technology (IgT) 5/98 (ATM switching chipsets)
- Abrizio 6/99 (broadband switch chip fabrics)
- **Siemens**
 - RadNet 12/97 (access switches for ATM) (acquired with Newbridge Networks)
 - Argon Networks 3/99 (gigabit switch routers)
 - Castle Networks 3/99 (technologies to converge voice and data)
- **Texas Instruments**
 - Telogy Networks 8/99 (internet telephony)
- **Vitesse Semiconductor**
 - XaQti 5/99 (active flow processors)

Source: <http://www.techfest.com/networking/comp/acquisit.htm>

B

Acquisition Summary (Cisco and Lucent)

Appendix B shows a summary of the acquisitions to date executed by:

- ◆ Cisco Systems
- ◆ Lucent Technologies

Cisco Systems

Acquired	Date	Price (\$)	Emp	Fnd	Loc	Technology Competence	Organization	Comments
Growth Networks, Inc.	02/16/00	355M	53	1998	CA	Market leader in Internet switching fabrics, a new category of networking silicon.	Join Cisco's Public IP Carrier Systems Group within the Service Provider Line of Business.	provide service providers with next-generation routing and switching infrastructures.
Altiga Networks	01/19/00	567M	76	1998	MA	Market leader in integrated VPN solutions for remote access applications.	Part of the Enterprise Line of Business.	VPNs are fundamental for enterprises seeking to achieve global reach, ubiquitous access and enable new business applications.
Compatible Systems Corp.	01/19/00		68	1988	CO	Leading developer of standards-based, reliable and scalable VPN solutions for service provider networks.	Part of the Service Provider Line of Business.	
Pirelli Optical Div.	12/20/99	2.15B	701	1995	Milan	DWDM (fiber optics), market share of just under 10% (WDM equipment).	701 employees will join Cisco's optical product group in the SP line business.	Adding the WDM unit will plug a major hole in the product line Cisco sells to telecom SPs. The optical system business of Pirelli had 1999 revenue of \$225M.
Internet Engineering Group, L.L.C.	12/17/99	25M	13	1996	MI	Strengthen Cisco's optical internetworking strategy.	Part of the Cisco's Optical Internetworking Business Unit.	Add compliance or compatibility with the most widely-fielded routing software implementations, such as Cisco's IOS.
Worldwide Data Systems, Inc.	12/16/99	25.5M	-	1998	NJ	Consulting and engineering services for converged data and voice network.	Part of the Cisco's Professional Services Business Unit (Customer Advocacy Group).	VoIP solutions.
V-Bits, Inc.	11/11/99	128M	30	1997	CA	Leading provider of standards-based digital video processing systems for CATV service providers.	Part of the Cisco's Cable Products and Solutions group.	Cable head-end device.
Aironet Wireless Communications, Inc.	11/09/99	799M	131	1993	OH	Leading developer of high-speed wireless LAN products.	Desktop Switching Business Unit within Cisco's small/Medium line of business.	-
Tasmania Network Systems, Inc.	10/26/99	25M	16	1999	CA	Leading developer of network caching software technology.	Content Services business unit in the Enterprise line of business.	Tasmania technologies will be integrated into Cisco's current Cache Engine 500 series products.
WebLine Communications Corp.	09/22/99	325M	120	1996	MA	Leading provider of customer interaction management software for Internet customer service and	Part of the Application Technology Group.	Web collaboration tool.

Cocom A/S	09/15/99	65.5M	66	1995	Denmark	e-commerce. Leading European developer of high-speed Internet access solutions over cable, satellite and wireless networks based on international standards.	Cable Product and Solutions group within the SP line of business See http://www.cisco.com/cable/cocom_qa.html .	This acquisition broadens Cisco's strategy to deliver industry leading standards-based broadband access products by adding Digital Video Broadcasting (DVB) solutions to Cisco's cable portfolio.
Cerent Corporation	08/26/99	6.9B	287	1997	CA	With more than 100 customers nationwide, leading developer of next-generation optical transport products.	Business unit within the Transport Group (SP line of business). Nearly doubles the number of employees focusing on the optical space to bring the total to approximately 900.	Optical transport market is expected to be a \$10 billion market in 2002 according to analysts. Combined with Cerent, Monterey brings a complete infrastructure solution to help customers transition to New World networks.
		5M	132	1997	TX	Innovator of infrastructure-class, optical cross-connect technology that is used to increase network capacity at the core of an optical network.		
MaxComm Technologies, Inc.	08/18/99	143M	35	1998	MA	Leading developer of broadband Internet technology that brings data and multiple voice lines to consumers.	-	Broadband access technologies such as ADSL and cable to connect residential customers to public networks.
Calista, Inc.	08/16/99	55M	-	1995	UK	Leading developer of Internet technology that allows different business phones to work together for the first time over an open Internet-based infrastructure.	Enterprise line of business.	-
StratumOne Communications, Inc.	06/29/99	435M	78	1997	CA	Leading developer of highly integrated, high-performance semiconductor technology.	Optical Internetworking Business Unit within the Service Provider line of business.	This acquisition brings innovative semiconductor technology to Cisco's families of high-end routers.
TransMedia Communications, Inc.	06/17/99	407M	66	1998	CA	Industry-leading Media Gateway technology that seamlessly unites the multiple networks (ATM, IP, PSTN) of public voice communications.	Multiservice Switching Business Unit.	Accelerated migration from Old World circuit-based networks to New World packet-based networks.
Amiteva Technologies, Inc.	04/28/99	170M	144	1995	VA	Leading developer of middleware, which provides a unified means for enabling voicemail, fax, and e-mail messages over an IP-based network.	-	Combine solutions from acquisitions of Selsius, GeoTel, and Amiteva, to provide basic voice services and advanced voice functionality such as call center and unified communication over a single, standards-based network.

GeoTel Communications Corp.	04/13/99	2B	310	1993	MA	Leading provider of software solutions for distributed voice call centers for enterprise and service provider customers.	-	New World communications network where data, voice and video traffic will travel over a single network infrastructure based on the open, standards-based Internet architecture.
Sentient Network, Inc.	04/08/99	445M	102	1995	CA	Industry's highest density ATM Circuit Emulation Service (CES) Gateway, which is capable of transporting circuit-based private line services across packet-based ATM networks.	Part of Cisco's SP (Service Provider) Line of Business.	-
Fibex Systems			100	1997		Integrated Access Digital Loop Carrier (IADLC) products, devices that combine traditional voice services with data services using ATM as the underlying architecture.		-
Pipelinks, Inc.	12/02/98	126M	73	1996	CA	Pioneer in SONET/SDH routers capable of simultaneously transporting circuit-based traffic and routing IP traffic.	Small and medium-sized businesses in multi-tenant building environments.	Build upon Cisco's end-to-end optical internetworking strategy.
Selsius Systems, Inc.	10/14/98	145M	51	1997	TX	Leading supplier of network PBX systems for high-quality telephony over IP networks.	Part of Cisco's Enterprise line of business.	Enhances Cisco's data/voice/video integration strategy by bringing open, standards-based technology to conventional PBX and telephone equipment.
Clarity Wireless Corp.	09/15/98	157M	39	1996	CA	Leading developer of wireless communication technology for computer networking and Internet service markets.	SP line of business.	Clarity's technology extends Cisco's broadband access portfolio of DSL and cable to include fixed wireless access.
American Internet Corp.	08/21/98	56M	50	1995	CA	Leading provider of software solutions for IP address management and Internet access AIC's products: Network Registrar and Access Registrar.	SP line of business.	Extend American Internet's technology into other areas including the service provider line of business
Summa Four, Inc.	07/28/98	116M	210	1976	NH	Leading provider of programmable switches.	Part of Cisco's Network-to-User Business unit within SP line of business.	Offer value-added telephony applications to new and existing service providers as well as extending these services to a voice-over-IP infrastructure.

Class Data Systems	05/04/98	50M	34	1996	Israel & CA	CLASS Data's software solutions enable policy-based quality of service in IP networks.	Part of Cisco's Enterprise line of business.	-
Precept Software, Inc.	03/11/98	84M	50	1995	CA	Leading multimedia networking software company.	Part of Cisco's IOS technology group and sales organization.	Cisco will continue to sell Precept's IP/TV product.
NetSpeed, Inc.	03/10/98	236M	140	1996	TX	Market leader in Digital Subscriber Line (DSL) technology in North America.	Part of Cisco's Network-to-User Business unit within SP line of business.	-
WheelGroup Corp.	02/18/98	124M	75	1995	TX	WheelGroup is an innovator in network security software products.	-	"Active audit" is the third element of Cisco's multi-phase security architecture.
LightSpeed International, Inc.	12/22/97	160M	70	1995	VA	Innovator in voice signaling translation technology.	Part of Cisco's Service Provider line of business.	Solutions in both the enterprise and SP markets as voice traffic transitioned from purely circuit switched networks to integrated circuit and packet/cell switched networks.
Dagaz	07/28/97	108M	30	1985	NJ	Dagaz Digital Subscriber Line (xDSL) Access Multiplexer and Customer Premises Expertise to Complement Existing Products.	Part of the Network to User Business Unit.	-
Ardent Communications Corp.	06/24/97	156M	40	1996	CA	Pioneer in designing combined communications support for compressed voice, LAN, data and video traffic across public and private Frame Relay and ATM networks.	Part of the Multiservice Access Business Unit within Cisco's SP line of business.	Based on Cisco IOS software, Ardent's low cost platforms will natively support multiservice traffic and implement voice compression.
Global Internet Software Group	06/24/97	40.25 M	20	19**	CA	Pioneer in the Windows NT network security marketplace.	-	Centri Enhances Cisco's Firewall Expertise with Offering for Small and Medium-Sized Businesses.
SkyStone Systems Corp.	06/09/97	66.5M	40	1994	Canada	Innovator of high-speed Synchronous Optical Networking/Synchronous Digital Hierarchy (SONET/SDH) technology.	Part of Cisco's Service Provider line of business.	-
Telesend	03/26/97	Undisclosed	-	19**	CA	Cisco announced a new channel unit for D4 DSL Frame Muxes, the Cisco 90i.	-	Entered the DSL market with launch of the industry's most cost-effective digital access solution.

Metaplex, Inc.	12**/96	-	-	19**	-	Specialist in network product development in the IBM enterprise marketplace.	-	Enterprise SNA solutions.
Netsys Technologies, Inc.	10/14/96	79M	50	1991	CA	Pioneer in network infrastructure management and performance analysis software.	Part of Cisco's Central Engineering team.	Together with Netsys, Cisco will offer network infrastructure management solutions for Cisco IOS technologies.
Granite Systems, Inc.	09/03/96	220M	50	1995	CA	Gigabit Ethernet switching and multilayer switching technology.	Part of Cisco System's Workgroup Business Unit	Granite System's technology allows customers to use the CiscoFusion(tm) architecture for scalable switched internetworks.
Nashoba Networks, Inc.	08/06/96	100M	40	1993	MA	Token Ring switching technologies.	Part of the InterWorks Business Unit	Enhance Cisco's product offerings in the fast-growing Token Ring switching arena the Nashoba Concord product, which will become the Catalyst 1800
Telebit's MICA Technologies	07/22/96	200M	50	19**	MA	Modem ISDN Channel Aggregation (MICA) technologies Innovator in developing remote-access and digital modem technology for computer networks.	the Dial Technology Division within Cisco's Access Business Unit	MICA technology combined with Cisco IOS(tm) software.
Stratacom, Inc.	04/22/96	4B	1200	19**	CA	Leading supplier of ATM and Frame Relay high-speed WAN switching equipment that integrates and transports a wide variety of information, including voice, data and video.	-	\$500M in sales. The combination of Cisco with StrataCom will enable Cisco to provide end-to-end solutions across public, private or hybrid networks.
TGV Software, Inc.	01/23/96	115M	More than 130	19**	CA	Leading supplier of Internet software products that enable connectivity between disparate computer systems over local area, enterprise-wide and global computing networks.	Internet Business Unit	Cisco will integrate value-added links between TGV software and Cisco IOS software.
Network Translation, Inc.	10/27/95	Undisclosed	-	19**	CA	Networking manufacturer of cost-effective, low maintenance network address translation and Internet firewall hardware and software.	-	Market Opportunity: PIX Firewall, Web Cache Engine, and Local Director

Grand Junction Networks, Inc.	09/27/95	348M	85	1992	Canada	Inventor and a leading supplier of Fast Ethernet (100Base-T) and Ethernet desktop switching products.	-	extends Cisco's LAN switch and Fast Ethernet offerings for its CiscoPro™ product family to address desktop switching, a popular high-speed alternative for 10Base-T hub users
Internet Junction, Inc.	09/06/95	5.5M	10	1994	CA	Developer of Internet gateway software that connects desktop users with the Internet Internet Junction's Passport connects multiple PC users on Novell LANs to the Internet.	Cisco's Business Development and Access Business Unit groups	The acquisition will broaden Cisco's offerings for Internet application access to the desktop and incorporate additional management and security capabilities. Key functions of Internet Junction Passport will be integrated into the Cisco IOS™ software.
Combinet, Inc.	08/10/95	114.2M	100	1988	CA	Leading maker of ISDN remote-access networking products.	Access Business Unit	Combinet platforms and functions will integrate within the functions of the Cisco IOS™ software.
LightStream Corporation	12/08/94	120M	60	1993	MA	Industry leading enterprise-class ATM switching assets and technology. Developed one of the most advanced enterprise-level ATM switches on the market, the LightStream 2020.	Independent business unit, called the ATM Enterprise Business Unit.	Joint venture between Bolt Beranek and Newman (BBN) and Ungermann-Bass (now UB Networks).
Kalpana, Inc.	10/24/94	-	150	-	CA	Leading provider of Ethernet switches worldwide.	-	Inventor of Ethernet switching, and designs and manufactures internetworking products.
Newport Systems Solutions	01/12/94	-	55	-	CA	Leading supplier of software-based routers for connecting computer networks.	Subsidiary of Cisco Systems.	-
Crescendo Communications, Inc.	09/21/93	-	60	-	CA	Crescendo's key technologies are at the heart of a number of leading-edge trends in the industry, including CDDI/FDDI, LAN switching, and ATM.	Seven regional offices in the U.S. and distributors in Europe and Asia.	Crescendo has received a number of key awards, including LAN Magazine's "1993 Product of the Year Award," LAN Computing's "1992 Standards Achievement Award," and Data Communications' "1992 Hot Products Award."

Source: Author

Lucent Technologies

Acquired	Date	Price (\$)	Emp	Fnd	Loc	Technology Competence	Organization	Comments
Ortel Corporation	02/07/00	2.95B	550	-	CA	Leading developer of optoelectronic components for cable TV (CATV) networks.	Part of Lucent's optoelectronics component division.	Lucent expects the acquisition to be completed during the quarter ending June 30, 2000.
VTC, Inc.	02/04/00	100M	230	-	MN	Supplier of semiconductor components to computer hard disk drive manufacturers.	Part of the Analog Products group.	Lucent expects the transaction to be completed in the quarter ending March 31, 2000.
SpecTran	02/02/00	64M	500	1981	MA	Design and manufacture of specialty optical fibers and fiber optic products.	SpecTran Communication Fiber Technologies and SpecTran Optics Company (See http://www.lucent.com/press/0799/990715.coa.html) CEO intends to stay with Lucent for a transition period.	Last year, 2 companies signed an agreement giving SpecTran rights to certain Lucent fiber patents.
Xedia Corp.	11/15/99	246M	90	1993	MA	Developer of high performance Internet access routers for wide area network that deliver next-generation, IP VPN.	Chairman/president of Xedia will become, respectively, CEO/vice president of Lucent's Enterprise WAN Systems group.	Xedia's customer base includes WorldCom's UUNET, PSINet, etc. and has significant relationship with Westcon, Verio, etc.
Excel Switching	11/03/99	1.7B	460	1988	MA	Leading developer of programmable switches. Excel's open, programmable switching platforms serve as a bridge between circuit/packet networks and enable SPs to quickly enter new markets.	Excel has 4,300 systems installed in 70 countries. Part of Lucent's Switching and Access business unit CEO of Excel will assume a key leadership role within Lucent.	The Excel platform can extend and enhance Lucent's SESS Switching portfolio and will complement the recently announced software switch for IP networks. 44% growth of revenues (Excel).
International Network Services	10/15/99	3.7B	2,200	1991	CA	Provide professional services for the full life cycle of a network, including planning, design, implementation, operations and optimization, and maintains expertise in the most complex network technologies and multi-vendor environments.	INS will become part of the Lucent's NetCare Organization of 5,500 people that CEO of INS will lead. Currently NetCare has more than 10,000 enterprise and SP customers including Bell Atlantic, Covad, AT&T, etc.	INS's revenues grew at more than 20%. INS's customers include more than 50 of the Fortune 100 companies including AT&T, WorldCom, Cisco, Microsoft, etc.
CCOM	07/01/99	-	10	1989	NJ	Developer of award-winning directory solution and CTI software.	Join Lucent's Business Communications Systems group as part of its Innovative Desktop Solution unit.	Lucent has been offering CCOM's products to its customers for a number of years.

Nexabit Networks	07/19/99	900M	120	1997	MA	Start-up developer of high-performance IP WAN switching/routing equipment Nexabit's NX64000 is the world's fastest Multi-Terabit switch/router.	CEO of Nexabit will join Lucent as Advanced IP Core Technologies Vice-President in Lucent's InterNetworking Systems Group.	Has an agreement to integrate Lucent's leading DWDM optical components in to Nexabit products.
Ascend Communications	06/24/99	24B	4,000	1989	MA	Leading provider of WAN core switching and access data networking equipment for telecom carrier, ISPs, corporation and government users worldwide.	Part of Lucent's new InterNetworking Systems unit CEO of Ascend will become the president of Lucent's InterNetworking Systems.	27 of the 30 largest global SPs use Lucent and Ascend switching equipment in their data networks.
Batlk Equipments	06/17/99	Undis closed	400	1979	Brazil	Global telecommunications equipment manufacturer and integrator.	-	These acquisitions are a continuation of Lucent's commitment to growth in Brazil.
Zetax Tecnologia	06/07/99	Undis closed	200	19**		Develops, markets, and supplies telecommunications infrastructure equipment to network operators.	-	
Mosaix	04/05/99	145M	550	19**	W/A	Provider of award-winning software that links companies' front and back offices.	Lucent Customer Care Solutions?	To expand Lucent's call center product portfolio and step into the fast-growing area of customer relationship management solutions.
Enable Semiconductor	03/02/99	50M	40	19**	CA	Lucent gains Enable's portfolio of Fast Ethernet ICs and technology and experienced team of some 40 Ethernet IC developers.	Enable's current CEO, who reports to Networks and Communications at Lucent's Micro-electronic Group, will head the combined team.	Enable's sales function will be integrated into the Lucent sales force.
Kenan Systems Corp.	03/01/99	1.4B	1200	1982	MA	World leader in the rapidly growing third-party billing and customer care software business.	Lucent's Communications Software Group	Dr. Kenan E. Sahin lectured at MIT Sloan from 1969 to 1982.
Sybarus Technologies	02/22/99	Undis closed	35	1998	Canada	Provide integrated circuit, software and systems design services for advance high-capacity voice and data communication systems.	Lucent's Microelectronic Group gains the Sybarus team of some 35 skilled engineers with extensive SONET/SDH design expertise.	-
Wave Access	01/22/99	50M	65	1993	MA, Israel	Specialize in high-performance packet radio technology for wireless internet access and metropolitan area network.	Part of Lucent's Wireless Network Group	-
Pario Software	11/24/98	Undis closed	4	1997	CA	Start-up developer of highly-reliable, next-generation network security software for IP-based network.	Part of Lucent's Remote Access Business Unit based in CA.	Its customers include WebTV Networks, Pacific Bell Internet Services, etc.

Quadritek	10/06/98	50M	70	1993	PA	Start-up developer of highly-reliable, next generation IP network administration software.	Lead the IP address management team within the Data Networking System's Enterprise Infrastructure Product Group (EIPG).	Leader in delivering IP name and address management software, with more than 400 customers worldwide.
JNA	09/24/98	70M	-	1961	Australia	Major Australian supplier of data networking and telecommunications systems and services to industry, government, SPs for the past 37 years.	JNA's R&D capabilities will be integrated into Lucent's Bell Labs R&D community over time.	-
LANNET	08/28/98	117M	500	1985	Israel	Leading supplier of next-generation Ethernet and ATM switching solutions for local area networks.	LANNET's CEO will join Lucent as president of its EIPG's Israel Technology Center.	-
MassMedia	07/28/98	Undisclosed	12	1995	MA	Supply a family of leading-edge products that manage connections across data, voice, and video networks.	President of MassMedia will join Lucent as director within Data Networking Systems' R&D organization and CTO as director of technology marketing.	-
SDX Business Systems PLC	07/14/98	-	-	19**	UK	One of the UK's leading providers of business communications systems.	Add SDX's talented people to Lucent's Business Communications Systems organization.	Expand the breadth of our product line in Europe, especially in the fast-growing small and medium-sized call center markets.
Yurie Systems	05/29/98	1B	-	1992	MD	Global leader in ATM access technology and equipment for data, voice and video networking.	Yurie's chairman is now president of Lucent's Carrier Networks within the Data Networking Systems Group.	-
Optimay GmbH	04/20/98	65M	-	1990	Germany	Development of software products and services for Global System for Mobile Communications (GSM) cellular phones.	-	Consistent with Lucent's Microelectronics Group's strategy to expand its position as a leading supplier of chip sets for GSM cellular phone.
TKM Communications, Inc.	03/11/98	-	45	1988	Canada	Specialize in call center integration.	-	Allow Lucent's NetCare Professional Services to increase its international call center consulting and integration business.
Hewlett-Packard's LMDS Wireless Business	02/17/98	Undisclosed	-	19**	CA	Leader in next generation microwave radio technology.	Wireless Broadband Networks Division (new).	The Strategies Group estimates that the U.S. infrastructure market for LMDS will grow to at least \$8B in the next ten years.

Prominet Corporation	01/23/98	200M	-	1996	MA	Leader in the rapidly emerging Gigabit Ethernet, high performance networking industry.	CEO of Prominet is now president, Gigabit Ethernet Switching Products, within Lucent's Data Networking Systems group.	-
Livingston Enterprise	12/16/97	650M	203	1986	CA	Global leader in systems that remotely connect computers to internet SPs.	Livingston's CEO is now president, of Lucent's Remote Access Business Unit.	-
Octel Communications	09/29/97	1.8B	3,000	1982	CA	Leader in voice, fax and electronic messaging technologies	Octel Messaging Division was formed.	Messaging, including voice, fax and electronic mail, has become a major growth area in recent years among business and personal users.
Triple C Call Center	05/12/97	Undisclosed	18	1994	Germany	Specialize in call center consultancy and systems integration.	-	-
Agile Networks	10/08/96	100M	60	1991	MA	Agile's advanced, intelligent data switching products support Ethernet as well as ATM technology.	Part of Lucent's Business Communications System unit.	-

Source: Author

C

Metrics for the Familiarity Matrix

Market Familiarity

Market familiarity is a measure of the acquiring company's understanding of the customer base and business patterns in the markets served by the acquired companies. Acquisitions that replicate the acquirer's own market experiences are regarded as the base market of the company. Those that involve some degree of market change, but with important aspects of market sameness, are considered to be in a new but familiar market zone of the Familiarity Matrix. Acquisitions whose market characteristics are largely different from the acquirer's are considered new and unfamiliar.

This thesis regards buyer segment and functionality of product as the most important factors for measuring market familiarity. Market familiarity of an acquisition can be defined by the following equation.

$$\text{Market Familiarity} \equiv w_b \times M_b + w_f \times M_f \quad (1)$$

M_b : Similarity in buyer segment

M_f : Similarity in functionality of products

w_b : Weight coefficient for buyer segment factor

w_f : Weight coefficient for product functionality factor

As for networking industry, the buyer segment includes four clusters: consumer, enterprise, service provider, and telecom. In the evaluations of Chapter 3 and 4, it is presumed that similarity in buyer segment is shown in Table C-1. Level of similarity varies from 1 to 3, where level 3 means more familiar and level 1 is less familiar. For instance, if the customer of a company Cisco acquired is in the enterprise segment, the similarity level of the acquisition is 3, that is, more familiar.

Table C-1. Similarity in Buyer Segmentation

<i>Acquirer</i>	<i>Customer of Target Company</i>			
	Consumer	Enterprise	Service Provider	Telecom
<i>Cisco</i>	2	3	3	1
<i>Lucent</i>	1	2	3	3

Source: Author

Regarding functionality of product, the market segment is classified into six clusters: campus, access, WAN, multi-service, network management, and others. Also, it is presumed that similarity in functionality of product is shown in Table C-2. Level of similarity varies from 1 to 3 as in C-1. Thus, if the core product of the company that Lucent acquired is related to campus, the similarity level of the acquisition is 1, that is, less familiar.

Table C-2. Similarity in Functionality of Product

<i>Acquirer</i>	<i>Core Product of Target Company</i>					
	Campus	Access	WAN	Multi-service	Network Management	Others
<i>Cisco</i>	3	2	1	2	2	1
<i>Lucent</i>	1	2	3	2	2	1

Source: Author

This thesis sets up weight coefficients for buyer segment and product functionality factors into 2 and 1 respectively, because customer base is considered more

important for market fitness. Consequently, degree of market familiarity has 7 levels ranging from 3 to 9.

Technology Familiarity

A similar assessment is carried out with respect to the technical similarities between an acquirer and its acquisitions, with the extent of technology familiarity reflecting the acquirer's understanding of the core technologies imbedded in each of the acquired companies, based on the acquirer's own internal technical capabilities.

This thesis regards technology category and integrity of product as the most important factors for measuring technology familiarity. Therefore, technology familiarity of an acquisition can be defined by the following equation:

$$\text{Technology Familiarity} \equiv w_t \times M_t + w_i \times M_i \quad (2)$$

M_t : Similarity in technology category

M_i : Similarity in integrity of products

w_t : Weight coefficient for technology category factor

w_i : Weight coefficient for product integrity factor

Technology categories related to the networking industry are mainly classified into seven: narrowband (copper), broadband (fiber), CATV, wireless, networking protocol, application protocol, network management, and others. In the evaluations in Chapter 3 and 4, it is presumed that similarity in technology category is shown in Table C-3. Level of similarity varies from 1 to 3 in the same way as that of market familiarity. In case of Cisco, if core competence of the target company in technology is network management, similarity level of the acquisition is 3, that is, more familiar.

Table C-3 Similarity in Technology Category

Acquirer	Core Technology of Target Company						
	Narrowband (copper)	Broadband (fiber)	Wireless	Networking Protocol	Application Protocol	Network Mgmt	Others
<i>Cisco</i>	3	2	2	3	2	3	1
<i>Lucent</i>	3	3	3	2	1	2	2

Source: Author

Table C-4 shows the technology items of each technology category and their maturity levels: mature, evolving, and embryonic. Maturity information is not directly related to the metrics of the Familiarity Matrix, but used for analyses of technological success in Chapter 3 and 4.

Levels of product integrity are classified into high, middle, and low, each of which is weighted as familiarity factor 3, 2, and 1. If a product of the acquired company is integrated into an acquirer's product immediately after the acquisition, the level of product integrity is regarded as high. If a product of the acquired company strengthens a line-up of the acquirer's products in the near future, the level of product integrity is regarded as middle. Otherwise is regarded as low level of product integrity. Such leveling has to be done by subjectively investigating press releases, journal articles, and other information sources. For example, the level of product integrity is regarded as high for each of the following articles.

Together with Netsys, Cisco will offer network infrastructure management solutions for Cisco IOS™ technologies, while simplifying network management and planning for customers. Netsys' technology will help provide a consistent and overarching network management capability and will offer an important complement to emerging web-based management solution.

---Press Release, Cisco Systems (10/14/96)

Source: http://www.cisco.com/warp/public/146/pressroom/1996/oct96/1014_netsys.html

Table C-4. Technology Classification

Category (Alphabetic Order)	Technology Items	Maturity	
Application Protocol	Caching	Evolving	
	Call-center application	Evolving	
	Collaboration	Evolving	
	CTI	Evolving	
	IP service software	Mature	
	IP/TV	Embryonic	
Broadband (fiber)	Messaging	Evolving	
	ATM access	Evolving	
	ATM emulation	Evolving	
	ATM switch	Evolving	
	CDDI, FDDI	Mature	
	Digital loop carrier	Mature	
	Digital video broadcasting	Embryonic	
	DWDM	Embryonic	
	Fiber optics	Evolving	
	Gigabit Ethernet	Embryonic	
	High-speed internetworking	Embryonic	
	High-speed routing software	Evolving	
	Optical cross-connect	Evolving	
	Optoelectronics	Embryonic	
SONET/SDH	Mature		
Narrowband (copper)	ADSL	Evolving	
	Digital modem	Evolving	
	Ethernet, Fast Ethernet	Mature	
	ISDN	Mature	
	Switching system	Mature	
	Token Ring	Mature	
	xDSL	Evolving	
Networking Protocol	Data networking	Evolving	
	Internet gateway software	Mature	
	IP-based PBX	Evolving	
	Media gateway	Evolving	
	Programmable switch	Evolving	
	Remote access	Mature	
	SNA	Mature	
	Unified communication middleware	Evolving	
	VLAN	Evolving	
	Voice signaling translation	Evolving	
	VoIP	Embryonic	
	VPN, IP VPN	Embryonic	
	Network Management	Billing management	Evolving
		Firewall	Evolving
IP address management		Mature	
Network consulting		Evolving	
Network security		Evolving	
Performance management		Evolving	
Others	Policy networking	Embryonic	
	Digital video processing	Evolving	
	DSP	Mature	
	Semiconductor design	Evolving	
Wireless	Cellular	Evolving	
	Microwave radio	Mature	
	Wireless	Evolving	
	Wireless LAN	Evolving	

Source: Author

Lucent Technologies and Nexabit already have an agreement to integrate Lucent's leading Dense Wavelength Division Multiplexing (DWDM) optical components into Nexabit products. The joint work will enable Nexabit products to provide integrated switch routing of IP traffic directly onto a DWDM optical core network at an industry leading OC192 standard rate of 10 gigabits per second per wavelength.

---Press Release, Lucent Technologies (06/25/99)

Source: <http://www.lucent.com/press/0699/990625.coa.html>

This thesis sets up the weight coefficients for technology category and product integrity factors into 2 and 1, respectively, because commonality of technology category is defined from more unquestionable information. Consequently, degree of technology familiarity has 7 levels ranging from 3 to 9.

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